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INTRODUCTION
This publication will describe the current standard of care for surgical incisions and review the medical literature regarding the use of closed incision negative pressure therapy (ciNPT; V.A.C.® Therapy, KCI USA, Inc., San Antonio, TX). The monograph will also provide clinical experience and scientific evidence regarding the PREVENA™ Incision Management System (KCI USA, Inc., San Antonio, TX), which provides ciNPT in an easy-to-use design.

PREVENA™ INCISION MANAGEMENT SYSTEM DESCRIPTION
PREVENA™ Therapy incorporates all of the functional elements of ciNPT. The system has the added advantages of being simple in concept and having anatomically adaptable dressings which are uniquely designed to manage and protect surgical incisions following primary closure. The dressings are easy to apply and use in the operating room (OR). The system may also transition from the OR to the hospital and/or outpatient setting for use by multiple care givers.

The PREVENA™ Incision Management System consists of the following components:
- The PREVENA™ 125 Therapy Unit and the PREVENA PLUS™ 125 Therapy Unit deliver 7 days of continuous negative pressure at -125mmHg through the dressing to the incision site; the unit is battery powered, lightweight, easily portable, and designed for single-patient use.
- The PREVENA™ 45mL Canister and the PREVENA PLUS™ 150mL Canister collect exudate from the incision.
- The PREVENA™ Patch Strips, which may be used to help seal leaks around the dressing. All patient-contact materials are manufactured without natural rubber latex and DEHP [Di(2-ethylhexyl)phthalate] except for the following products that do contain DEHP:
  - SENSAT.R.A.C.™ Pad and tubing for the PREVENA PLUS™ CUSTOMIZABLE™ Dressing
  - PREVENA PLUS™ 150mL Canister and tubing.
- The PREVENA™ Incision Dressings are applied over clean sutured or stapled incisions in a simple process.

INDICATIONS AND USE
The PREVENA™ Incision Management System is intended to manage the environment of closed surgical incisions and surrounding intact skin in patients at risk for developing post-operative complications, such as infection, by maintaining a closed environment via the application of a negative pressure wound therapy system to the incision. The PREVENA™ Incision Dressing skin interface layer with silver reduces microbial colonization in the fabric.

The PREVENA™ Therapy System is applied immediately post-surgery (i.e., in a sterile field) to closed incisions for a minimum of 2 days and up to a maximum of 7 days.

CONTRAINICATION
The only contraindication is sensitivity to silver due to its presence in the skin interface layer, although the concentration is very low (0.019%).

Complete safety information is provided in product labeling and available on acelity.com.
MECHANISMS OF ACTION AND RETICULATED OPEN CELL FOAM OVERVIEW

PREVENA™ Incision Management System is uniquely designed to manage and protect surgical incisions by:

- Helping to hold incision edges together
- Reducing edema
- Delivering continuous -125mmHg up to 7 days
- Acting as a barrier to external contamination
- Decreasing lateral tension of sutured/stapled incisions
- Removing fluids and infectious materials

Designed to be flexible
PREVENA™ Incision Dressings are designed to allow for movement, enhancing the post-operative rehabilitation process

*In a canister  †In computer and bench models
PREVENA™ Therapy utilizes Reticulated Open Cell Foam technology and -125mmHg pressure under -125mmHg of negative pressure, the Reticulated Open Cell Foam dressing collapses to its geometric center. This brings the incision edges together, reduces lateral tension, and also allows for improved fluid management.4-5

PREVENA™ Therapy utilizes Reticulated Open Cell Foam technology and -125mmHg pressure:
- Contours in PREVENA™ dressing allow for even distribution of negative pressure
- Adhesive film creates a barrier to external contaminants
- Designed to conform to articulating joints to allow movement
- Skin interface layer contains 0.019% ionic silver, which reduces bacterial colonization in the fabric
- Multiple sizes and configurations
- PREVENA™ 125 Therapy Unit and PREVENA™ Dressings are shower friendly*

*See PREVENA™ Therapy Patient and Clinician Guides for additional details
STANDARD OF CARE (SOC) FOR SURGICAL INCISIONS

Surgical incisions have traditionally been closed by primary intention using sutures, staples, tissue adhesives, paper tape, or a combination of these methods.

- Easterlin and colleagues reported that a drawback of sutures and staples is that they are tensioning devices, which concentrate the spreading force to small points along the incision. These tension points may result in ischemia and, possibly, necrosis of the tissue.
- In 2009, Livesey, et al. in a randomized controlled trial (RCT) compared skin adhesive versus surgical staples in total hip replacement surgeries. They reported that staples were quicker and easier to use than skin adhesive, and surgeons found skin adhesive to be more technically challenging. However, laparoscopic surgeons have found that proficient use of tissue adhesive comes with experience. A disadvantage to the use of tissue adhesive over incisions is that the adhesive may interfere with healing since it can act as a barrier to epithelialization.
- Paper tape has been used alone or in conjunction with sutures or staples for the treatment of surgical incisions. Atkinson reported in an RCT that paper tape was fast to apply, significantly decreased scar volume and prevented hypertrophic scars. A disadvantage to the use of paper tape is that it is not effective in moist or bleeding wounds, as moisture may wash away the adhesive or compromise the integrity of the paper itself. Atkinson recommends that paper tape should not be applied until after 5 days post-surgery or after the surgical incision has epithelialized.

Many products have been used for the treatment of closed surgical incisions. These include traditional gauze dressings and advanced therapies such as hydrocolloids, growth factors, cultured skin, low energy ultrasound, and ciNPT. Advanced therapies, such as topically applied growth factors, cultured skin, and ciNPT, were initially developed to assist patients with open chronic and acute wounds that were difficult to heal and then found to be useful over closed incisions.

LITERATURE REVIEW OF CLOSED INCISION NEGATIVE PRESSURE THERAPY

V.A.C. Therapy (KCI USA, Inc., San Antonio, Texas) has become a proven advanced wound therapy system for treating acute and chronic open wounds. Physicians and clinicians recognize the potential utility of this adjunctive therapy in their day-to-day practice and report using it in novel ways to address patient needs.

The body of evidence for using ciNPT has been growing steadily since 2006. Based on the Evidence Rating Scale for Therapeutic Studies developed by the American Society of Plastic Surgeons (ASPS), there are currently 8 Level 1 RCTs reporting clinical experience with ciNPT and PREVENA Therapy. Figure 3 categorizes the 29 ciNPT and PREVENA Therapy journal articles according to their ASPS levels of evidence: 8 RCTs (Level I), 7 prospective comparative studies (Level II), 9 retrospective cohort or comparative studies (Level III), 2 case series (Level IV), and 4 case reports/preclinical research (Level V). As shown in Figure 3, the types of incisions treated with ciNPT and PREVENA Therapy continue to expand and include fractures (eg, hip, lower extremity), abdominal wall reconstruction, laparotomy, sternal, and vascular surgical sites.
**Figure 3.** ciNPT and PREVENA™ Therapy clinical journal articles sorted according to ASPS Level of Evidence

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<th>LEVEL</th>
<th>FIRST AUTHOR (YEAR)</th>
<th>THERAPY</th>
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<td>High-energy fractures†</td>
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*ciNPT = Closed Incisional NPT as delivered by V.A.C.® Therapy  †Calcaneus, pilon, and tibial plateau fractures
The ciNPT and PREVENA™ Therapy clinical publication summaries below and in Table 3 are listed in order according to their ASPS rating level.

**EVIDENCE LEVEL I**

- In a prospective multicenter RCT, Stannard and colleagues compared the use of ciNPT against standard postoperative dressings (Control) over clean closed surgical incisions after high-energy fractures. The study population consisted of 249 patients with 263 calcaneus, pilon, or tibial plateau fractures.\(^{18}\)
  - Of those patients, 130 with 141 fractures were randomized to ciNPT and 119 with 122 fractures were randomized to Control (standard postoperative dressings).
  - The results revealed 23 total infections in the Control group compared to 14 in the ciNPT group (\(p = 0.049\)) and 20 cases of dehiscence in the Control group compared to only 12 in the ciNPT group (\(p = 0.044\)).\(^{18}\)
  - These findings illustrate the effective use of ciNPT over clean closed surgical incisions after high-energy fractures.
- Stannard, et al., presented interim results from 2 RCTs that compared the use of ciNPT against standard postoperative dressings (Control) for draining hematomas and clean closed surgical incisions after high energy fractures.\(^{19}\)
  - A total of 44 patients were randomized into the hematoma study. The Control group (n = 31) drained for a mean of 3.1 days compared to only 1.6 days for the ciNPT group (n = 13) (\(p = 0.03\)).
  - An additional 44 patients were randomized into the fracture study. The Control group (n = 24) drained for 4.8 days compared to only 1.8 days for the ciNPT group (n = 20) (\(p = 0.02\)).
  - These preliminary findings demonstrated decreased drainage time following ciNPT treatment of patients with hematomas or severe fractures.\(^{19}\)
- The first prospective RCT of the PREVENA™ Incision Management System was published in 2011 by Pachowsky, et al.\(^{28}\) The study included 19 consecutive patients treated with PREVENA™ Therapy or standard postoperative dressings (Control) over closed incisions following total hip arthroplasty.\(^{28}\)
  - Ten patients were randomized to the Control arm and 9 to the PREVENA™ Therapy arm.
  - Postoperative seromas were measured in both groups on the fifth and tenth postoperative days.
  - Results showed significantly decreased volume of postoperative seromas in the PREVENA™ Therapy group versus the Control on day 10 (1.97 vs. 5.08mL; \(p = 0.021\)). A seroma was present in 44% of the PREVENA™ Therapy patients and 90% of Control patients.
  - In addition, the PREVENA™ Therapy group required significantly fewer days of antibiotics (8.44 ± 2.24 vs. 11.8 ± 2.82 days, \(p = 0.005\)), and a secretion in the wound after day 5 was reported in fewer patients in the PREVENA™ Therapy group versus the Control (1 vs. 5 patients, respectively).
  - The authors concluded in their study the use of PREVENA™ Therapy decreased the development of postoperative seromas and improved wound healing.\(^{28}\)
- In a prospective RCT by Pauser, et al., 21 patients with femoral neck fractures (FNF) treated with hip hemiarthroplasty (HA) were randomized to receive either PREVENA™ Therapy or standard postoperative dressings (Control) over clean sutured wounds.\(^{29}\)
  - Eleven patients were randomized to the PREVENA™ Therapy group; ten patients received the standard postoperative dressing.
  - There were no differences in patient age, coagulation time, postoperative wound size, or wound secretion volume.
  - Compared to the Control, PREVENA™ Therapy patients had:
    » Reduced seroma volume at postoperative day 5 (0.257 ± 0.75cm³ vs. 3.995 ± 5.01cm³, respectively; \(p<0.05\)); at postoperative day 10, no difference was reported.
    » Fewer days of wound secretions (0.9 ± 1.0 days vs. 4.3 ± 2.45 days, respectively; \(p = 0.005\))
    » Fewer dressing changes (5.4 vs. 9.5, respectively, \(p<0.0001\))
    » Reduced time (and materials) for dressing changes (14.9 ± 3.9 minutes vs. 42.9 ± 11.0 minutes, respectively; \(p<0.0001\))
  - The authors concluded that using PREVENA™ Therapy for closed wounds in the HA setting might help to reduce complications of prolonged wound healing and postoperative seroma in the wound...and save time needed for wound care.\(^{29}\)
Lee et al (2017) presented results from a single-center RCT that evaluated 64 patients following great saphenous vein (GSV) harvest for coronary artery bypass surgery whose incisions were treated with either PREVENA™ Therapy (n = 35) or conventional dry gauze dressings (control; n = 29). PREVENA™ Therapy was applied at the time of GSV harvest under sterile conditions in the operating room and remained in place until the day prior to hospital discharge or to a maximum of 7 days.

- Wounds were inspected for all patients prior to discharge and at 6 weeks postoperatively.
- Two patients in each group withdrew consent postoperatively. There were no significant differences between the groups with respect to baseline demographics and clinical characteristics (PREVENA™ Therapy group = 33; control = 27).
- In the PREVENA™ Therapy group, the device was tolerated for the full duration of treatment in 30/33 patients (91%) for an average of 4.8 ± 1.45 days.
- In the PREVENA™ Therapy group, 2 patients died postoperatively, and 2 patients were unable to complete the quality of life questionnaire. Twelve patients were lost to follow-up at 6 weeks: 4 in the PREVENA™ Therapy group and 8 in the control group.
  - Initial assessment: PREVENA™ Therapy (n = 29); control (n = 25).
  - 6-week follow-up assessment: PREVENA™ Therapy (n = 26); control (n = 17)
- Treatment was discontinued for 2 patients due to a malfunctioning pressure sensor and for 1 patient with allergic contact dermatitis to the dressing adhesive.

Compared to the Control, PREVENA™ Therapy patients had:
  - Earlier date of hospital discharge (6 days vs. 10 Days, respectively; p=0.008).
  - Increased ability for self-care at initial assessment [23/29 (79.3%) vs. 13/25 (52.0%), respectively; p=0.023].
  - Increased quality of life EQ-5D-3L score at initial assessment (73 vs. 59, respectively; p=0.039)
  - Increased mobility at initial assessment [25/29 (86.2%) vs. 14/25 (56.0%), respectively; p=0.0117] and follow-up assessment [22/26 (84.6%) vs. 11/17 (64.7%), respectively; p=0.0123]
- The authors concluded that using PREVENA™ Therapy for GSV harvest following coronary artery bypass surgery “…is safe, well tolerated, and improves postoperative recovery with prolonged impact on mobility at 6 weeks.”

In a prospective, single-center RCT, Lee et al (2017) studied the effect of PREVENA™ Therapy on surgical site infections (SSI) in primarily closed groin incisions following lower extremity revascularization surgeries.

- Lower extremity revascularization patients (n = 102) were randomized, and characterized as high-risk based upon: previous femoral artery surgical exposure, BMI >30 kg/m2, or the incidence of ischemic tissue loss.
- The study group had PREVENA™ Therapy applied to 53 patients with groin incisions, and the control group had 49 patients with groin incisions that received a standard dressing (ie, sterile gauze) over their incision.
- After the revascularization procedure, 1 in-hospital SSI in the groin was reported for each group.
- The PREVENA™ Therapy group had a significantly shorter mean length of stay in the hospital compared to the control group (6.4 days vs. 8.9 days, respectively; p=0.02).
- The PREVENA™ Therapy group exhibited a decreased 30-day SSI rate compared to the control group (11.3% vs. 18.4%, respectively; p=0.24).
- There was no difference in surgical revision or readmission rates between the PREVENA™ Therapy group and the control group.
- The authors suggested that the application of PREVENA™ Therapy over groin incisions after revascularization surgeries contributed significantly to reduced mean duration of hospital stay among patients at high-risk for complications.

In a randomized clinical study, Gunatilake et al (2017) compared the short-term postoperative clinical outcomes of 82 obese pregnant women undergoing cesarean delivery and who received PREVENA™ Therapy (n = 39) or standard of care (SOC) dressing (control; n = 43).

- PREVENA™ Therapy was applied over closed incisions and remained in place for 5-7 days; SOC dressings were used for 1-2 days.
- All patients were discharged on postoperative day 3 or 4, and wound outcomes were followed for 42 ±10 postoperative days.
- Primary endpoint: presence or absence of surgical site occurrences (SSOs)
- Secondary endpoint: incidence of surgical interventions
- Surgical site assessments and additional data collected: Outcomes of incisional pain scores at rest and with pressure on the incision (as assessed by the Wong-Baker Faces Scale) and use of narcotic and analgesic therapies.
- Compared to the SOC group, patients treated with PREVENA™ Therapy had:
  » Fewer SSOs (2/39 [5.1%] vs. 7/43 [16.3%], respectively; p=0.16)
  » Less surgical interventions (6/43 [14%] vs. 1/39 [2.6%], respectively; p=0.11)
  » Significantly less incisional pain:
    • at rest (20/46 [43.5%] vs. 39/46 [84.8%], respectively; p<0.001);
    • with incisional pressure (25/46 [54.3%] vs. 42/46 [91.3%], respectively; p<0.001)
  » A 30% reduction in total opioid use (55.9 mg vs. 79.1 mg, respectively; p=0.036).
- In this study of obese cesarean patients, there was a trend in SSO reduction and a statistically significant reduction in postoperative pain and narcotic use.32
  • In a prospective, randomized single-center study, Pleger et al (2017) compared the effectiveness of PREVENA™ Therapy to conventional therapy (adhesive plaster) on groin incisions after a vascular procedure.33
    - One hundred patients with 129 groin incisions were analyzed.
    - Inclusion in the trial was contingent upon patients presenting with at least one main-risk factor (eg, obesity, chronic obstructive pulmonary disease, renal insufficiency, diabetes mellitus, and malnutrition) to wound healing.
    - PREVENA™ Therapy was applied to 58 groin incisions while a conventional dressing (adhesive plaster) was applied to 71 groin incisions in the Control group.
    - Postoperative wound evaluations (based on the Szilagyi classification) occurred on Days 5-7 and Day 30.
    - On postoperative Days 5-7, patients who received PREVENA™ Therapy had no (0%) wound healing complications compared to 15 (21.1%) in the Control group (p<0.0005).
    - On postoperative Day 30, patients who received PREVENA™ Therapy had 5 (8.6%) wound healing complications compared to 15 (21.1%) in the Control group (p=0.023).
    - On postoperative Day 30, the PREVENA™ Therapy group had 1 patient (1.7%) undergo a surgical revision compared to 10 (14.1%) in the Control group (p=0.022).
    - In comparison to patients within the Control group, patients receiving PREVENA™ Therapy exhibited a significant reduction in the incidence of overall postoperative wound complications (5/58 [8.6%] vs. 30/71 [42.3%]; p<0.0005).
    - The authors suggested that PREVENA™ Therapy over groin incisions “reduced the incidence of incision complications and revision procedures after vascular surgery.”33

**EVIDENCE LEVEL II**

- In a prospective comparative study, Grauhan and associates analyzed 150 consecutive obese (BMI ≥ 30) cardiac surgery patients, whose sternotomy wound incisions were treated with either PREVENA™ Therapy (n = 75) or conventional sterile wound dressings (Control; n = 75).34
  - Wound infection within 90 days was the primary study endpoint.
  - Patients were assigned to treatment groups by alternating based on time of operation. Patients with diabetes were assigned ‘half and half to both groups, with priority.’
  - PREVENA™ Incision Dressing was placed under sterile conditions in the OR and remained in place at a negative pressure of -125mmHg for the first 6 to 7 postoperative days. Control dressings were changed on the first or second postoperative day and every 1-2 days thereafter.
  - All patients in both groups were followed for at least 90 days. There were no significant preoperative differences between the groups.
  - PREVENA™ Therapy group had significantly fewer wound infections than the Control group: 3/75 (4%) vs. 12/75 (16%), respectively; p = 0.0266; odds ratio, 4.57; 95% confidence interval (CI), 1.23-16.94.
  - PREVENA™ Therapy group also had significantly fewer patients that had wound infections with Gram-positive skin flora: 1 vs. 10, respectively; p = 0.0090; odds ratio, 11.39; 95% CI, 1.42-91.36.
In the PREVENA™ Therapy group, 71/75 (95%) of the incisions were primarily closed when the dressing was removed in 6 to 7 days. No wound infections occurred after this closure. In contrast, 9 of the 12 reported Control group wound infections occurred beyond postoperative day 7 and up to day 35.

The authors concluded that PREVENA™ Therapy over clean, closed surgical incisions for the first 6 to 7 postoperative days significantly reduced wound infection after median sternotomy for high-risk obese cardiac surgery patients.34

In a prospective case-control pilot study, Weir evaluated the use of PREVENA™ Therapy in 8 patients undergoing vascular bypass procedures.35

- Patients requiring bilateral femoral incisions received PREVENA™ Therapy over one femoral area, while the contralateral femoral area received a standard postoperative dressing (Control).
- Patients required intraoperative heparin and postoperative anticoagulation therapy.
- Patients had at least one of the following risk factors for development of wound complications: obesity, diabetes, hypertension, hypercholesterolemia, smoking within 6 weeks prior to surgery, and HIV/AIDS.
- Wound complications requiring surgical intervention occurred in three of the control wounds, while no wound complications occurred where PREVENA™ Therapy was applied.
- The author suggested that using PREVENA™ Therapy in high risk patients undergoing vascular surgery potentially reduced wound complications with no observable increase in hemorrhage.35

In a prospective comparative study, Grauhan, et al., compared the wound infection rate of 3,745 cardiac surgery patients whose sternotomy incisions were treated with either PREVENA™ Therapy (n = 237) or conventional sterile wound tape dressings (Control; n = 3,508).36

- PREVENA™ Incision Dressing was applied immediately after skin suturing and remained in place for 6-7 days. Control dressings were changed on the first or second postoperative day and every 1-2 days thereafter.
- Wound infection within 30 days was the primary endpoint.
- The PREVENA™ Therapy group had a significantly lower infection rate than the Control group: 3/237 (1.3%) vs. 119/3508 (3.4%), respectively (p<0.05; odds ratio 2.74).
- In the PREVENA™ Therapy group, 234/237 (98.7%) of the incisions were primarily closed when the dressings was removed 6-7 days after application.
- The authors concluded using PREVENA™ Therapy for the first 6-7 days over clean, closed surgical incisions reduced the incidence of postoperative wound infections, and the reduced rate in wound infections may be cost effective for patients, hospitals, and health insurance companies.36

Swift and colleagues conducted a prospective comparative study that analyzed 319 women at increased risk for infectious morbidity and wound complications whose wounds were treated with either PREVENA™ Therapy or conventional skin sutures (or staples) without the use of PREVENA™ Therapy (Historical Control) after cesarean delivery.37

- Historical control (n = 209): Patients' chart reviews between 19 Apr 2007 and 07 Sep 2011.
- Patients were followed as part of postpartum care or were followed up at 6 weeks postpartum.
- Wound/infection (any deep or superficial surgical site infection, as defined by the Centers for Disease Control) and wound separation without infection were the primary study endpoints.
- Compared to the Historical Control, PREVENA™ Therapy patients had:
  » Fewer postoperative complications (21.0% vs. 6.4%, respectively; p = 0.0007)
  » Fewer wound infections (11.5% vs. 2.7, respectively; p = 0.008)
  » Fewer cases of endometritis (6.7% vs. 0.9%, respectively; p = 0.023)
  » Approximately the same number of wound separation cases (3.8% vs. 2.7%, respectively; p = 0.754)
- The PREVENA™ Therapy group, who were at increased risk for postoperative infections and wound complications, had significant reductions in deep and superficial infectious morbidity after the PREVENA™ Therapy system was applied to closed cesarean section incisions.37
• In a prospective, case-control pilot study, Cantero et al (2016) investigated the utility of PREVENA™ Therapy after ileostomy reversal procedures in the reduction of surgical site infections (SSI) compared to conventional closure and dressings.38
  - A total of 60 patients participated in the study.
  - PREVENA™ Therapy was administered to 17 consecutive patients after undergoing ileostomy reversal; 43 control patients (historical cohort) received conventional dressings after ileostomy reversal.
    » There were no significant differences in demographic or clinical variables between the PREVENA™ Therapy group and control group.
    » Nine patients (21%) presented with a surgical site infection compared to no patients in the PREVENA™ Therapy group (0%) (p<0.038).
    » There were no complications resulting from the application of PREVENA™ Therapy after ileostomy reversal.
    » Other procedure-related complications (eg, ileus or obstruction) occurred in 30% of patients.
  - The authors suggested that PREVENA™ Therapy was “safe and easy to use and may prevent SSIs in dirty wounds, such as those from ileostomy.”38

• In a prospective, comparative study, Seyvan et al (2016) compared clinical outcomes of PREVENA™ Incision Management System versus the PICO◊ Single Use Negative Pressure Wound Therapy System (Smith & Nephew, Hull, United Kingdom) in cardiac surgery patients undergoing median sternotomy.39
  - A total of 303 patients were assigned to either the PREVENA™ Therapy group or the PICO◊ group in an alternate fashion. Thirty-one patients were excluded due to death related to patient disease, re-thoracotomy, or discontinuation of therapy; thus, 272 patients were evaluated.
  - The PREVENA™ Therapy group consisted of 139 patients. PREVENA™ Therapy was applied immediately after skin suturing and remained in place at a negative pressure of -125mmHg.
  - The PICO◊ group consisted of 133 patients. PICO◊ was applied immediately after skin suturing and remained in place at a negative pressure of -80mmHg.
  - All patients were followed for at least 90 days post-surgery.
  - The number of patients developing an infection within 90 days after surgery was recorded.
  - The two groups did not significantly differ in age, gender, body mass index, or incidence of chronic obstructive pulmonary disease and diabetes. However, the PICO◊ group had significantly more patients requiring a left internal mammary artery (LIMA) graft for revascularization of the myocardium (p=0.02).
  - Compared to the PICO◊ group, patients treated with PREVENA™ Therapy resulted in significantly fewer infections (0/139 vs. 5/133 respectively; p=0.027). In the PICO◊ group, there were 4 (3%) deep infections and 1 (0.7%) superficial infection.
  - The authors concluded that PREVENA™ Therapy significantly reduced the rate of surgical site infections when compared to PICO◊ in this patient population.39

• In a single-center, prospective, comparative study, Redfern et al (2017) examined the use of PREVENA™ Therapy over clean surgical incisions after total joint (knee or hip) replacement and whether PREVENA™ Therapy would reduce the rates of wound complications (eg, surgical site infection, hematoma, and seroma).40
  - The PREVENA™ Therapy group was comprised of 192 patients representing 196 incisions. The historical Control group consisted of 400 patients.
  - PREVENA™ Therapy was applied over the closed incision for 6-8 days postoperatively.
  - For the Control group, a sterile gauze dressing was applied over the closed incision with standard dressing changes.
  - The rate of surgical site complications requiring medical or surgical intervention, including surgical site infections (deep and superficial infections), wound dehiscence, hematomas, seromas, edema/swelling, and drainage, were compared between groups.
  - PREVENA™ Therapy had:
    » a significantly higher percentage of patients experiencing a reaction to the dressing compared to the Control group (13.8% vs. 2.25%, respectively; p<0.0001)
    » a significantly lower number of patients who received pain management 24 hours postoperatively compared to the Control group (2.6±1.8 vs. 3.6±2.2, respectively; p<0.0001)
- There was a significant reduction in the overall complication rate requiring medical or surgical intervention in the PREVENA™ Therapy group when compared with the Control group (1.5% vs. 5.5%, respectively; \( p=0.02 \)), including:
  - A significant reduction in the rate of superficial infections in patients treated with PREVENA™ Therapy (0.0% vs. 2.25%; \( p=0.03 \)).
  - A significant reduction in the rate of hematomas in patients treated with PREVENA™ Therapy (0.0% vs. 2.25%; \( p=0.02 \)).
  - A significant reduction in the rate of edema/swelling in patients treated with PREVENA™ Therapy (0.5% vs. 3.25%; \( p=0.02 \)).
- Although not statistically significant, there was a reduction in deep infection (1.0% vs 1.25%; \( p=0.81 \)), wound dehiscence (1.5% vs. 3.25%; \( p=0.2 \)), seromas (0.0% vs. 0.5%; \( p=0.16 \)), and drainage (1.0% vs. 3.25%; \( p=0.07 \)) requiring medical or surgical intervention in the PREVENA™ Therapy group when compared with the Control group.
- Upon logistical regression (considering age, gender, BMI, treatment group, surgical site, and relevant comorbidities as independent risk factors for incidence of any postoperative complication) patients undergoing PREVENA™ Therapy were 4 times less likely to experience a surgical site complication when compared with the Control group (\( p=0.0277 \), odds ratio of 4.251, 95% confidence interval 1.172-15.414).
- In this study, PREVENA™ Therapy reduced the overall incidence of complications requiring medical or surgical intervention for hip and knee arthroplasty but did not significantly impact the rate of deep infection.\(^{40}\)

**Important Disclaimer:** Although the authors reported use of ciNPT for a mean of 7.07 ± 1.16 days (range: 6-8 days), this mean time of application is outside the recommendations for Optimum Use as stated in the PREVENA™ Incision Management System Clinician Guide Instructions for Use: “The PREVENA™ Incision Management System is to be continuously applied for a minimum of 2 days up to a maximum of seven days.” Use for greater than 7 days is not recommended or promoted by KCI.

**EVIDENCE LEVEL III**

- A comparative retrospective study by Matatov and associates evaluated the infection incidence and severity in 90 pts with 115 groin incisions that were treated with either PREVENA™ Therapy (\( n=41 \) pts with 52 incisions) or a skin adhesive or absorbent (\( n=49 \) pts with 63 incisions; Control).\(^{41}\)
  - Severity of infection was graded using the Szilagyi scale, which ranks degree of infection from grade I (lowest) to grade 3 (highest).
  - PREVENA™ Therapy was applied intraoperatively and removed after 5-7 days.
  - Mean times of wound evaluation in the PREVENA™ Therapy group were 7 and 33 days postoperatively vs. 10 and 40 days in the Control group.
  - PREVENA™ Therapy-treated incisions had a significantly lower overall rate of infection: 3/52 (6%) vs. 19/63 (30%), \( p = 0.0011 \).
  - The 3 infections in the PREVENA™ Therapy group were all rated as Szilagyi grade I, whereas the 19 in the Control group included 10 (16%) grade I, 7 (11%) grade II, and 2 (3%) grade III infections.
  - The authors reported PREVENA™ Therapy “significantly decreased the incidence of groin wound infection in patients after vascular surgery.”\(^{41}\)
- Reddy reported on the use of PREVENA™ Therapy on complex cardiothoracic surgery patients.\(^{42}\)
  - Charts were reviewed from complex, cardiothoracic surgery patients (\( n=27 \)) who received PREVENA™ Therapy over closed sternal incisions.
  - PREVENA™ Therapy was applied immediately after skin suturing and remained in place at a negative pressure of -125mmHg for a mean duration of 5.6±0.9 days.
    - All patients received antibiotics prior to surgery (-30 minutes), during surgery (4 hours), and up to 24 hours postoperatively.
  - All patients were evaluated within the first 30 days post-surgery; mean follow-up was 6.7±3.1 weeks.
  - Patient risk factors included: obesity (BMI ≥ 30 kg/m²; 27/27, 100%), diabetes (25/27, 92.6%), hypertension (16/27, 59.3%) and ≥5 comorbidities (20/27, 74%).
  - Within the first 30 days post-surgery, PREVENA™ Therapy resulted in:
    - A majority of patients with intact incisions with good approximation and no major sternal complications (21/27; 77.8%)
    - Two patients experienced minor dehiscences, and 4 patients had superficial cellulitis that were treated and resolved.
All patients had intact incisions at the final follow-up visit.
- The author concluded that in these cardiac patients “…ciNPT over closed sternal incisions resulted in favorable outcomes within 30 days of surgery.”

- In a retrospective study, Gabriel evaluated the effectiveness of using PREVENA™ Therapy with a CUSTOMIZABLE™ Dressing over closed incisions following immediate postmastectomy reconstruction as part of 2-stage expander/implant breast reconstruction. Charts were reviewed from breast reconstruction surgery patients (n=13; 25 breasts) who received PREVENA™ Therapy over closed, postmastectomy incisions.

- As part of immediate postmastectomy reconstruction, all patients had PREVENA™ Therapy using a CUSTOMIZABLE™ Dressing applied over the closed incision in the sterile field of the operating room followed by continuous negative pressure at -125mmHg for an average of 4.3 days.
  - Patients underwent one of 3 types of mastectomies: nipple sparing, reduction-pattern, or skin-sparing
  - Surgical drains were used with PREVENA™ Therapy (mean drain placement was 8.2 days); all incisions were closed with absorbable sutures and protected with a sterile dressing.

- All patients were followed for 3-months.
- Fourteen breasts underwent nipple-sparing mastectomies, 6 breasts had a reduction-pattern mastectomy, and 5 breasts received a skin-sparing mastectomy.

- In the nipple-sparing mastectomy group, one breast developed a delayed hematoma on postoperative Day 13 that resolved by the 3-month follow-up visit.

- In the reduction-pattern mastectomy group, 3 breasts developed superficial dehiscence that resolved with local wound care. One breast developed flap necrosis that required surgical revision.

- In the skin-sparing mastectomy group, no complications were reported.

- At the 3-month follow-up, 24/25 (96%) breasts achieved complete healing.

• Cooper et al conducted a retrospective review and assessed the efficacy of PREVENA™ Therapy compared to a sterile antimicrobial dressing (control) on wound complications, surgical site infections (SSIs), and reoperations after hip and knee revision surgery.

- Charts were reviewed from patients (n=138) who underwent major hip or knee procedures from October 2012 through August 2015.
  - PREVENA™ Therapy group: 30 patients
  - Control group: 108 patients

- PREVENA™ Therapy was applied immediately after skin suturing and remained in place at a negative pressure of -125mmHg. Control dressings were applied over standard surgical sutures and left in place for a minimum of 5 days unless a premature dressing change was required due to saturation.

- The primary outcome measures were incidence of wound complications, incidence of total SSIs, and reoperation rate for wound complications; all patients were followed for 90 days.

- Compared to Control, PREVENA™ Therapy resulted in:
  - Fewer overall wound complications (6.7% vs. 26.9%, respectively; p=0.024)
  - Fewer total SSIs (3.3% vs. 18.5%, respectively; p=0.045)
  - A trend toward fewer reoperations (3.3% vs. 13.0%, respectively; p=0.191)

- The authors’ findings suggest that “…ciNPT may decrease wound complications and SSIs in patients undergoing revision hip and knee surgery.”

- In a small retrospective review, Zaidi and El-Masry (2017) compared wound complication occurrence in 181 high-risk surgical patients following laparotomy who received PREVENA™ Therapy (n=69) or standard of care (SOC) dressings (Control: n=112).

- PREVENA™ Therapy or SOC dressings were applied over the closed incision and remained in place for 7 days.

- All patients were followed for 30 days after surgery.
Primary endpoint: the presence of deep incision infection or dehiscence within the follow up period.
- Compared to the Control group, patients treated with PREVENA™ Therapy developed: significantly fewer wound complications (23/112 [20.5%] vs. 2/69 [2.9%], respectively; p<0.0009)
- The authors concluded that PREVENA™ Therapy "was associated with a positive clinical outcome and was a safe and effective method of postsurgical management in our general surgery patients considered to have risk of developing wound complications following laparotomy."

In a retrospective, single-center study, Lo Torto et al (2017) evaluated PREVENA™ Therapy after monolateral pectoralis major muscle flap (MPMF) coverage following median sternotomy access.
- A total of 78 patients at high risk for complications, who presented with deep sternal wound infection (DWSI) after cardiac surgery, were included in the execution of this study.
- Thirty patients with post-sternotomy DWSI received a MPMF, followed by application of PREVENA™ Therapy over the flap incision.
- Forty-eight Control patients (historical cohort) with post-sternotomy DWSI received a MPMF and conventional dressings.
- There were no statistically significant differences observed between the PREVENA™ Therapy group and Control group relative to their demographics, cardiac surgery-associated variables and comorbidities.
- Four adverse events were reported within the PREVENA™ Therapy group compared to 18 adverse events for the Control group.
  » Seroma: 1/30 (3%) PREVENA™ Therapy patients vs. 0/48 (0%) Control patients; p=0.38
  » Hematoma: 2/30 (7%) PREVENA™ Therapy patients vs. 4/48 (8%) Control patients; p=1
  » Wound dehiscence: 0/30 (0%) PREVENA™ Therapy patients vs. 7/48 (15%) Control patients; p=0.04
  » Surgical revision: 1/30 (3%) PREVENA™ Therapy patients vs. 7/48 (15%) Control patients; p = 0.14
- Mean postoperative time within intensive care unit was reduced among patients within the PREVENA™ Therapy group compared to the Control group (3.7 ± 1.3 days vs. 4.2 ± 2 days, respectively).
- The authors reported that PREVENA™ Therapy helped to improve the outcomes of DSWI surgical treatment with MPMF in patients at high-risk for complications.

In a retrospective, comparative cohort study, Cooper et al (2018) compared the utility of PREVENA™ Therapy versus standard postoperative dressings (ie, sterile, antimicrobial hydrofiber dressing) in patients who underwent lower extremity periprosthetic fracture surgeries involving either hip or knee implants.
- The retrospective study encompassed a 6.5-year period, and evaluated the effect of PREVENA™ Therapy on the rate of incisional complications, surgical site infections (SSIs), and surgical revisions.
- Sixty-seven consecutive patients, who underwent lower extremity periprosthetic fracture surgeries, participated in the study.
- Following lower extremity periprosthetic fracture surgery, PREVENA™ Therapy was administered to 27 patients whereas 40 Control patients received antimicrobial hydrofiber dressings.
- There were no statistically significant differences between the PREVENA™ Therapy group and control group as it pertained to demographic variables, fracture location, or procedure type.
- A significant difference was reported for the incidence of surgical site complications between groups.
  » One patient in the PREVENA™ Therapy group (4%) developed a postoperative wound complication compared to 14 patients (35%) treated with antimicrobial dressings (p=0.002).
  » No patients in the PREVENA™ Therapy group (0%) presented with a deep SSI compared to 10 patients (25%) treated with antimicrobial dressings (p=0.004).
  » One patient in the PREVENA™ Therapy group (4%) required surgical revision compared to 10 patients (25%) treated with antimicrobial dressings (p=0.021).
- The authors suggested that PREVENA™ Therapy applied after lower extremity periprosthetic fracture surgeries effectively decreased wound complications, SSIs, and surgical revisions.

In a retrospective, single-center study, Nickl et al (2017) compared the utility of PREVENA™ Therapy versus conventional wound dressings...
in high-risk, obese, poststernotomy patients, who received unilateral pectoralis major flap to manage deep sternal wound infections.48

- Forty-seven obese patients underwent unilateral pectoralis major flap to treat deep sternal wound infections after cardiac procedures.
- Nineteen patients received PREVENA™ Therapy between 2011 and 2016; 28 Control patients had incisions treated with conventional wound dressing between 2000 and 2010.
  » There were no statistically significant differences between the PREVENA™ Therapy group and Control group related to demographics, variables related to cardiac surgery, and comorbidities.
- Postoperative assessments entailed observing in-hospital mortality, complications, duration of intensive care management after surgery, and duration of hospitalization.
  » Six patients (31.6%) treated with PREVENA™ Therapy experienced adverse events compared to 10 patients (35.7%) in the Control group.
  » In the Control group, 9 patients (32.1%) required surgical revision due to hematoma, wound infection or significant wound-repair disturbances, whereas only 1 patient (5.3%) within the PREVENA™ Therapy group required surgical revision (p=0.034).
  » In the PREVENA™ Therapy group, the median postoperative time in the intensive care unit (ICU) after the unilateral pectoralis major flap procedure was 0 (0-5) days, whereas in the Control group, the median postoperative time in ICU after the unilateral pectoralis major flap procedure was 3.5 (0-34) days (p<0.001).
  » Concerning overall duration of hospitalization, there were no significant differences between the PREVENA™ Therapy group and Control group (median, 14 vs. 19.5 days, respectively; p = 0.179).
- The authors suggested that PREVENA™ Therapy applied in conjunction with unilateral pectoralis major flap to treat deep sternal wound infections helped reduce revision surgery rates.

- In a retrospective, case-control study, Schurtz et al (2018) compared the effect of PREVENA™ Therapy versus adhesive, breathable, non-woven postoperative dressings in patients, who underwent an exploratory laparotomy.49
  - The retrospective study encompassed a 2.25-year period and evaluated the effect of PREVENA™ Therapy on surgical site infections (SSIs) and readmission rates.
  - Ninety-six consecutive patients, who underwent an exploratory laparotomy, were retrospectively identified for the study. Following the procedure, PREVENA™ Therapy was applied under sterile conditions to laparotomy incisions of 48; there were 48 Control patients who had laparotomy incisions treated with an adhesive, breathable, non-woven postoperative dressing.
    » There were no statistically significant differences between the PREVENA™ Therapy group and Control group as it pertained to demographic variables or procedure type.
    » Three patients (6%) treated with PREVENA™ Therapy developed SSIs compared to 11 patients (23%) in the Control group (p = 0.04).
    » Seven Control patients (15%) had a higher likelihood of being readmitted compared to 1 patient in the PREVENA™ Therapy group (2%) (p = 0.05).
  - The authors suggested that PREVENA™ Therapy applied after exploratory laparotomy surgeries effectively decreased wound complications, SSIs, and incidence of readmission.
  - Although the authors reported use of ciNPT for up to 8 days, this time of application is outside the recommendations for Optimum Use as stated in the PREVENA™ Incision Management System Clinician Guide. The Instructions for Use state: “The PREVENA™ Incision Management System is to be continuously applied for a minimum of two days up to a maximum of seven days.” Use for greater than 7 days is not recommended or promoted by KCI.49

EVIDENCE LEVEL IV
- The first case series evaluating use of the PREVENA™ Incision Management System was published in 2011 by Colli.50
  - A total of 10 patients with mean Fowler risk score of 15.1 received application of PREVENA™ Therapy over clean, closed sternal incisions for 5 days following cardiac surgery.
  - All wounds and surrounding skin showed complete wound healing and an absence of skin lesions following removal of the dressing.
There were no cases of infection. No device-related complications were observed and no other wound complications occurred during the 30-day follow-up period.

Authors concluded the system “may help achieve uncomplicated wound healing in patients at risk of developing wound complications following cardiothoracic surgery.”50

Bollero and colleagues evaluated use of PREVENA™ Therapy after excision of wide pathological scars in a series of 8 patients.51

- Mean age of the patients was 33 years (range 20-60 years) and treated scars were mature and usually the result of hypertrophic scars.
- Scar sites were located in body areas with skin stretch during flexion/extension movements. PREVENA™ Therapy was placed to improve incision edge apposition.
- PREVENA™ Therapy Dressing was applied intraoperatively at continuous -125mmHg.
- Seven of 8 patients completed treatment successfully.
  - One incision was longer than the PREVENA™ Incision Dressing but closed without complications.
- The scar of one patient was close to the pubic area and, even though the area was shaved, an air-tight seal could not be achieved. Consequently, the patient discontinued treatment after 1 day.
- The authors concluded “Easy intraoperative application and postoperative management, associated with good compliance of patients, make PREVENA™ Therapy a safe home-care device.”51

EVIDENCE LEVEL V

A single case study of a patient with a distal lower limb incision site treated with PREVENA™ Incision Management System following popliteal-tibial bypass grafting has also been reported.52

- The author noted the incision did not become edematous or deteriorate at any time, even after the PREVENA™ Incision Dressing was removed.
- Ongoing tissue healing was maintained without any complications, and the patient was discharged on postoperative day 12 after regaining full mobility and removal of sutures.52

Collectively, findings from these studies demonstrate the potential value of ciNPT. This evidence also supports the ability of the PREVENA™ Incision Management System to provide ciNPT comparable to traditional V.A.C.® Therapy Systems. Findings published in the literature report that patients benefiting from ciNPT or PREVENA™ Therapy were often those at greater risk for infection, seroma, hematoma, and dehiscence.56

These patients were often found to have one or more risk factors (Table 4) that might affect wound healing57,58 and/or were undergoing high-risk surgery. A multidisciplinary group of surgical and infectious disease experts met in December 2014 and developed an algorithm for when a surgeon might consider using ciNPT (Figure 4).
**Figure 4. ciNPT Risk Factor Assessment**

**Patient Related Risk Factors**
- Diabetes mellitus
- ASA score ≥3
- Advanced Age
- Obesity
- Active tobacco use
- Hypoalbuminemia
- Corticosteroid usage
- Active alcoholism
- Male sex
- Chronic renal insufficiency
- Chronic obstructive pulmonary disease
- Hematoma

**General Incision Related Risk Factors**
- High-tension incision
- Repeated incisions
- Extensive undermining
- Traumatized soft tissue

**Operation Related Risk Factors**
- Edema
- Contamination
- Emergency procedure
- Mechanically unfavorable site

**General**
- Open General
- Open Colorectal
- Open Urology
- Open OB/Gyn
- Incisional Hernia Repair

**Plastic**
- Postbariatric abdominoplasty
- Breast reconstruction
- Big soft tissue defects (Necrotizing Fasciitis)
- High tension incision
- Soilage risk
- Repeat incisions

**Orthopaedic**
- Open reduction and internal fixation of fractures: Acetabulum, Pilon, Calcaneous, Tibial Plateau
- Fasciotomy
- Above knee amputation
- Below knee amputation

**Vascular**
- Above knee amputation
- Below knee amputation
- Synthetic graft implantations

**Cardiovascular**
- Sternotomy
SCIENCE SUPPORTING PREVENA™ THERAPY – BENCH AND ANIMAL STUDIES

As adjunctive therapy, the PREVENA™ Incision Management System provides a closed environment for managing clean, closed surgical incisions through application of Negative Pressure Wound Therapy. Data from bench testing, computer modeling and animal studies have shown PREVENA™ Therapy helps hold the closed incision edges together and protects the incision from external contamination. Preliminary data suggest PREVENA™ Therapy may play a role in realigning and reducing tensile forces across the incision and improving fluid flow; however, such results have not been confirmed in humans. Tables 5A and 5B summarize the biomechanical and physiological study results, respectively, of the PREVENA™ Incision Management System.

Biomechanical Properties

When there is a disruption in the skin’s integrity from an incision, the edges immediately retract. Typically, sutures or staples are used to re-approximate the incision edges; however, these closure methods may not be sufficient for some incisions, which re-open as a result of excessive edema or other factors. Both bench and computer finite element studies (summarized below and in Table 5A) have provided insight into the biomechanical effects of ciNPT.

• Because lateral tension (appositional tension/force) can increase the risk of a dehisced incision, a simulated closed incision model was used to determine the force required to separate sutured or stapled incisions with and without PREVENA™ Therapy.3
  o The data showed that a force of 61.7 ± 0.3N was required to extend the sutured incision edges approximately 10mm compared to a force of 92.9 ± 2.6N when the PREVENA™ Therapy was applied over the closed incision (p<0.05), resulting in an increase of 51% in force for the same displacement without the therapy.
  o Furthermore, a force of 69.3 ± 0.4N was required to extend the stapled incision edges approximately 10mm compared to a force of 98.8 ± 0.0N with PREVENA™ Therapy (p<0.05), resulting in an increase of 43% in force for the same displacement without the therapy.3
  o These results are summarized in Table 6 and suggest PREVENA™ Therapy in conjunction with sutures or staples may aid in holding together incision edges subjected to appositional forces, more than either sutures or staples alone.

To further evaluate the biomechanical effects of PREVENA™ Therapy on the integrity of the incisional closure, a scientific study was performed using 2 finite element computer models.3

• The first finite element computer model assessed the effects of PREVENA™ Therapy on lateral tension.3
  o This model simulated a sutured incision with the incision being sutured throughout the depth.
  o Lateral tension in the range of 2.2 to 2.5 kPa at the skin surface was then created by computer software.
  o When negative pressure was applied with PREVENA™ Therapy, the simulated lateral strain was reduced by approximately 50% (0.9 to 1.2 kPa) along the incision (Figure 5), which helped relieve the tension created by the sutures.
  o Literature suggests that reduction in lateral strain is important for maintaining the integrity of the closed incision.3
The second computer model simulated a cross-section of an incision with sutures, represented as tied surfaces, at the epidermal and subdermal levels (Figure 6A). Skin tension was applied as a smooth increase from 0 to 150 kPa (-125 mmHg) over 0.2 seconds. Negative pressure was applied from 0 to 16.7 kPa (-125 mmHg), starting at 0.4 seconds and attaining target negative pressure at 1 second. With only sutures in place, the lateral tensile stress was substantial at the superficial (27.8 kPa) and deep (8.4 kPa) layers (Figure 6B). With the PREVENA™ Incision Dressing under negative pressure, the gap in the simulated incision closed and the vertical compression in the sides of the incision was eliminated (Figure 6C). The lateral tensile stress at the superficial sutures decreased to 15.4 kPa (decrease of 45%) and at the deep suture to 4.2 kPa (decrease of 50%).

These bench evaluations showed the PREVENA™ Therapy system significantly increased the force required to disrupt the closed incision approximately 50% as compared with closure alone. With negative pressure, the direction of the stress was normalized to a distribution typical of intact tissue, and appositional forces were bolstered at the incision.
Figure 6. Finite Element Analysis model 2: lateral stress color contour plot of the incision (A). PREVENA™ Therapy model results for strain, after application of skin tension over a sutured incision. Red arrows indicate direction and relative magnitude of principal strain at each element. Tensile loads across the incision were concentrated at the sutures (B). PREVENA™ Therapy model results for strain, after application of skin tension and then negative pressure (-125mmHg) through the PREVENA™ Incision Dressing. Red arrows indicate direction and relative magnitude of principal strain at each element (C). Tensile loads were distributed more evenly across the incision plane, without local shear and in a direction commensurate with intact native tissue.³

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**Physiological Properties**

The data from appositional and finite element models showed PREVENA™ Therapy may favorably alter the biomechanical environment of the incision area. The increased apposition of tissue and the decreased tension along the incision may also allow for improved fluid flow. This may be because flow of fluid through the capillaries, interstitium and lymphatics is modulated by the biomechanical environment of the extracellular matrix. By relieving tension on tissue and redistributing tension in a more uniform manner (similar to native tissue), vessels may remain open and less constricted, supporting lymph flow and edema reduction, and reduction of inflammation which may ultimately facilitate healing of the closed incision.

*In vivo* studies summarized below and in Table 5B have provided evidence of improved fluid flow with the PREVENA™ Incision Management System. However, these results have not been confirmed in clinical studies.

- A hematoma/seroma study used a porcine model in which subcutaneous voids with overlying sutured incisions were created on the ventral sides of 8 swine.4
  - Stable isotope-labeled nanospheres were introduced into each subcutaneous dead space.
  - Each contralateral incision was randomly assigned to PREVENA™ Therapy or the Control (semipermeable film dressing; 3M™ Tegaderm™ Dressing) for 4 days.
  - After therapy, the hematoma/seroma in each defect was weighed (with differences averaged for each animal), fluid levels in the canister were monitored, 5 pre-identified lymph nodes were harvested, and 5 key organs were biopsied.
  - Results showed a 63% decrease in hematoma/seroma mass with the PREVENA™ Incision Dressing versus the Control (mean 15 ± 3 g vs. 41 ± 8 g, respectively; *p*<0.002), without any fluid collection in the PREVENA™ Canister.
  - In lymph nodes, there were ~60 μg (~50%) more 30- and 50-nm nanospheres from PREVENA™ Therapy-treated incisions compared to Control sites (*p* = 0.04 and *p* = 0.05, respectively).
  - Nanosphere incidence was significantly greater from PREVENA™ Therapy sites versus Control sites in lungs, liver and spleen (*p* <0.05); no nanospheres were found in kidney biopsies.
  - In this scientific model, application of PREVENA™ Therapy significantly decreased hematoma/seroma levels without fluid collection in the canister, which may be explained by increased lymph clearance.4

- Another porcine study compared PREVENA™ Therapy to standard dry dressings (Control) over closed spinal incisions. Scar quality, biomechanical characteristics, and histology were endpoints of interest.5
  - In 8 mature, miniature pigs, the two dressings were applied to adjacent sutured incisions over the spine.
  - After 3 or 5 days, incisions were assessed using scar scale, biomechanical (e.g., failure load, failure energy, and stress), and histological testing. ANOVAs compared the groups (3 vs. 5 days, PREVENA™ Therapy vs. Control, *p*<0.05).
  - Incisions treated with PREVENA™ Therapy had a significantly improved scar scale height grade (*p*<0.026) compared to those treated with standard dressings, which showed inflammation, edema and swelling around the incision (Figures 7A and 7B). The incision line treated with PREVENA™ Therapy was barely visible, indicating progression of healing.
  - Control group scores were lower for failure load (4.9 ± 4.0 vs. PREVENA™ Therapy, 16.5 ± 14.6N), energy absorbed (8.0 ± 9.0 vs. 26.9 ± 23.0 mJ), and ultimate stress (62 ± 53 vs. 204 ± 118 N/mm²).
  - Histological analysis demonstrated no differences in incision scar width between the two groups.
  - In this porcine study the authors noted, “a trend toward improved early healing strength and in a significantly improved incision appearance,” for incisions treated with PREVENA™ Therapy.5

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**Figure 7.** (A) Representative sample with scar height score 1 (score of 5/8 control-treated incisions. (B) Representative sample with scar height score 0 (score of 8/8 PREVENA™ Therapy-treated and 3/8 control-treated incisions.

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The impact of PREVENA™ Therapy was assessed by means of a whole-genome microarray study that measured the biological processes that the PREVENA™ Incision Management System may affect at later time periods.61

- Samples were obtained from contralateral sutured porcine incisions treated with PREVENA™ Therapy versus ABD pads (Control) for 5 days.
- Signal intensities across microarrays were normalized. Features with signal/noise values ≥ 3 and quality flag values <5000 were considered “detected” and were subjected to analysis with a \( p < 0.05 \).
- Pilot study analysis indicated there was decreased inflammation (expressed by key chemokine and cytokine markers) in PREVENA™ Therapy treated incisions versus the Control.
- Additionally, PREVENA™ Therapy affected fewer genes compared to the Control, thereby resuming negative pressure gene expression to a normalized skin phenotype.61
- This decreased gene expression in PREVENA™ Therapy treated incisions may be correlated to the observed biomechanical strength of negative pressure-treated incisions in porcine models.53

In a pilot study performed by Kilpadi, et al., contralateral incisions of swine were sutured and treated with PREVENA™ Therapy or ABD pads (Control) for 5 days. Incisions were then left untreated.53

- Compared with the Control at 40 days post-surgery, PREVENA™ Therapy treated incisions had improved mechanical properties (peak strain and strain energy density) and narrower healed incisions in the deep dermis. Peak stress and elastic modulii for both groups did not differ statistically when compared to naïve skin. (Table 7)
- Compared with the Control at 5 days post-surgery, PREVENA™ Therapy treated incisions had fewer genes differently expressed and showed reduced up-regulation of genes associated with inflammation, hypoxia, retardation of re-epithelialization, impaired wound healing, and scarring.
- These data suggest that short-term negative-pressure treatment over incisions may improve scar biomechanics compared to ABD pads, potentially enhancing tissue compliance and function, and reducing the likelihood of scar dehiscence. However, these animal results have not been confirmed in humans.
- These results parallel a previous porcine incision study showed PREVENA™ Therapy treated incisions had significantly improved scar height grade versus Control-treated samples.5 Strength testing in that study also suggested that negative pressure may have greater effect at earlier stages of healing.5 A previous study by Aarabi and colleagues showed that increased strength of a healed incision may be a result of early reduced incisional tension, which has been shown to decrease hypertrophic scarring.52 These results have not been confirmed for PREVENA™ Therapy or ciNPT in humans.

The PREVENA™ Incision Management System also facilitates incision healing by protecting the incision from external contamination.

- The protection provided by the polyurethane layer was assessed by challenging the film with one of the smallest non-pathogenic viruses.
  - The Phi-X174 bacteriophage (27nm in size)63 was used in a phage penetration test.
  - Test squares were cut from the polyurethane film drape on the dressing and clamped into a penetration test cell.
  - The top side of the film was exposed to air and the bottom side of the film was in contact with the foam.
  - A 60mL bacteriophage suspension was introduced into the top side of the test cell for 5 minutes.
  - After this time, a 2 pound-force per square inch gauge (PSIG) pressure was applied to the viral suspension for a 1 minute interval.
  - The film was monitored for penetration before and after pressure was applied.
  - A total of 4 samples were prepared from the films at random locations.
  - Resulting bacteriophage concentrations64 are listed in Table 8.
  - The biological assay and visual inspection showed no penetration.
  - These results indicate that the exterior drape of the PREVENA™ Incision Dressing can act as a microbial barrier to viral contamination (as small as 27nm)64 and bacterial sources.
CASE STUDIES
Clinical experience with the PREVENA™ Incision Management System is reported in the following case studies in which PREVENA™ Therapy was used over clean closed surgical incisions.

As with any case study, the results and outcomes should not be interpreted as a guarantee or warranty of similar results. Individual results may vary depending on the patient’s circumstances and condition.

Case Study 1: Sternotomy Incision (Figure 8)
A 70-year-old male patient presented with a non-ST elevation myocardial infarction. Medical history included type II diabetes, peripheral vascular disease, renal insufficiency, hyperlipidemia and pulmonary hypertension. After further investigation, patient was diagnosed with triple vessel coronary artery disease and severe mitral insufficiency. An urgent triple coronary artery bypass grafting (CABG) and mitral valve replacement (MVR) were performed.

Due to the patient’s critical state, comorbidities, and combined procedures, he was at elevated risk for postoperative incision complications (Figure 8A). The PREVENA™ Incision Dressing was applied along the incision with special care taken to leave enough distance between the inferior aspect of the incision and the chest tubes to secure a proper seal (Figure 8B). On postoperative Day 3, the patient cardiopulmonary arrested, requiring immediate resuscitative chest compressions. However, the integrity of the PREVENA™ Incision Dressing was maintained.

When the PREVENA™ Incision Dressing was removed, the incision edges appeared well apposed and were healing appropriately (Figure 8C). In contrast, the chest tube sites, which were not treated with PREVENA™ Therapy, demonstrated some drainage. The patient was discharged home on postoperative Day 18 with his incision continuing to heal well.

Figure 8. Postoperative CABG and MVR via sternotomy on a 70-year-old male patient. (A) Clean closed surgical incision. (B) Application of PREVENA™ Incision Management System. (C) Surgical incision following removal of PREVENA™ Incision Dressing.

Patient data and photos courtesy of Broadus Z. Atkins, MD
Case Study 2: Total Hip Arthroplasty Revision (Figure 9)

A 68-year-old female underwent total hip arthroplasty (THA) revision for a femoral stress fracture. Medical history included previous hip surgery and Class I obesity (BMI = 32.6) at time of surgery. X-rays were performed to locate the original hip prosthesis (Figure 9A). After removal and replacement of the THA hardware, the PREVENA™ Incision Management System was applied over the incision (Figure 9B), and the PEEL & PLACE™ Dressing - 20cm remained in place until removal on Day 7 (Figure 9C).

Figure 9. Total hip arthroplasty (THA) revision on a 68-year-old female patient. (A) X-ray film of hip prosthesis. (B) Application of PREVENA™ Incision Management System with PEEL & PLACE™ Dressing - 20cm. (C) Incision after dressing removal on Day 7.

Patient data and photos courtesy of H. John Cooper, MD
Case Study 3: Total Knee Replacement (Figure 10)
A 47-year-old male with a history of refractory Hodgkin’s lymphoma on chemotherapy fell down a flight of stairs and suffered a complex proximal tibial fracture (Figure 10A).

The patient received initial closed reduction and initial external fixation, after which he developed significant medial skin blisters and was eventually treated with open reduction with internal fixation with a lateral locking plate (Figure 10B). At 7 months post surgery, the patient had a range of motion of -5 to 75 degrees after multiple rounds of physical therapy (Figure 10C). He subsequently underwent a total knee arthroplasty after the removal of hardware and lysis of adhesions (Figure 10D).

Following the total knee arthroplasty, the PREVENA™ Incision Management System with the CUSTOMIZABLE™ Dressing (KCI, an Acelity company, San Antonio, TX) was applied over the closed incision at -125mmHg (Figure 10E).

PREVENA™ Therapy was discontinued after 3 days (Figure 10F). Patient was discharged from the hospital on postoperative Day 3. At 2 weeks post surgery, the incision was progressing toward healing (Figure 10G). By 3 months post surgery, the patient had a range of motion of 0 to 110 degrees, and the incision had healed well with no drainage or incision problems (Figure 10H).

Figure 10. Total knee replacement on a 47-year-old male patient. (A) X-rays of complex tibial plateau fracture after falling down a flight of stairs. Patient had initial closed reduction and external fixator placement. (B) X-rays post open reduction and internal fixation. (C) X-rays at 7 months post surgery. Range of motion was -5 to 75 degrees after multiple rounds of physical therapy. (D) Removal of hardware and lysis of adhesions, showing the extensive incision/dissection for the total knee arthroplasty. (E) PREVENA™ Therapy with the CUSTOMIZABLE™ Dressing placed over the closed incision. (F) Incision after the CUSTOMIZABLE™ Dressing was removed on postoperative Day 3. (G) Incision 2 weeks post surgery. (H) Healed incision at 3 months post surgery.
Case Study 4: Abdominal Wall Reconstruction (Figure 11)
A 38-year-old obese female underwent abdominal Fleur-de-Lis style panniculectomy 1 year post-laparoscopic gastric bypass. The patient lost 85 pounds and had a stable weight for 6 months. Markings were performed with the patient in the standing position prior to surgery (Figure 11A). A Fleur-de-Lis pattern horizontal and vertical panniculectomy was performed, leaving the umbilicus in its natural position, attached to its stalk (Figures 11B-C). Primary closure was achieved with an inverted “T” pattern, using resorbable intradermal sutures (Figure 11D). The PREVENA™ CUSTOMIZABLE™ System was applied over the incision (Figure 11E) and remained in place until removal on Day 7 (Figure 11F). The patient did not have any postoperative incision complications.

Figure 11. Abdominal wall reconstruction on a 38-year-old female patient. (A) Surgical markings prior to surgery. (B) Surgical incision for panniculectomy. (C) Tissue that was removed. (D) Incision after primary closure. (E) Application of PREVENA™ Therapy. (F) Incision after dressing removal on Day 7.

Patient data and photos courtesy of Dr. Ron Silverman, University of Maryland, School of Medicine, Baltimore, MD and Senior Vice President and Chief Medical Officer, Acelity, San Antonio, TX.
Case Study 5: Panniculectomy (Figure 12)

An obese female presented with end-stage renal disease. She was on dialysis and awaiting a renal transplant. However, the patient's transplant surgeon requested a plastic surgery consultation prior to her renal transplant to evaluate the patient for a panniculectomy for her large, overhanging abdominal pannus (Figure 12A) in order to reduce the complexity and risk of the renal transplant procedure.

Post panniculectomy (Figures 12B and 12C), PREVENA™ Incision Management System with the CUSTOMIZABLE™ Dressing (KCI, an Acelity company, San Antonio, TX) was placed over the complete closed incision at -125mmHg (Figures 12D and 12E). The patient was discharged home on postoperative Day 1 with the dressing in place.

PREVENA™ Therapy was discontinued after 7 days. At postoperative Day 13, the incision remained intact with good reapproximation (Figure 12F). The patient did not have any postoperative incision complications.

Figure 12. Panniculectomy for abdominal pannus on an obese female patient. (A) Patient with overhanging abdominal pannus. (B) Removal of pannus. (C) Removed pannus. (D) Completely closed incision. (E) Application of PREVENA™ Therapy for 7 days. (F) Incision at postoperative Day 13.

Patient data and photos courtesy of Dr. Devinder Singh and Dr. Ron Silverman, MD, FACS.
Case Study 6: Breast Reconstruction (Figure 13)
Patient was a 27-year-old female with a history of obesity, preoperative chemotherapy, and axillary dissection of the left breast. Patient (Figure 13A) received reduction-pattern mastectomy on both breasts.

Following surgery, the PREVENA™ Incision Management System with the CUSTOMIZABLE™ Dressing (KCI, an Acelity company, San Antonio, TX) was placed over the complete closed incision at -125mmHg (Figure 13B).

PREVENA™ Therapy was discontinued after 5 days, and patient was discharged from the hospital on Day 6. The patient experienced a superficial dehiscence in the left breast in a location where the PREVENA™ Incision Management System did not cover; the dehiscence resolved with local wound care. Both incisions were intact at 4 weeks (Figure 13C) and remained intact at 2 months post mastectomy surgery (Figure 13D). Patient underwent breast reconstruction with silicone implants, fat injections, and nipple reconstruction with good results at 2 months post reconstruction surgery (Figure 13E).

Figure 13. Breast reconstruction on a 27-year-old female patient. (A) Patient prior to reduction pattern mastectomy. (B) Application of PREVENA™ Therapy following reduction pattern mastectomy. (C) 4-weeks post mastectomy surgery. (D) 2-months post mastectomy surgery. (E) 2-months post breast reconstruction surgery with silicone implants, fat injections, and nipple reconstruction.

Patient data and photos courtesy of Dr. Allen Gabriel.
Case Study 7: Cesarean Section (Figure 14)

Patient was a 30-year-old female, gravid 4, para 3 with a history of late prenatal care. Medical history also included anemia, smoking, pre-pregnancy weight of 250 lbs (BMI = 40.4), and Class III Obesity (BMI = 41.4) (Figure 14A) at time of surgery. Patient underwent a cesarean section (C-section) at 39-weeks gestation.

PREVENA™ Incision Management System with the PEEL & PLACE™ Dressing - 20cm was applied to the incision post C-section (Figure 14B).

PREVENA™ Therapy was discontinued after 7 days (Figures 14C and 14D).

Figure 14. Cesarean section on a 30-year-old female patient. (A) Day 0: Patient prior to surgery. (B) Day 0: Application of PREVENA™ Therapy. (C) Day 7: Dressing prior to removal. (D) Day 7: Surgical incision after dressing removal.

Patient data and photos courtesy of Dr. Lance T. Frye, Oklahoma State University Center for Health Sciences, Oklahoma City, OK.
**Case Study 8: Breast Reconstruction (Figure 15)**

Patient was a 55-year-old female with right breast cancer and a BMI of 46 (Figure 15A). Patient underwent lumpectomy with right sentinel node biopsy and reconstruction with tissue rearrangement and left breast reduction. Following surgery, the PREVENA™ Incision Dressings were placed over closed incisions on each breast (Figure 15B). The PREVENA™ System was discontinued after 7 days (Figure 15C). At the 4-month follow-up visit, the incisions remained closed without complication (Figure 15D).

**Figure 15.** Right breast lumpectomy with reconstruction and left breast reduction on a 55-year-old female patient. (A) Patient prior to surgery. (B) Application of PREVENA™ System for 7 days. (C) Incision after removal of dressing. (D) Incision at 4 months after lumpectomy and reconstruction surgery.

Patient data and photos courtesy of Dr. Allen Gabriel.
A prospective multicenter RCT investigated the use of negative pressure wound therapy over closed incisions (ciNPT) to prevent wound dehiscence and infection after high-risk lower extremity fractures.

There were a total of 23 infections in the Control group (standard postoperative dressings) and 14 in the ciNPT group, which represented a significant difference in favor of ciNPT ($p = 0.049$).

The relative risk of developing an infection was 1.9 times higher in control patients than in patients treated with ciNPT (95% confidence interval, 1.03-3.55).

A conservative hypothetical cost model applied to the clinical results of this study shows potential cost savings during the inpatient stay per patient of $3,128 with the use of ciNPT.

The economic model based on the clinical assessment on ortho trauma patients uses select study data to provide an illustration of estimates of costs for use of ciNPT or standard postoperative dressings (Control). This model is an illustration and not a guarantee of actual individual costs, savings, outcomes or results. The hospital is advised to use this model as an illustration only to assist in an overall assessment of products and pricing.

### Economic Model

<table>
<thead>
<tr>
<th>High Risk Lower Extremity Fractures</th>
<th>Hypothetical Economic Model</th>
<th>ciNPT (n=130)</th>
<th>Control (n=119)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Infections†</td>
<td>14</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Number of Dehiscence†</td>
<td>12</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Total Infection Cost (Incremental cost of infection = $31,141 per patient)‡</td>
<td>$435,974</td>
<td>$716,243</td>
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</tr>
<tr>
<td>Total Dehiscence Cost (Incremental cost of dehiscence = $12,607 per patient)¶</td>
<td>$148,884</td>
<td>$248,140</td>
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</tr>
<tr>
<td>Per Patient Infection Cost (Total Infection Cost / n)</td>
<td>$3,354</td>
<td>$6,019</td>
<td></td>
</tr>
<tr>
<td>Per Patient Dehiscence Cost (Total Dehiscence Cost / n)</td>
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<td>$2,085</td>
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</tr>
<tr>
<td>Per Patient Cost of Therapyϕ</td>
<td>$495</td>
<td>$18</td>
<td></td>
</tr>
<tr>
<td>Total Cost Per Patient (USD)</td>
<td>$4,994</td>
<td>$8,122</td>
<td></td>
</tr>
</tbody>
</table>

† Model assumes that patients could only have 1 infection and 1 dehiscence
‡ Thakore RV et al. Surgical site infection in orthopedic trauma: A case-control study evaluating risk factors and cost. Journal of Clinical Orthopaedics and Trauma. 2015;(6):220-226. The median cost for treatment for patients with SSIs was $31,141.36
¶ Weighted national estimates from HCUP National (Nationwide) Inpatient Sample (NIS), 2014. Agency for Healthcare Research and Quality (AHRQ), based on data collected by individual States and provided to AHRQ by the States.36
ϕ KCI estimate based on price of PREVENA® PEEL & PLACE® Dressing System and Control therapy (gauze) changed once a day at $18 a week

The economic model based on the clinical assessment on ortho trauma patients uses select study data to provide an illustration of estimates of costs for use of ciNPT or standard postoperative dressings (Control). This model is an illustration and not a guarantee of actual individual costs, savings, outcomes or results. The hospital is advised to use this model as an illustration only to assist in an overall assessment of products and pricing.
Closed-Incision Negative-Pressure Therapy Versus Antimicrobial Dressings After Revision Hip and Knee Surgery: A Comparative Study†44

- This study evaluated the efficacy of PREVANA™ Therapy compared to a sterile antimicrobial dressing (AMD) AQUACEL™ Ag on wound complications, surgical site infections (SSIs), and reoperations after hip and knee revision surgery over a 34-month period.
- PREVANA™ Therapy was used selectively in higher-risk patients with multiple risk factors for SSIs over the last 15 months of the study period.
- A hypothetical cost model applied to the clinical results of this study shows potential cost savings per patient of $1,499 with the use of PREVANA™ Therapy.

 Patients treated with PREVANA™ Therapy developed fewer overall wound complications (6.7% vs 26.9%, \( p = 0.024 \)) and fewer total SSIs (3.3% vs 18.5%, \( p = 0.045 \)) than patients treated with AQUACEL™ Ag.
- There were trends toward a lower rate of superficial wound dehiscence (6.7% vs 19.4%, \( p = 0.163 \)), fewer deep periprosthetic joint infections (0.0% vs 9.3%, \( p = 0.118 \)), and fewer reoperations (3.3% vs 13.0%, \( p = 0.191 \)) among patients treated with PREVANA™ Therapy.

Economic Model

<table>
<thead>
<tr>
<th>Hip (THA) and Knee (TKA) Surgery Revision Hypothetical Economic Model</th>
<th>PREVANA™ Therapy (n = 30)</th>
<th>AQUACEL® Ag (n = 108)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Infections (a)</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Percent of SSIs</td>
<td>3.3%</td>
<td>18.5%</td>
</tr>
<tr>
<td>Cost per SSI† (b)</td>
<td>$15,129</td>
<td>$15,129</td>
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<tr>
<td>Cost of SSI Per Patient (a*b)/n)</td>
<td>$504</td>
<td>$2,802</td>
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<tr>
<td>Cost of Therapy Per Patient◊</td>
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<td>$31</td>
</tr>
<tr>
<td>Total Cost Per Patient (USD)</td>
<td>$1,334</td>
<td>$2,833</td>
</tr>
</tbody>
</table>

† Cooper HJ, Bas MA. Closed-Incision Negative-Pressure Therapy Versus Antimicrobial Dressings After Revision Hip and Knee Surgery: A Comparative Study. J Arthroplasty 2016;31:1047-1052.44

* Although the authors reported use of ciNPT for a mean of 9.2 days (ranging from 6 to 14 days), this mean time of application is outside the recommendations for Optimum Use as stated in the PREVANA™ Incision Management System Clinician Guide Instructions for Use: “The PREVANA™ Incision Management System is to be continuously applied for a minimum of two days up to a maximum of seven days.” Use for greater than 7 days is not recommended or promoted by KCI.


◊KCI estimate based on price of PREVANA™ PEEL & PLACE™ Dressing plus three days of inpatient NPT, and Control therapy changed once a day, at $18 a week.

◊KCI estimate based on price of PREVANA™ PEEL & PLACE™ Dressing System and AQUACEL Ag price is an estimate; individual prices may vary.

The hypothetical economic model uses select study data to provide an illustration of estimates of costs for use of PREVANA™ Therapy or AQUACEL™ Ag. This model is an illustration and not a guarantee of actual individual costs, savings, outcomes or results. The hospital is advised to use this model as an illustration only to assist in an overall assessment of products and pricing.
Prevention of Poststernotomy Wound Infections in Obese Patients by Negative Pressure Wound Therapy

• A prospective, single center clinical trial evaluated the use of PREVENA™ Therapy compared to standard post-operative dressings (Control) for the prevention of wound infection within 90 days after median sternotomy procedures in 150 consecutive obese (BMI ≥ 30) patients.

• Patients treated with PREVENA™ Therapy developed fewer wound infections (3/75 [4%] vs. 12/75 [16%], \( p = 0.0266 \)) than patients treated with standard post-operative dressings.

• Wound infections with Gram-positive skin flora were found in only 1 patient in the PREVENA™ Therapy group compared with 10 patients in the control group (\( p = 0.0090 \)).

• A hypothetical cost model applied to the clinical results of this study shows a potential cost savings per patient of $4,024 with the use of PREVENA™ Therapy.

### Economic Model

<table>
<thead>
<tr>
<th>Post-sternotomy Hypothetical Economic Model</th>
<th>PREVENA™ Therapy (n = 75)</th>
<th>Control (n=75)</th>
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<tbody>
<tr>
<td>Number of Infections (a)</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Percent of Infections</td>
<td>4.0%</td>
<td>16.0%</td>
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<tr>
<td>Cost per Infection( ^{\dagger} ) (b)</td>
<td>$37,513</td>
<td>$37,513</td>
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<td>Cost of Infection Per Patient (a( \times )b)/n</td>
<td>$1,501</td>
<td>$6,002</td>
</tr>
<tr>
<td>Cost of Therapy Per Patient( ^{\dagger} )</td>
<td>$495</td>
<td>$18</td>
</tr>
<tr>
<td>Total Cost Per Patient (USD)</td>
<td>$1,996</td>
<td>$6,020</td>
</tr>
</tbody>
</table>

\( ^{\dagger} \) KCI estimate based on price of PREVENA™ PEEL & PLACE™ Dressing System and Control therapy (gauze) changed once a day at $18 a week.

The hypothetical economic model uses select study data to provide an illustration of estimates of costs for use of PREVENA™ Therapy or standard post-operative dressings (Control). This model is an illustration and not a guarantee of actual individual costs, savings, outcomes or results.

The hospital is advised to use this model as an illustration only to assist in an overall assessment of products and pricing.
Closed-Incision Negative-Pressure Therapy in High-Risk General Surgery Patients Following Laparotomy: A Retrospective Study

- The aim of this study was to compare wound complication (skin wound dehiscence or deep incisional infection) occurrence in patients with multiple comorbidities who received PREVENA™ Therapy or conventional care (Control) within 30 days following laparotomy.

- Inclusion criteria were obesity (BMI ≥ 35 kg/m²), or two or more of the following risk factors: malignancy, history of smoking, immunosuppression, malnutrition, emergency surgery, diffuse atherosclerotic disease.

- Compared to the control group, patients treated with PREVENA™ Therapy had significantly fewer wound complications (2/69 [2.9%] vs. 23/112 [20.5%], respectively; \( p<0.0009 \)).

- The relative risk of a wound complication in the PREVENA™ Therapy group was 0.14 (95% CI 0.03-0.58) compared with the control group of 0.12 (95% CI 0.03-0.51); suggesting that infection is less likely to occur in PREVENA™ Therapy treated incisions.

- A hypothetical cost model applied to the clinical results of this study shows potential cost savings per patient of $2,777 with the use of PREVENA™ Therapy.

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**Economic Model**

<table>
<thead>
<tr>
<th>Hypothetical Economic Model</th>
<th>PREVENA™ Therapy (n = 69)</th>
<th>Control (n=112)</th>
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</thead>
<tbody>
<tr>
<td>Deep Incisional Infection</td>
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<tr>
<td>Skin Wound Dehiscence</td>
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<td>0</td>
</tr>
<tr>
<td>Total Wound Complications</td>
<td>2</td>
<td>23</td>
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<tr>
<td>Total Infection Cost (Incremental cost of infection = $17,995 per patient)</td>
<td>$17,995</td>
<td>$413,885</td>
</tr>
<tr>
<td>Total Dehiscence Cost (Incremental cost of dehiscence = $12,407 per patient)</td>
<td>$12,407</td>
<td>$0</td>
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<tr>
<td>Total Complication Cost (a)</td>
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<td>Complication Cost Per Patient (a/n)</td>
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<td>Cost of Therapy Per Patient*</td>
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<td>Total Cost Per Patient (USD)</td>
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<td>$3,713</td>
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† KCI estimate based on price of PREVENA™ PEEL & PLACE™ Dressing System and Control therapy (gauze) changed once a day at $18 a week.

The hypothetical economic model uses select study data to provide an illustration of estimates of costs for use of PREVENA™ Therapy or standard post-operative dressings (Control). This model is an illustration and not a guarantee of actual individual costs, savings, outcomes or results.

The hospital is advised to use this model as an illustration only to assist in an overall assessment of products and pricing.
Reduction of **Groin Wound Complications** in Vascular Surgery Patients Using Closed Incision Negative Pressure Therapy (ciNPT): A Prospective, Randomized, Single-Institution Study

- The aim of this prospective, randomized, single-institution study was to investigate the effectiveness of PREVENA™ Therapy compared to conventional adhesive dressing (Control) on groin incisions after vascular surgery.
- The PREVENA™ Therapy group had 43 patients and 58 groin incisions and the control group consisted of 57 patients and 71 groin incisions.
- Wound evaluation based on the Szilagyi classification (Grade I, II, and III) took place postoperatively on days 5–7 and 30.
- In this study, patients with cutaneous wound dehiscence, skin necrosis and single local infection signs were classified as grade I. Wound dehiscence in the subcutaneous layer, hematoma, lymphatic fistula, lymphocele, seroma, single local infection signs and systemic infection parameters were classified as grade II. All classical local infection signs (pain, swelling, redness and hyperaemia, warmth, dysfunction), systemic infection parameters and arterial graft infections were classified as grade III.
- PREVENA™ Therapy significantly reduced the incidence of local infection compared to the conventional dressing (1/43 [2.3%] vs. 10/57 [17.5%, respectively; \( p = 0.022 \)).
- Compared to the control group, the PREVENA™ Therapy group showed a significant reduction in wound complications after both evaluation periods (5/58 [8.62%] vs. 30/71 [42.3%), \( p < 0.0005 \)).
- PREVENA™ Therapy showed a significant reduction in revision surgeries (1/58 [1.7%] vs. 10/71 [14.1%), respectively; \( p = 0.022 \)) until 30 days postoperatively compared to the control group.
- A hypothetical cost model applied to the clinical results of this study shows a potential cost savings per patient of $2,694 with the use of PREVENA™ Therapy.

### Vascular Groin Hypothetical Economic Model

<table>
<thead>
<tr>
<th>Vascular Groin Hypothetical Economic Model</th>
<th>PREVENA™ Therapy</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Patients (n)</td>
<td>43</td>
<td>57</td>
</tr>
<tr>
<td>Number of Local Infections (a)</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Percent of Local Infections</td>
<td>2.3%</td>
<td>17.5%</td>
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<td>Cost Per Local Infection(^{(a)}) (b)</td>
<td>$20,842</td>
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<td>Cost of Local Infection Per Patient (a(^*)b)/n)</td>
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<td>Cost of Therapy Per Patient(^{(a)})</td>
<td>$495</td>
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<tr>
<td>Total Cost Per Patient (USD)</td>
<td>$980</td>
<td>$3,674</td>
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\(^{(a)}\) KCI estimate based on price of PREVENA™ PEEL & PLACE™ Dressing System and Control therapy (gauze) changed once a day at $18 a week.

The hypothetical economic model uses select study data to provide an illustration of estimates of costs for use of PREVENA™ Therapy or standard post-operative dressings (Control). This model is an illustration and not a guarantee of actual individual costs, savings, outcomes or results.

The hospital is advised to use this model as an illustration only to assist in an overall assessment of products and pricing.
MONOGRAPH SUMMARY
This monograph contains a review of clinical journal and conference literature on the use of closed incision negative pressure therapy (ciNPT) and PREVENA™ Therapy. Additionally, it describes the bench testing, computer modeling, and published scientific studies of proposed biomechanical and physiological mechanisms of the PREVENA™ Incision Management System. Actual patient results are presented as case studies to transition from scientific evidence to clinical experience. Additional clinical research is still needed to fully understand the scientific and medical impact of ciNPT and the PREVENA™ Incision Management System in the surgical arena.

Table 1. Comparison of Dressing Materials

<table>
<thead>
<tr>
<th>Dressing Component</th>
<th>ciNPT with V.A.C.® Therapy Dressing Configuration</th>
<th>PEEL &amp; PLACE™ Dressing and CUSTOMIZABLE™ Dressing Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin interface layer</td>
<td>Non-adhering Dressing (petrolatum-coated gauze dressing)</td>
<td>Fabric with 0.019% silver (currently marketed as InterDry™ Ag [Coloplast®, Minneapolis, MN], which is used for skin fold management)</td>
</tr>
<tr>
<td>Foam bolster (no patient contact)</td>
<td>V.A.C.® GRANUFOAM™ Dressing (polyurethane foam with black pigment)</td>
<td>Same V.A.C.® GRANUFOAM™ Dressing (with black pigment replaced by pigment violet 23)</td>
</tr>
<tr>
<td>Drape</td>
<td>V.A.C.® Drape (polyurethane film with acrylic adhesive)</td>
<td>Polyurethane film with acrylic adhesive</td>
</tr>
</tbody>
</table>

Table 2. ASPS Evidence Rating Scale for Therapeutic Studies

<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Qualifying Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>High-quality, multicenter or single-center, randomized controlled trial with adequate power; or systematic review of these studies</td>
</tr>
<tr>
<td>II</td>
<td>Lesser-quality, randomized controlled trial; prospective cohort or comparative study; or systematic review of these studies</td>
</tr>
<tr>
<td>III</td>
<td>Retrospective cohort or comparative study; case-control study; or systematic review of these studies</td>
</tr>
<tr>
<td>IV</td>
<td>Case series with pre/post test or only post test</td>
</tr>
<tr>
<td>V</td>
<td>Expert opinion developed via consensus process; case report or clinical example; or evidence based on physiology, bench research or ‘first principles’</td>
</tr>
</tbody>
</table>

Table 3. Literature review of the use of ciNPT and PREVENA™ Therapy over surgical incisions

<table>
<thead>
<tr>
<th>Author</th>
<th>Study Type</th>
<th>Patients</th>
<th>Results/Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stannard JP, et al. (Journal of Orthopaedic Trauma, 2012)</td>
<td>RCT V.A.C.® Therapy (ciNPT) vs. Standard Postoperative Dressings</td>
<td>249 patients with 263 calcaneus, pilon and tibial plateau fractures • Randomization: ciNPT, 130 patients (141 fractures) vs. Control, 119 patients (122 fractures).</td>
<td>• Significant decrease for incidence of dehiscence (12 cases [ciNPT] vs. 20 cases [Control]; $p = 0.044$) • Significant decrease for total infections (14 cases [ciNPT] vs. 23 cases [Control]; $p = 0.049$) • Incidence of acute infection trended lower with ciNPT (1 case) vs. control (5 cases)</td>
</tr>
</tbody>
</table>
Table 3. Literature review of the use of ciNPT and PREVENA™ Therapy over surgical incisions (cont.)

<table>
<thead>
<tr>
<th>Author</th>
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<th>Patients</th>
<th>Results/Conclusions</th>
</tr>
</thead>
</table>
| Stannard JP, et al.     | RCT (Interim Analysis)              | V.A.C.* Therapy (ciNPT) vs. Standard Postoperative Dressings            | • 44 patients with high-energy trauma wounds with draining hematomas (31 Control and 13 ciNPT)  
  • 44 patients with high-energy fractures (24 Control and 20 ciNPT)  
  • High-energy trauma wounds: Control group drained a mean of 3.1 days compared to only 1.6 days for ciNPT ($p = 0.03$)  
  • High-energy fractures: Control group drained a mean of 4.8 days compared to only 1.8 days for ciNPT ($p = 0.02$) |
| Pachowsky M, et al.     | RCT                                 | PREVENA™ Incision Management System vs. Standard Postoperative Dressings | • 19 patients (10 Control and 9 PREVENA™ Therapy) with closed incisions after total hip arthroplasty  
  • Postoperative seromas were measured in both groups on the fifth and tenth postoperative days.  
  • Significantly decreased development of postoperative seromas in the PREVENA™ Therapy group on postoperative day 10 (average volume of 1.97mL) compared to Control (5.08mL) ($p = 0.021$)  
  • A seroma was present in 44% of the PREVENA™ Therapy patients and 90% of the Control patients  
  • The PREVENA™ Therapy group received significantly fewer days of antibiotics (8.44 ± 2.24 vs. 11.8 ± 2.82 days, $p = 0.005$)  
  • A secretion in the wound after day 5 was reported in fewer patients in the PREVENA™ Therapy group (1 vs. 5 patients) |
| Pauser J, et al.        | RCT                                 | PREVENA™ Incision Management System vs. Standard Postoperative Dressings | • 21 patients with femoral neck fractures (FNF) treated with hip hemiarthroplasty (HA) who were randomized to receive either PREVENA™ Therapy or standard postoperative dressings (Control) over clean sutured wounds.  
  • Control: 10 patients  
  • PREVENA™ Therapy: 11 patients  
  • There were no differences in patient age, coagulation time, postoperative wound size, or wound secretion volume.  
  • Compared to the Control, PREVENA™ Therapy patients had:  
  o Reduced seroma volume at postoperative day 5 (0.257 ± 0.75 cm³ vs. 3.995 ± 5.01 cm³, respectively; $p<0.05$); at postoperative day 10, no difference was reported  
  o Fewer days of wound secretions (0.9 ± 1.0 days vs. 4.3 ± 2.45 days, respectively; $p = 0.0005$)  
  o Fewer dressing changes (5.4 vs. 9.5, respectively; $p<0.0001$)  
  o Reduced time (and materials) for dressing changes (14.9 ± 3.9 minutes vs. 42.9 ± 11.0 minutes, respectively; $p<0.0001$)  
  • The authors concluded using PREVENA™ Therapy for closed incisions in the HA setting “might help to reduce complications of prolonged wound healing and postoperative seroma in the wound...and save time needed for wound care.” |
Lee AJ, et al.30
(Interactive Cardiovascular and Thoracic Surgery, 2017)
RCT
PREVNA™ Incision Management System vs. conventional dry gauze dressings

- 64 patients following great saphenous vein harvest following coronary artery bypass surgery.
- PREVNA™ Therapy (n=35)
- Control (n=29)
- Primary study endpoint: rates of device complication and malfunction
- Dressing changes
  - PREVNA™ Therapy: Applied at the time of GSV harvest in the OR and remained in place for ≤7 days.
  - Control: <information not provided>
- Wounds were inspected for all patients prior to discharge and at 6 weeks postoperatively.
- Two patients in each group withdrew consent postoperatively. There were no significant differences between the groups with respect to baseline demographics and clinical characteristics (PREVNA™ Therapy group=33; control=27).
  - In the PREVNA™ Therapy group, the device was tolerated for the full duration of treatment in 30/33 patients (91%) for an average of 4.8 ± 1.45 days.
  - In the PREVNA™ Therapy group, 2 patients died postoperatively, and 2 patients were unable to complete the quality of life questionnaire. Twelve patients were lost to follow-up at 6 weeks: 4 in the PREVNA™ Therapy group and 8 in the control group.
    - Initial assessment: PREVNA™ Therapy (n=29); control (n=25)
    - 6 week follow-up assessment: PREVNA™ Therapy (n=26); control (n=17)
- Treatment was discontinued for 2 patients due to a malfunctioning pressure sensor and for 1 patient with allergic contact dermatitis to the dressing adhesive.
- Compared to the Control, PREVNA™ Therapy patients had:
  - Earlier date of hospital discharge (6 days vs. 10 days, respectively; p=0.008).
  - Increased ability for self care at initial assessment [23/29 (79.3%) vs. 13/25 (52.0%), respectively; p=0.023].
  - Increased quality of life EQ-5D-3L score at initial assessment (73 vs. 59, respectively; p=0.039).
  - Increased mobility at initial assessment [25/29 (86.2%) vs. 14/25 (56.0%), respectively; p=0.0117] and follow-up assessment [22/26 (84.6%) vs. 11/17 (64.7%), respectively; p=0.0123].
- The authors concluded that using PREVNA™ Therapy for GSV harvest following coronary artery bypass surgery “…is safe, well tolerated, and improves postoperative recovery with prolonged impact on mobility at 6 weeks.”

Table 3. Literature review of the use of ciNPT and PREVNA™ Therapy over surgical incisions (cont.)
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<table>
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</table>
| Lee K, et al.   | RCT PREVENA™ Incision Management System vs. standard sterile gauze dressing | • 102 lower extremity revascularization patients with closed groin incisions:  
  o PREVENA™ Therapy group (n = 53)  
  o Control conventional dressing (n = 49) | • One SSI reported for Control and PREVENA™ Therapy groups: PREVENA™ Therapy, 2% vs. control, 2% (p=0.74)  
  • PREVENA™ Therapy had significantly shorter hospital length of stay: PREVENA™ Therapy, 6.4 days vs. Control group, 8.9 days (p=0.02)  
  • PREVENA™ Therapy had reduced 30-day SSI rate: PREVENA™ Therapy, 11.3% vs. control, 18.4% (p=0.24)  
  • There was no difference in surgical revision or readmission rate between the PREVENA™ Therapy group and the Control group.  
  • The authors concluded that there was a trend toward reduced SSI rates and a significantly reduced mean duration of hospital stay in the PREVENA™ Therapy group compared to the Control group. |
| Gunatilake R, et al. | RCT PREVENA™ Incision Management System vs. conventional sterile wound dressings | • 82 obese pregnant women undergoing cesarean delivery:  
  o PREVENA™ Therapy (n = 75)  
  o Control (n = 75)  
  • Primary study endpoint: presence or absence of surgical site occurrences  
  • Treatment  
    o PREVENA™ Therapy: Applied over closed incision and remained in place for 5-7 days.  
    o Control: SOC dressings were applied over closed incisions for 1-2 days.  
    • Patients were discharged on postoperative day 3 or 4; wound outcomes were followed for 42±10 postoperative days. | • Compared to the control group, patients treated with PREVENA™ Therapy had:  
  o Fewer SSOs (2/39 [5.1%] vs. 7/43 [16.3%], respectively; p=0.16)  
  o Significantly less incisional pain:  
    - at rest (20/46 [43.5%] vs. 39/46 [84.8%], respectively; p<0.001);  
    - with incisional pressure (25/46 [54.3%] vs. 42/46 [91.3%], respectively; p<0.001);  
  A 30% reduction in total opioid use (55.9 mg vs. 79.1 mg, respectively; p=0.036).  
  • Using PREVENA™ Therapy for incision management in an obese population undergoing cesarean delivery reduced incisional wound complications and required significantly less narcotics, suggesting a possible role in postpartum and postoperative pain management. |
Table 3. Literature review of the use of ciNPT and PREVENA™ Therapy over surgical incisions (cont.)

<table>
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<tr>
<th>Author</th>
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</tr>
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<tbody>
<tr>
<td>Pleger SP, et al. 33</td>
<td>RCT</td>
<td>• 100 patients with 129 closed groin incisions.</td>
<td>• PREVENA™ Therapy reduced wound healing complications (WHC): Control group saw 42.3% WHC compared to PREVENA™ Therapy 8.6% WHC (p&lt;0.0005)</td>
</tr>
</tbody>
</table>
|                         | PREVENA™ Incision Management System vs. conventional adhesive plaster dressing | o Groin incisions (n = 58) for study group treated with PREVENA™ Therapy (-125 mmHg)  
 o Groin incisions (n = 71) for control group treated with conventional adhesive plaster dressing  
 o All patients received perioperative antibiotics. | • PREVENA™ Therapy lowered surgical revisions among >50 subgroup: 6 of 26 in control group required revision in contrast with 1 of 31 in ciNPT group (p = 0.029)          |
|                         |                                     |                                                                          | • The PREVENA™ Therapy group had a significant effect on main and perioperative risk factors.                                                       |
|                         |                                     |                                                                          | • PREVENA™ Therapy across groin incisions for vascular procedures significantly reduces the incidence of WHC on postoperative days 5-7 and 30, as well as, reduces surgical revisions until postoperative day 30. |
| Grauhan O, et al. 34    | Prospective Comparative Study       | • 150 consecutive obese (BMI ≥ 30) patients, whose sternotomy wound incisions were treated with:  
 o PREVENA™ Therapy (n = 75)  
 o Control (n = 75)  
 • Primary study endpoint: Wound infection within 90 days  
 • Patients allocated to treatment groups by alternating based on time of operation.  
 o Patients with diabetes assigned “half and half to both groups, with priority.”  
 • Dressing changes:  
 o PREVENA™ Therapy: Placed under sterile OR conditions; kept at -125mmHg for the first 6 to 7 postoperative days.  
 o Control: Changed on the first or second postoperative day and every 1-2 days thereafter.  
 • No significant preoperative patient differences between groups.  
 • All patients followed for at least 90 days. | • PREVENA™ Therapy group, compared to Control group, had significantly fewer  
 o Wound infections: 3/75 (4%) vs. 12/75 (16%), respectively; p = 0.0266; odds ratio, 4.57; 95% confidence interval (CI), 1.23-16.94.  
 o Patients whose wound infections had Gram-positive skin flora: 1 vs. 10, respectively; p = .0090; odds ratio, 11.39; 95% CI, 1.42-91.36.  
 • Timing of wound infection incidence:  
 o PREVENA™ Therapy group: 71/75 (95%) of the incisions were primarily closed when the dressing was removed in 6 to 7 days. No wound infections occurred after postoperative day 7.  
 o Control group: 9/12 wound infections occurred beyond postoperative day 7 and up to day 35.  
 • Authors concluded that PREVENA™ Therapy over clean, closed surgical incisions for the first 6 to 7 postoperative days significantly reduced wound infection after median sternotomy for high-risk obese cardiac surgery patients |
| Weir G 35               | Prospective Case-Control Pilot Study | • Eight patients undergoing vascular bypass procedures.  
 • Patients required bilateral femoral access.  
 • PREVENA™ Therapy was placed on one femoral area; contralateral femoral area received standard post-operative dressing (Control).  
 • Patients required intra-operative heparin and postoperative anti-coagulation therapy.  
 • Patients had at least one of the following risk factors for development of wound complications: obesity, diabetes, hypertension, hypercholesterolemia, smoking within 6 weeks prior to surgery, and HIV/AIDS. | • Wound complications requiring surgical intervention occurred in three of the control wounds, while no wound complications occurred where PREVENA™ Therapy was applied.  
 • The authors suggested that using PREVENA™ Therapy in high-risk patients undergoing vascular surgery potentially reduced wound complications with no observable increase in hemorrhage. |
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</table>
| Grauhan O, et al.³⁶  
(International Wound Journal, 2014) | Prospective Comparative Study  
PREVENA™ Incision Management System vs. conventional sterile wound dressings (Control) | • 3745 cardiac surgery patients undergoing sternotomy  
  o PREVENA™ Therapy (n = 237)  
  o Control (n = 3,508)  
• Primary study endpoint: Wound infection within 30 days  
• Dressing changes  
  o PREVENA™ Therapy: Applied immediately after skin suturing and remained in place for 6-7 days.  
  o Control: Changed on the first or second postoperative day and every 1-2 days thereafter.  
• All patients followed for at least 30 days | • The PREVENA™ Therapy group had a significantly lower infection rate than the Control group: 3/237 (1.3%) vs. 119/3508 (3.4%), respectively; p<0.05; odds ratio 2.74.  
• In the PREVENA™ Therapy group, the infections were primarily closed when the dressing was removed 6-7 days after application.  
• The authors concluded using PREVENA™ Therapy for the first 6-7 days over clean, closed surgical incisions reduced the incidence of postoperative wound infections, and the reduced rate in wound infections may be cost effective for patients, hospitals, and health insurance companies. |
| Swift SH, et al.³⁷  
(Journal of Reproductive Medicine, 2015) | Prospective Comparative Study  
PREVENA™ Therapy vs. Conventional skin sutures (or staples) without the use of ciNPT (Control) | • 319 women at increased risk for infectious morbidity and wound complications after cesarean delivery  
  o Control: 209 patients  
  o PREVENA™ Therapy: 110 patients  
• Patients were followed as part of postpartum care or were followed up at 6 weeks postpartum. | • Compared to the Control, PREVENA™ Therapy patients had:  
  o Fewer postoperative complications (21.0% vs. 6.4%, respectively; p = 0.0007)  
  o Fewer wound infections (11.5% vs. 2.7%, respectively; p = 0.008)  
  o Fewer cases of endometritis (6.7% vs. 0.9%, respectively; p = 0.023)  
  o Approximately the same number of wound separation cases (3.8% vs. 2.7%, respectively; p = 0.754)  
• The PREVENA™ Therapy group, who were at increased risk for postoperative infections and wound complications, had significant reductions in deep and superficial infectious morbidity after the PREVENA™ Therapy system was applied to closed cesarean section incisions. |
| Cantero R, et al.³⁸  
(Advances in Skin & Wound Care, 2016) | Prospective Comparative Study  
PREVENA™ Incision Management System vs. conventional dressings  
Incidence of SSI between groups was evaluated. | • Patients (n = 60) underwent ileostomy reversal:  
  o 17 consecutive patients with PREVENA™ Therapy study group  
  o 43 control patients (historical cohort) treated with standard post-operative dressings for control group  
• Patients were provided prophylactic antibiotics. | • There were no significant differences in demographic variables between PREVENA™ Therapy and control groups.  
• The Control group reported significantly more incidences of SSI (n = 9; 21%) compared with 0 SSI (0%) in the PREVENA™ Therapy group (p < 0.038)  
• No complications attributable to PREVENA™ Therapy; however, other procedure-related complications occurred in 30% of patients.  
• The authors suggested that PREVENA™ Therapy was safe, user-friendly and may prevent SSIs in contaminated wounds, such as those that may arise because of ileostomy closure. |
### Table 3. Literature review of the use of ciNPT and PREVENA™ Therapy over surgical incisions (cont.)

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</tr>
</thead>
</table>
| Seyvan, A.        | Prospective, comparative study           | PREVENA™ Incision Management System vs. PICO◊ Single Use Negative Pressure Wound Therapy System | • A total of 303 patients were assigned to either the PREVENA™ Therapy group or the PICO◊ group in an alternate fashion. Thirty-one patients were excluded due to death related to patient disease, re-thoracotomy, or discontinuation of therapy; thus, 272 patients were evaluated.  
• The PREVENA™ Therapy group consisted of 139 patients. PREVENA™ Therapy was applied immediately after skin suturing and remained in place at a negative pressure of -125mmHg.  
• The PICO◊ group consisted of 133 patients. PICO◊ was applied immediately after skin suturing and remained in place at a negative pressure of -80mmHg.  
• The number of patients developing an infection within 90 days after surgery was recorded.  
• The two groups did not significantly differ in age, gender, body mass index, or incidence of chronic obstructive pulmonary disease and diabetes.  
• The PICO◊ group had significantly more patients requiring a left internal mammary artery (LIMA) graft for revascularization of the myocardium ($p=0.02$).  
• Compared to the PICO◊ group, patients treated with PREVENA™ Therapy resulted in significantly fewer infections (0/139 vs. 5/133 respectively; $p=0.027$). In the PICO◊ group, there were 4 (3%) deep infections and 1 (0.7%) superficial infection.  
• In this patient population, PREVENA™ Therapy significantly reduced the rate of surgical site infections when compared to PICO◊. |
| Redfern, et al.    | Single-center, prospective comparative study | PREVENA™ Incision Management System vs. historical Control (application of sterile gauze dressings) | • 192 PREVENA™ Therapy patients representing 196 incisions  
• 400 historical Control patients  
PREVENA™ Therapy had:  
• a significantly higher percentage of patients experiencing a reaction to the dressing compared to the Control group (13.8% vs. 2.25%, respectively; $p<0.0001$)  
• a significantly lower number of patients who received pain management 24 hours postsurgically compared to the Control group (2.6±1.8 vs. 3.6±2.2, respectively; $p<0.0001$)  
There was a significant reduction in the overall complication rate requiring medical or surgical intervention in the PREVENA™ Therapy group when compared with the Control group (1.5% vs. 5.5%, respectively; $p=0.02$), including:  
• A significant reduction in the rate of superficial infections in patients treated with PREVENA™ Therapy (0.0% vs. 2.25%; $p=0.03$).  
• A significant reduction in the rate of hematomas in patients treated with PREVENA™ Therapy (0.0% vs. 2.25%; $p=0.02$).  
• A significant reduction in the rate of edema/swelling in patients treated with PREVENA™ Therapy (0.5% vs. 3.25%; $p=0.02$).  
• A significant reduction in the rate of edema/swelling in patients treated with PREVENA™ Therapy (0.5% vs. 3.25%; $p=0.02$).  
• Although not statistically significant, there was a reduction in deep infection (1.0% vs. 1.25%; $p=0.81$), wound dehiscence (1.5% vs. 3.25%; $p=0.2$), seromas (0.0% vs. 0.5%; $p=0.16$), and drainage (1.0% vs. 3.25%; $p=0.07$) requiring medical or surgical intervention in the PREVENA™ Therapy group when compared with the Control group.  
In this study, PREVENA™ Therapy reduced the overall incidence of complications requiring medical or surgical intervention for hip and knee arthroplasty but did not significantly impact the rate of deep infection. |
Table 3. Literature review of the use of ciNPT and PREVANA™ Therapy over surgical incisions (cont.)

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Matatov T, et al. (Journal of Vascular Surgery, 2013)</td>
<td>Retrospective Review of Patient Records PREVANA™ Incision Management System vs. Skin Adhesive or Absorbent (Control)</td>
<td>90 vascular surgery patients with 115 groin incisions for longitudinal or transverse femoral cut-down o PREVANA™ Therapy: 41 patients (52 incisions) o Control: 49 patients (63 incisions)</td>
<td>Used Szilagyi scale to rate degree of infection from grade I (lowest) to grade III (highest) o PREVANA™ Therapy was applied intraoperatively and removed after 5-7 days. o Mean times of wound evaluation: PREVANA™ Therapy: 7 and 33 days postoperatively vs. Control: 10 and 40 days. o PREVANA™ Therapy-treated incisions had significantly lower overall rate of infection: 3/52 (6%) vs. 19/63 (30%), p = 0.0011 o Incidence and severity of infections by group: o PREVANA™ Therapy: 3 infections, all Szilagyi grade I o Control: 19 infections, 10 (16%) Szilagyi grade I, 7 (11%) grade II, and 2 (3%) grade III o According to the authors, PREVANA™ Therapy “significantly decreased the incidence of groin wound infection in patients after vascular surgery.”</td>
</tr>
</tbody>
</table>

| Reddy VS (Cureus, 2016) | Retrospective Review of Patient Records PREVANA™ Incision Management System | 27 patients undergoing cardiothoracic surgery o Patient risk factors included: obesity (27/27, 100%), diabetes (25/27, 92.6%), hypertension (16/27, 59.3%) and ≥5 comorbidities (20/27, 74%). o Treatment: o PREVANA™ Therapy: Applied after immediately after skin suturing and remained in place at a negative pressure of -125mmHg for a mean duration of 5.6±0.9 days. o All patients received antibiotics prior to surgery (-30 minutes), during surgery (4 hours), and up to 24 hrs postoperatively. o All patients were evaluated within the first 30 days postoperatively; mean follow-up was 6.7±3.1 weeks. | Within the first 30 days post-surgery, PREVANA™ Therapy resulted in: o A majority of patients with intact incisions with good approximation and no major sternal complications (21/27; 77.8%) o Two patients experienced minor dehiscences and 4 patients had superficial cellulitis that were treated and resolved. o All patients had intact incisions at the final follow-up visit. o The author concluded that in these cardiac patients “…ciNPT over closed sternal incisions resulted in favorable outcomes within 30 days of surgery.” |
Table 3. Literature review of the use of ciNPT and PREVENA™ Therapy over surgical incisions (cont.)

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<tr>
<td>Gabriel A et al43</td>
<td>Retrospective Review of Patient Records</td>
<td>• 13 patients (25 breasts) undergoing postmastectomy reconstruction as part of 2-stage expander/implant breast reconstruction</td>
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<td></td>
<td>PREVENA™ Incision Management System</td>
<td>• Treatment:</td>
<td>• Fourteen breasts underwent nipple-sparing mastectomies. 6 breasts had a reduction-pattern mastectomy, and 5 breasts received a skin-sparing mastectomy.</td>
</tr>
<tr>
<td></td>
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<td>o PREVENA™ Therapy: a CUSTOMIZABLE™ Dressing was applied over the closed incision in the sterile field of the operating room followed by continuous negative pressure at -125 mmHg for an average of 4.3 days</td>
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<td>o Patients underwent one of 3 types of mastectomies: nipple sparing, reduction-pattern, or skin-sparing</td>
<td>• In the nipple-sparing mastectomy group, one breast developed a delayed hematoma on postoperative Day 13 that resolved by the 3-month follow-up visit.</td>
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<td>o Surgical drains were used with PREVENA™ Therapy (mean drain placement was 8.2 days)</td>
<td>• In the reduction-pattern mastectomy group, 3 breasts developed superficial dehiscence that resolved with local wound care. One breast developed flap necrosis that required surgical revision.</td>
</tr>
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<td>o All incisions were closed with absorbable sutures and protected with a sterile dressing.</td>
<td>• No complications were reported in the skin-sparing mastectomy group.</td>
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<td></td>
<td></td>
<td>• All patients were followed for 3 months.</td>
<td>• At the 3-month follow-up, 24/25 (96%) breasts achieved complete healing.</td>
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<td>• The authors concluded that PREVENA™ Therapy with CUSTOMIZABLE™ or PEEL &amp; PLACE™ Dressings “…could be a viable option over closed incisions following immediate postmastectomy reconstruction as part of 2-stage expander/implant breast reconstruction.”</td>
</tr>
<tr>
<td>Cooper HJ et al44</td>
<td>Retrospective Review of Patient Records</td>
<td>• 138 patients undergoing hip and knee revision surgery</td>
<td>• Compared to the Control, PREVENA™ Therapy resulted in:</td>
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<tr>
<td></td>
<td>PREVENA™ Incision Management System vs. antimicrobial dressings (Control)</td>
<td>o PREVENA™ Therapy (n=30)</td>
<td>o Fewer overall wound complications (6.7% vs. 26.9%, respectively; (p=0.024))</td>
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<td></td>
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<td>o Control (n=108)</td>
<td>o Fewer total SSIs (3.3% vs. 18.5%, respectively; (p=0.045))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Primary outcome measures: incidence of wound complications, incidence of total SSIs, and reoperation rate for wound complications</td>
<td>o A trend toward fewer reoperations (3.3% vs. 13.0%, respectively; (p=0.19))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment:</td>
<td>• The authors’ findings suggest that “…ciNPT may decrease wound complications and SSIs in patients undergoing revision hip and knee surgery.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o PREVENA™ Therapy: Applied after skin suturing and remained in place at a negative pressure of -125 mmHg</td>
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<td>o Control: antimicrobial dressings were applied over standard surgical sutures and remained in place for a minimum of 5 days unless a premature dressing change was required due to saturation.</td>
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<td></td>
<td></td>
<td>• All patients were followed for 90 days.</td>
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</tbody>
</table>
Table 3. Literature review of the use of ciNPT and PREVENA™ Therapy over surgical incisions (cont.)

<table>
<thead>
<tr>
<th>Author</th>
<th>Study Type</th>
<th>Patients</th>
<th>Results/Conclusions</th>
</tr>
</thead>
</table>
| Zaidi A & El-Masry S<sup>45</sup> (Colorectal Dis, 2017) | Retrospective Comparative Study PREVENA™ Incision Management System vs standard wound dressings (Control) | • 181 high-risk surgical patients following laparotomy  
  o PREVENA™ Therapy group (n=69)  
  o Control (n=112)  
  • Patient chart reviews between October 2011 and March 2012.  
  • Control group: Standard wound dressings; dressings removed on postoperative day 7.  
  • PREVENA™ Therapy group: PREVENA™ Therapy applied at -125 mmHg continuously; dressing removed on postoperative day 7.  
  • All patients were followed for 30 days after surgery.  
  • Primary outcome: presence of deep incision infection or dehiscence within the follow-up period.  
  • Compared to the Control group, patients treated with PREVENA™ Therapy developed: significantly fewer wound complications (23/112 [20.5%] vs. 2/69 [2.9%], respectively; p<0.0009)  
  • The relative risk of wound complications in the PREVENA™ Therapy group was 0.14 (95% CI 0.03-0.58) with an odds ratio of 0.12 (95% CI 0.03-0.51).  
  • The authors concluded that PREVENA™ Therapy “was associated with a positive clinical outcome and was a safe and effective method of postsurgical management in our general surgery patients considered to have risk of developing wound complications following laparotomy.” |}

| Lo Torto F, et al<sup>46</sup> (International Wound Journal, 2017) | Retrospective single-center study PREVENA™ Incision Management System vs. conventional wound dressings | High-risk patients (n = 78) with deep wound sternal infection after sternotomy  
  o Treatment: pectoral muscle flap coverage plus PREVENA™ Therapy (n = 30)  
  o Control (historical cohort): pectoral muscle flap coverage with conventional dressings (n = 48)  
  • There were no significant differences observed in demographic, sternotomy, and comorbidity variables between Control and PREVENA™ Therapy groups.  
  • PREVENA™ Therapy reported fewer adverse events:  
    o Seroma – PREVENA™ Therapy, 1/30 (3%) vs. control 0/48 (0%); p = 0.38  
    o Hematoma – PREVENA™ Therapy, 2/30 (7%) vs. Control 4/48 (8%); p = 1  
    o Dehiscence – PREVENA™ Therapy, 0/30 (0%) vs. Control 7/48 (15%); p = 0.04  
  • Surgical Revision – PREVENA™ Therapy, 1/30 (3%) vs. Control 7/48 (15%); p = 0.14  
  • The authors reported PREVENA™ Therapy as a worthwhile adjunctive intervention in tandem with MPMF in patients at high-risk for complications, who present with DWSI after median sternotomy access. |
Cooper HJ, et al.47 (Injury, 2018)  
Retrospective, Comparative Cohort Study  
PREVENA™ Incision Management System vs. conventional antimicrobial dressings  
Incidence of postoperative incisional complications, SSIs, and surgical revisions between groups was evaluated.  
- Patients (n = 67) underwent lower extremity periprosthetic fracture surgery:  
  - 27 test patients had incision managed by PREVENA™ Therapy  
  - 40 Control patients had incision managed with standard post-operative dressings (ie, sterile, antimicrobial hydrofiber dressing)  
- There were no statistically significant differences in demographic variables, fracture location, or type of procedure between PREVENA™ Therapy and control groups.  
- PREVENA™ Therapy reduced postoperative incisional complications: 14 control group patients (35%) experienced complications compared with 1 patient (4%) in the PREVENA™ Therapy group (p = 0.002).  
- PREVENA™ Therapy reduced the incidence of wound contamination by infectious material: Control group reported 10 SSI (25%) compared with 0 SSI (0%) in the PREVENA™ Therapy group (p = 0.004).  
- PREVENA™ Therapy reduced the need for surgical revisions: Control group reported 10 SSI (25%) compared with 1 SSI (4%) in the PREVENA™ Therapy group (p = 0.021).  
- The authors suggested that PREVENA™ Therapy applied after lower extremity periprosthetic fracture surgeries effectively decreased wound complications, SSIs, and surgical revisions.

Nickl S, et al.48 (J Reconstr Microsurg. 2017)  
Retrospective, single-center Study  
PREVENA™ Incision Management System vs. conventional postoperative dressings  
Incidence of deep sternal wound infections, rates of surgical revision, duration of stay in ICU or hospitalized were evaluated.  
- Patients (n = 47) underwent received unilateral pectoralis major flap to treat deep sternal wound infections:  
  - 19 test patients had incision managed by PREVENA™ Therapy  
  - 28 Control patients had incision managed with adhesive, breathable, non-woven post-operative dressings  
- There were no significant differences in demographics, variables related to cardiac surgery, and comorbidities between PREVENA™ Therapy and Control groups.  
- Control group reported 10 (35.7%) adverse events compared with 6 (31.6%) adverse events in the PREVENA™ Therapy group.  
- PREVENA™ Therapy patients underwent fewer surgical revisions: group (1 vs. 9; p = 0.034).  
- PREVENA™ Therapy reduced median postoperative time in ICU: Control group reported 3.5 (0-34) days vs. 0 (0-5) days in the PREVENA™ Therapy group (p < 0.001).  
- The authors suggested that PREVENA™ Therapy applied in conjunction with unilateral pectoralis major flap to treat deep sternal wound infections effectively decreased wound complications, incidence of surgical revision, and ICU length of stay.

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- The authors suggested that PREVENA™ Therapy applied in conjunction with unilateral pectoralis major flap to treat deep sternal wound infections effectively decreased wound complications, incidence of surgical revision, and ICU length of stay.  |
### Table 3. Literature review of the use of ciNPT and PREVENA™ Therapy over surgical incisions (cont.)

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<thead>
<tr>
<th>Author</th>
<th>Study Type</th>
<th>Patients</th>
<th>Results/Conclusions</th>
</tr>
</thead>
</table>
| Schurtz E, et al. (Am J Surg., 2018) | Retrospective, Case-control Study | PREVENA™ Incision Management System vs. conventional postoperative dressings | - Patients (n=96) underwent lower extremity periprosthetic fracture surgery:  
  - 48 test patients had incisions managed by PREVENA™ Therapy  
  - 48 Control patients had incisions managed with adhesive, breathable, non-woven postoperative dressings  
  - Incidence of SSIs and rates of readmission were evaluated.  
- There were no statistically significant differences in demographic or procedure type between PREVENA™ Therapy and Control groups.  
- PREVENA™ Therapy isolated incisions from external contaminants: Control group reported 11 SSIs (23%) compared with 3 SSIs (6%) in the PREVENA™ Therapy group (p = 0.04)  
- PREVENA™ Therapy reduced readmission rates: Control group reported 7 readmits (15%) compared with 1 readmit (2%) in the PREVENA™ Therapy group (p = 0.05)  
- The authors suggested that PREVENA™ Therapy applied after exploratory laparotomy surgeries effectively decreased wound complications, SSIs, and incidence of readmission. |
| Colli A, et al. (Journal of Cardiothoracic Surgery, 2011) | Case series | PREVENA™ Therapy | - 10 patients with closed sternal incisions and mean Fowler risk score of 15.1 following cardiac surgery  
- Wounds and surrounding skin showed complete wound healing with absence of skin lesions following dressing removal  
- No infections occurred during 30 day follow-up time  
- No device-related or other complications were observed with PREVENA™ Therapy |
- First use of PREVENA™ Therapy after pathological scar excision  
- Scar sites were located in body areas with skin stretch during flexion/extension movements.  
- PREVENA™ Incision Dressing was applied intraoperatively and maintained for 8 days at -125mmHg  
- 7 of 8 patients completed treatment successfully  
- 1 patient discontinued treatment after 1 day because scar was close to pubic area and, despite shaving, it was not possible to achieve and maintain an air-tight seal.  
- The authors concluded that “Easy intraoperative application and postoperative management, associated with good compliance of patients, make PREVENA™ Therapy a safe home-care device.” |
| Haghshenasskashani A, et al. (British Journal of Diabetes & Vascular Disease, 2011) | Case study | PREVENA™ Therapy | - 1 patient with distal lower limb incision site treated with PREVENA™ Incision Management System following popliteal-tibial bypass grafting  
- The incision did not become oedematous or deteriorate at any time, even after the PREVENA™ Incision Dressing was removed  
- Ongoing tissue healing was maintained without complication  
- Patient discharged on day 12 after regaining full mobility and removal of sutures. |
Table 4. Patient Risk Factors\textsuperscript{57-59}

<table>
<thead>
<tr>
<th>Risk Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 65</td>
</tr>
<tr>
<td>Wound infection</td>
</tr>
<tr>
<td>Pulmonary disease</td>
</tr>
<tr>
<td>Vascular disease</td>
</tr>
<tr>
<td>Hemodynamic instability</td>
</tr>
<tr>
<td>Ostomies</td>
</tr>
<tr>
<td>Hypoalbuminemia</td>
</tr>
<tr>
<td>Systemic infection</td>
</tr>
<tr>
<td>Obesity</td>
</tr>
<tr>
<td>Uremia</td>
</tr>
<tr>
<td>Hyperalimentation</td>
</tr>
<tr>
<td>Ascites</td>
</tr>
<tr>
<td>Malignancy</td>
</tr>
<tr>
<td>Hypertension</td>
</tr>
<tr>
<td>Length and depth of incision</td>
</tr>
<tr>
<td>Foreign body in the wound</td>
</tr>
<tr>
<td>Anemia</td>
</tr>
<tr>
<td>Jaundice</td>
</tr>
<tr>
<td>Diabetes – poor control</td>
</tr>
<tr>
<td>Active smoker</td>
</tr>
<tr>
<td>Type of injury</td>
</tr>
<tr>
<td>Radiation therapy</td>
</tr>
<tr>
<td>Steroid use</td>
</tr>
</tbody>
</table>

Table 5A. Biomechanical properties of the PREVENA™ Incision Management System

<table>
<thead>
<tr>
<th>Property Demonstrated</th>
<th>Study Description</th>
<th>Nonclinical Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helps hold closed incision edges together</td>
<td>\textit{In vitro} simulated incision model\textsuperscript{3}</td>
<td>• Sutures plus PREVENA™ Therapy resisted separation 51% better than sutures only (92.9 ± 2.6N vs. 61.7 ± 0.3N, respectively; (p&lt;0.05))</td>
</tr>
<tr>
<td></td>
<td>o Measured force needed to separate sutured and stapled incision edges 10mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Compared sutures plus PREVENA™ Therapy to sutures only and staples plus PREVENA™ Therapy to staples only</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May help realign and reduce tensile forces across the incision</td>
<td>\textit{Finite element computer model} \textsuperscript{1}</td>
<td>• Sutures only: tensile loads concentrated at sutures</td>
</tr>
<tr>
<td></td>
<td>o Evaluated tensile forces in a cross-section of a simulated incision closed with sutures</td>
<td>• Sutures plus PREVENA™ Therapy: tensile loads realigned and more evenly spread across a simulated incision</td>
</tr>
<tr>
<td></td>
<td>o Compared sutures only to sutures plus PREVENA™ Therapy</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>\textit{Finite element computer model} \textsuperscript{2}</td>
<td>• High lateral strain areas normally surround the incision line</td>
</tr>
<tr>
<td></td>
<td>o Simulated a sutured incision with lateral tension</td>
<td>• PREVENA™ Therapy led to reduced lateral strain around the suture lines of the incision</td>
</tr>
<tr>
<td></td>
<td>o Evaluated strain levels with and without PREVENA™ Therapy</td>
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<td></td>
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</tbody>
</table>
May help improve fluid flow

- In vivo porcine model was developed to evaluate effect of negative pressure (PREVENA™ Therapy) on hematoma/seroma formation, fluid removal into the canister, and lymph system involvement
  - Two sets of contralateral subcutaneous voids with overlying sutured incisions were created on the ventral sides of each of 8 swine.
  - Uniquely labeled 30 and 50nm nanospheres were introduced into each subcutaneous void.
  - Incisions were assigned to PREVENA™ Therapy or standard of care (SOC) (3M™ Tegaderm™ Dressing) over sutures for 4 days.
  - After therapy, the hematoma/seroma in each defect was weighed (with differences averaged for each animal), fluid levels in the canister were monitored, 5 pre-identified lymph nodes were harvested, and 5 key organs were biopsied.

  - Hematoma/seroma mass significantly reduced (63%) for PREVENA™ Therapy vs. SOC (mean 15 ± 3g vs. 41 ± 10g, respectively; p = 0.002)
  - No fluid found in PREVENA™ Canister
  - Lymph nodes had ~60 μg (~50%) more 30- and 50-nm nanospheres from PREVENA™ Therapy-treated incisions compared to Control sites (p = 0.04 and p = 0.05, respectively).
  - Nanosphere incidence significantly greater from PREVENA™ Therapy sites versus Control sites in lungs, liver and spleen (p<0.05); no nanospheres found in kidney biopsies.
  - According to the authors, in this scientific model, application of PREVENA™ Therapy significantly decreased hematoma/seroma levels without fluid collection in the canister, which may be explained by increased lymph clearance.

- In vivo porcine incision model compared PREVENA™ Therapy to standard dry dressings (Control)
  - In 8 mature mini-pigs, the two dressings were applied to adjacent sutured incisions over the spine.
  - After 3 or 5 days, incisions were assessed using scar scale rating, biomechanical testing (e.g., failure load, failure energy, and stress), and histological analysis.

  - PREVENA™ Therapy incisions had a significantly improved scar scale height grade (p<0.026)
  - The representative Control incision showed inflammation, edema and swelling around the incision (Figure 7A)
  - The representative PREVENA™ Therapy incision line was barely visible (Figure 7B)
  - Control group scores were lower for failure load (4.9 ± 4.0 vs. 16.5 ± 14.6N), energy absorbed (8.0 ± 9.0 vs. 26.9 ± 23.0 mJ), and ultimate stress (62 ± 53 vs. 204 ± 118 N/mm²).
  - Histology showed no differences in incision scar width between the two groups.
  - In this porcine study, authors noted, “a trend toward improved early healing strength and in a significantly improved incision appearance,” for incisions treated with PREVENA™ Therapy.
Helps facilitate incision healing

- In vivo porcine model used to assess whole-genome microarrays to gain insight into the biological processes of closed incision management (CIM).\cite{61}
  - Total RNA was isolated from the tissue
  - Quality and quantity of RNA were determined using the Experion™ Automated Electrophoresis System (Bio-Rad, Hercules, CA).

- Genomic pathway analysis via PANTHER™ (Gen-Probe™, San Diego, CA) indicated:
  - Increased integrin signaling in CIM-treated incisions compared to SOC-treated incisions (normalized to naïve)
  - Decreased inflammation mediated by key chemokine and cytokine marker expression in CIM-treated incisions compared to SOC-treated incisions (normalized to naïve)
  - CIM affects gene expression differently than SOC.\cite{61}

- In vivo porcine model used to compare the biomechanics of CIM-treated incisions to SOC-treated controls 40 days post-surgery.\cite{40}
  - Three adult female Yucatan swine (65-75 kg) received eight 6-cm long full-thickness dorsal incisions.
  - Incisions were closed with 2-0 Prolene sutures using a simple interrupted pattern.
  - Contralateral incisions received SOC (ABD Pads) or CIM for 5 days, then SOC for 5 days.
  - Sutures were removed on Day 10, and covered with Tegaderm™ dressing (3M; St. Paul, MN) for an additional 5 days. The incisions were left untreated until term (Day 40).
  - Mechanical testing: Tissue surrounding the incision scar was trimmed to a 10cm x 1cm strip including the epidermis, dermis, subdermal fat layer, and subcutaneous fat layer.
  - Gene Expression: 4-mm tissue biopsies were collected on days 6, 20, and 40.
  - Histomorphometric testing: Incision site and four strips of naïve skin from each of 5 animals were excised for processing.

- At 40 days post-surgery, mechanical properties (strain energy density, peak strain) were higher and the width of the healed area was narrower in CIM-treated incisions versus SOC (Table 7)
- At 5 days post-surgery, fewer genes were differentially expressed and showed reduced upregulation of genes associated with inflammation, hypoxia, retardation of re-epithelialization, impaired wound healing, and scarring in CIM-treated incisions versus SOC.
- These data suggest that surgical incision management with CIM, provided by the PREVENA™ Incision Management System, may improve the quality of the healed wound and reduce the likelihood of wound dehiscence.\cite{35}

- In vitro viral penetration study\cite{64} confirmed that PREVENA™ Incision Dressing protects the incision from external contamination
  - Test squares were cut from the polyurethane film and clamped into a penetration test cell.
  - A 60mL bacteriophage suspension was introduced into top side of test cell (5 min).
  - Film was monitored for penetration before and after 2 PSIG pressure was applied for 1 min.

- Both biological assay (Table 8) and visual inspection showed no penetration.
- These results indicate that the exterior drape of the PREVENA™ Incision Management System may be a microbial barrier to viral contamination (as small as 27nm) and bacterial sources.

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**Table 7. Characteristics of Clean, Closed Surgical Incisions in Yucatan Swine 40 Days Post-Surgery**

<table>
<thead>
<tr>
<th>Mechanical Property</th>
<th>Naïve</th>
<th>SOC</th>
<th>PREVENA™ Therapy</th>
<th>Percentage Difference (between PREVENA™ Therapy and SOC)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strain Energy Density (N/mm²)</td>
<td>0.37 ± 0.05</td>
<td>0.15 ± 0.02 (&lt;0.0001)</td>
<td>0.21 ± 0.04 (0.0097)</td>
<td>40</td>
<td>0.0373</td>
</tr>
<tr>
<td>Peak Strain (unitless)</td>
<td>0.26 ± 0.01</td>
<td>0.18 ± 0.01 (0.0005)</td>
<td>0.23 ± 0.02 (0.1512)</td>
<td>28</td>
<td>0.0455</td>
</tr>
<tr>
<td>Peak Stress (N/mm²)</td>
<td>3.1 ± 0.3</td>
<td>2.0 ± 0.2 (0.0233)</td>
<td>2.4 ± 0.3 (0.1845)</td>
<td>NS</td>
<td>0.2703</td>
</tr>
<tr>
<td>Elastic modulus (N/mm²)</td>
<td>17 ± 1</td>
<td>17 ± 1 (1.000)</td>
<td>17 ± 2 (1.000)</td>
<td>NS</td>
<td>1.000</td>
</tr>
<tr>
<td>Sample size (n)</td>
<td>12</td>
<td>10</td>
<td>9</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Data are shown as mean ± standard error; NS not significant, NA not applicable; *p*-values in parentheses are for difference from naïve.

**Table 8. Bacteriophage concentrations from penetration study**

<table>
<thead>
<tr>
<th>Dressing Area</th>
<th>Concentrations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Side/Pre-Pressure</td>
<td>8.7x10⁸ PFU/mL</td>
</tr>
<tr>
<td>Top Side/Post-Pressure</td>
<td>9.4x10⁸ PFU/mL</td>
</tr>
<tr>
<td>Bottom Side Assay</td>
<td>&lt;1 PFU/mL</td>
</tr>
</tbody>
</table>

* According to Nelson Labs, an assay titer value of <1 Plaque Forming Units (PFU)/mL is reported for assay plates showing no growth.
REFERENCES

Ref Type: Report
(2) P10(K) Summary: Prevena Incision Management System. K100821. 6-11-2010. San Antonio, TX, Kinetic Concepts, Inc.
Ref Type: Report
Follow local institutional protocols for infection control and waste disposal procedures. Local protocols should be based on the applicable federal, state and/or local government environmental regulations.

NOTE: Specific indications, contraindications, warnings, precautions and safety information exist for PREVENA™ Therapy. Please consult the applicable PREVENA™ System Clinician Guide instructions for use prior to application.

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