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A COMPARISON OF SUPRATHEL BURN DRESSING VS STANDARD CARE ON LENGTH OF HOSPITALIZATION, PAIN SCORES, OPIOID USE, TREATMENTS, AND OUTCOMES.

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UNIVERSITY OF SAN DIEGO
Hahn School of Nursing and Health Science:
Beyster Institute for Nursing Research

DOCTOR OF NURSING PRACTICE PORTFOLIO

by

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A portfolio presented to the

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DOCTOR OF NURSING
PRACTICE

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**A COMPARISON OF SUPRATHEL BURN DRESSING VS STANDARD CARE ON
LENGTH OF HOSPITALIZATION, PAIN SCORES, OPIOID USE, TREATMENTS,
AND OUTCOMES.**

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Abstract

Purpose: The purpose of this evidenced-based practice Doctor of Nursing Practice (DNP) project was to determine the impact and efficacy of using Suprathel artificial wound and burn dressing on patients treated at a UC San Diego Health Regional Burn Center for second-degree burns. The primary goal of this project will be to evaluate the impact of using Suprathel on hospital length of stay; compare wound infection rates, pain score, and morphine equivalent use; and to identify the cost-effectiveness of the Suprathel artificial wound and burn dressing.

Background: Burns are a global health concern causing significant morbidity and mortality, accounting for 180,000 deaths annually. Burn injuries are associated with a significant amount of pain and suffering, which has a substantial impact on the patient's quality of life. The thermal insult on the skin can affect both the epidermal and dermal layers depending on its duration and intensity. Unsuccessful burn treatment leads to major economic and psychological impacts on long-term somatic sequelae, imposing additional costs to the healthcare system.

Results: Suprathel artificial wound and burn dressing resulted in a reduction in patients' length of stay and a lack of complications, as well as the elimination of the need for multiple painful dressing changes and expedited wound healing and improved patient outcomes. The average length of stay for patients treated with Suprathel was four days, whereas it was five days for those who did not receive this treatment. Furthermore, Suprathel patients did not experience any significant complications compared to those who did not receive Suprathel dressing. The results of the overall pain assessment indicate a mild difference in MME use per day among the Suprathel and non-Suprathel groups. The average MME use per day in the Suprathel and non-Suprathel patients are 22.19 and 22.2, respectively. Lastly, calculated cost shows a marked decrease in cost in the Suprathel population versus the non-suprathel.

Evaluation: This intervention can ultimately eliminate the need and the burden associated with daily dressing changes for patients, caregivers, and staff. It also resulted in shorter hospitalization, reducing costs and allows them to return home which especially benefits pediatric patients. This results in better outcomes and less complications for those being treated for second degree burns.

Keywords: Suprathel, Second Degree Burn Treatment, Cost Effectiveness, Patient Outcomes

A COMPARISON OF SUPRATHEL BURN DRESSING VS STANDARD CARE ON LENGTH OF HOSPITALIZATION, PAIN SCORES, OPIOID USE, TREATMENTS, AND OUTCOMES.

Globally, thermal injuries are sustained by approximately 11 million people each year, 25% are patients under the age of 16, and therefore should be regarded as a serious epidemiological problem (Schriek et al., 2021). Furthermore, burns are a global health concern causing significant morbidity and mortality accounting for 180,000 deaths annually (Markiewicz et al., 2022). With burns being the fourth most frequent and common type of injury after traffic accidents, falls, and physical violence, more research in this area is needed (Markiewicz et al., 2022). Second degree burns are the most common burn injuries worldwide, especially in children (Blome et al., 2021). The last published Burn Incidence Fact Sheet of the American Burn Association (ABA) reports a total of 486, 000 people sought care for burns, of those 40,000 patients were hospitalized, and 30,000 of those patients were admitted to the 128 burn centers in the United States. Today, 96.7% of patients treated in a burn center will survive (ABA, 2016).

The burn wound and the healing process is characterized by a myriad of challenges. Although burns can be caused by a wide range of factors, the treatment and healing process is subject to some risks. Some burn wounds may be so complicated that they are difficult to heal (Haller et al., 2021). Depending on the severity of the burn, the patient may require treatment at a specialized burn center. This may involve skin grafts to cover large wounds, followed by emotional support and months of follow-up care (Wasiak et al., 2018). In addition, the medical care of burn patients needs a lot of experience, commitment, and multidisciplinary management. Surgical intervention and pharmacological approaches are usually a necessity in caring for burn patients. The patient may also need to cope with serious burn injuries that can cause scarring and reduced mobility (Hakkarainen et al., 2016).

Nationally, the Burn & Reconstructive Centers of America is the nation's largest healthcare system for burn care, hosting 16% of the nations dedicated burn beds and 20% of the nation's burn admissions. Their flag ship facility is the JMS Burn Center at Doctors Hospital in Augusta, Georgia and is currently the largest burn center in America (BRCA, 2023).

Developed for the Department of Defense, the United States Army Institute of Surgical Research Burn Center (USAISR) is the only military facility to serve this unique community. Located on Joint Base San Antonio in San Antonio, Texas the USAISR cares for both injured warfighters and their families from around the world, and for injured civilians from the local communities as they are the only ABA verified burn center in South Texas.

Locally, UC San Diego Health Regional Burn Center has served the San Diego and Imperial Counties since 1973. The professional care of patients is internationally recognized for its skill and knowledge. The state-of-the-art facility has an intensive care unit, a special burn care unit and an outpatient clinic for minor burn assessments and treatment. Over 400 patients are admitted to the Center each year with various levels of injury and hundreds more are treated on an outpatient basis. The Burn Center staff is involved in numerous research projects that are improving its ability to care for burn patients (UCSD, 2023).

Regardless of the facility in which a patient finds themselves, typical traditional daily dressing change consisting of a variety of antimicrobial ointments is the standard treatments for second degree burns. These dressing changes are extremely painful and require pre-medication with opioid pain medication and large quantities of dressing materials until the wounds are healed. The ointment impregnated gauze has had issues with staying in place, especially around major joints, and the abdomen, frequently leading to burn wound exposure and increasing the risk for infection. To mitigate these challenges several temporary skin substitutes (Biobrane,

xenograft, allograft, amniotic membrane, Trancyte, etc.) have been studied to decrease the number of painful dressing changes, reduce the systemic response, and accelerate the rate of healing. Regrettably, these skin substitutes struggled with increased infection rates and integration of the dressing into the wound bed. Depending on the depth of the wound, it was noted that allodermis and xenodermis may vascularize and integrate into the wound permanently leaving scar, or cause a delayed rejection reaction, opening previously epithelialized areas once again, also causing a systemic rejection response. Biologic membranes are known to carry the risk of slow virus or other infections even when properly applied. The supply is limited to the availability of the appropriate donor, which in some religions and cultures organ donation or xenograft use is prohibited. Additionally, several the previously widely used and studied biologics are no longer available for purchase or its availability is periodic. Most other advanced dressing lack translucency and require several dressing changes during the healing process, causing pain and anxiety (Blome et al., 2021)

Unfortunately, burn injuries are associated with a significant amount of pain and suffering, many survivors experience permanent scarring and disability which has a substantial impact on the patient's quality of life (Schiefer et al., 2021). These injuries are a complex combination where trauma and the mental health effects associated with the injury can magnify the negative attributes of each. Sustaining a significant burn such as this is often a traumatic event, either due to the cause of the injury, the emotional consequences of coping with the burn or the situation in which it occurred. Additionally, the emotional effect can be compounded after the incident and during the subsequent painful and ongoing treatment, changed body image, and through experienced and perceived stigma. The prevalence of trauma and associated mental health issues is high among burn survivors. (Cleary et al., 2020)

Trauma response can not only affect a patients psychological recovery, it also can interfere with many aspects of physical recovery (Cleary et al., 2020). Highlighting the importance of prompt treatment and appropriate dressing selection. The optimal dressing will provide a barrier of protection against infections, maintains a moist environment and promote, and accelerates wound healing. Additionally, creating a less painful experience, decreasing scar formation, all while remaining cost effective are important to consider when selecting the ideal dressing (Schiefer et al.,2021).

Per Blome et al. (2021), the ideal dressing for treating second degree burns would decrease pain, limit dressing changes, allow assessment of the healing process, prevent infection, accelerate wound healing, improve long term outcomes, and save on treatment costs. The authors continue to assert that Suprathel wound and burn dressing seems to fulfil most of these requirements.

Being that second-degree burns (partial thickness burns) are the most common type of burn injury, especially in children, there is no "gold standard" for the optimal treatment of this type of injury. Current treatment focuses on undistributed wound healing by providing a moist environment, removal of exudate, and prevention of infection and minimization of pain, scar formation, and functional impairment (Rashaan et al., 2017).

Over the last decade, a variety of dressings have been developed for the treatment of superficial burns. With significant progress being made in (semi) synthetic wound dressings to make improvements in treatment modalities in the quest to develop an ideal burn dressing. One of the latest innovations is Suprathel burn and wound dressing. Suprathel (of Polymedics Innovations GmbH, Filderstadt, Germany) is a biosynthetic, non-animal derived wound dressing that imitates the protective properties of the human epithelium by adhering to the wound bed at

body temperature (Rashaan et al., 2017). It is a porous and biodegradable copolymer membrane made of DL-Lactide, which is registered with the FDA (Blome et al., 2021). The microporous membrane of Suprathel, which has an elongation capacity of 250%, is water soluble. Its porous property is intended to prevent accumulation of wound exudate and ultimately preventing wound infection. Additionally, a moist wound environment is suggested to contribute to optimal wound healing. The dressing is transparent after application to the wound which enables inspection of the wound without removing the dressing (Rashaan et al.,2017). When the dressing is placed, and absorbs moisture, it conforms to the surface in which it is applied. The dressing then degrades into lactic acid, which is instantly buffered by wound exudate, creating a physiologic cell growth environment. After application of Suprathel, dressing changes are limited to just the outer dressing, leaving the wound unexposed, and therefore keeping the related pain for the patient low. If the wound epithelializes before it is fully degraded, it separates from the healed skin without regrowth (Blome et al. ,20121).

Suprathel dressing (approved in 2004), due to its unique wound healing properties, is considered a more favorable option as opposed to traditional burn dressings as it has been shown to help reduce the burden on patients, staff, and the healthcare system.

Purpose/Specific Aims

The purpose of this evidenced-based practice Doctor of Nursing Practice (DNP) project was to determine the impact and efficacy of using Suprathel artificial wound and burn dressing on patients treated at a UC San Diego Health Regional Burn Center for second degree burns. The goal of this project will be to evaluate the impact of using Suprathel on hospital length of stay; compare wound infection rates, pain score, and morphine equivalent use; and to identify the cost effectiveness of the Suprathel artificial wound and burn dressing.

Evidence-Bases Practice Model

The evidence-based project is designed utilizing the Johns Hopkins Nursing Evidence-Based Practice Model (JHNEBP). The model applies a problem-solving approach to decision-making in healthcare using a simple three-step process known as PET, which stands for Practice question (P), Evidence (E), and Translation (T). The model is accompanied by user-friendly tools that guide individuals and groups through the EBP process (Speroni, McLaughlin & Friesen, 2020). The aim is to ensure that the latest research findings and best healthcare practices are quickly and appropriately incorporated into patient care (Schaffer, Sandau & Diedrick, 2019).

Figure 1

Johns Hopkins Nursing Evidence-Based Practice Model

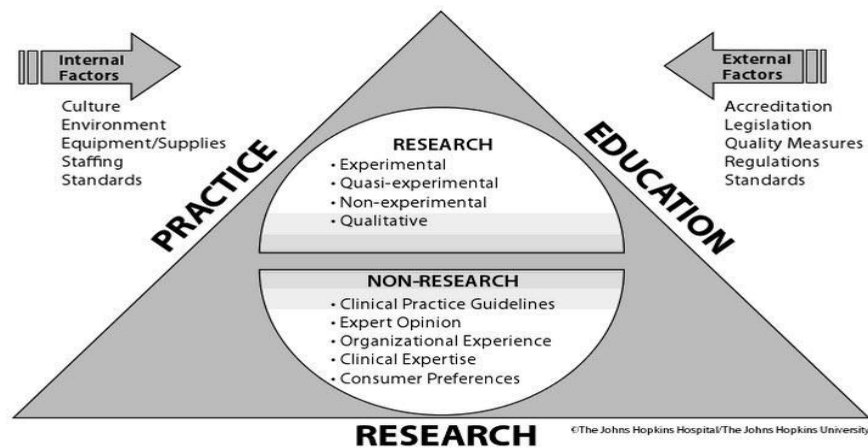


Figure 3.1 The Johns Hopkins Nursing Evidence-Based Practice Model

The first phase of the JHNEBP model is identifying the practice question. This phase comprises six steps, including the recruitment of an interprofessional team, defining the problem, developing, and refining the EBP question, identifying key stakeholders, determining the responsibility of project leadership, and scheduling team meetings (Schaffer, Sandau & Diedrick, 2019). In the next phase of searching for evidence, conducting an internal and external search for evidence, appraising the quality and level of each piece of evidence, summarizing individual

evidence, and synthesizing overall strength and quality of evidence. The interprofessional team then recommends change based on evidence synthesis (Schaffer, Sandau & Diedrick, 2019). The final phase is the translation into practice, which involves determining the fit and feasibility of recommendations for the translation plan, creating an action plan, securing support and resources, implementing an action plan, evaluating outcomes, disseminating, and reporting the findings (Speroni, McLaughlin & Friesen, 2020).

Literature Review

To support this evidence-based practice (EBP) screening project, a thorough literature search was completed using open access and subscription-based search engines provided through University of San Diego's Copley Library. Search engines included CINAHL Plus with Full Text, PubMed, Google Scholar, Cochrane Database of Systematic Reviews, and Ovid. Search terms and medical subject headings included Suprathel, Second Degree Burn Treatment, Cost Effectiveness, Patient Outcomes.

Table 1

Synopsis of Evidence

Author-year-Journal	Level of Evidence	Purpose	Research Design	Sample	Results	Relevance To Practice
Haller et al. (2021). Medicina	V	To examine the synthetic epidermal skin substitute Suprathel as a substitute in the treatment of partial thickness burns.	Systematic review	16 Suprathel and 12 porcine xenograft studies	Although Suprathel had a nearly six times larger Total Body Surface Area (TBSA) in their studies, it showed a significantly lower necessity for skin grafts and a significantly lower infection rate compared to in Porcine Xenografts	Suprathel is an effective replacement for porcine xenografts with even lower subsequent treatment rates

Hakkarainen et al. (2016). Journal of controlled release.	I	To investigate the potential of a wood-based nano fibrillar cellulose (NFC) wound dressing in a clinical trial on burn patients.	Clinical trials	9 burn patients	Epithelialization of the NFC dressing-covered donor site was faster compared to Suprathel.	NFC dressing is more promising for skin graft donor site treatment because it is biocompatible, attaches easily to the wound bed, and remains in place until the donor site has been renewed.
Blome et al. (2021). Burns.	I	To assess complications and outcomes using this absorbable synthetic membrane to treat second-degree burns.	Randomized controlled trial	229 burn patients, 138 pediatric, with superficial and deep second-degree wounds,	All wounds were treated with Suprathel and healed without grafting. Findings indicated fewer dressing changes and easier overall management of the wounds.	The membrane provides a simple, effective solution alternative with good outcomes and less pain than conventional and previously studied treatment options.
Schiefer et al. (2022). International wound journal.	I	To compare epicyte hydro to SUPRATHEL in the treatment of partial-thickness burns.	Clinical Study	20 patients with partial-thickness burn affecting more than 0.5% of TBSA	All wounds showed minimal exudation, and patients reported decreased pain with the only significant difference between the two dressings.	Epicitehydro can be used as an alternative to SUPRATHEL for the treatment of partial thickness burn wounds.
Hundeshagen et al. (2018). Journal of burn care & research	I	To compare Mepilex Ag (M), a silver-impregnated foam dressing, and Suprathel (S), a DL-lactid acid polymer, in the outpatient treatment of partial-thickness burns in pediatric and	Randomized, controlled, prospective clinical trial	62 burn patients	Pain ratings significantly reduced during the first 5 days after the burn in the Suprathel group. Viscoelasticity of burned skin was elevated compared with unburned skin in the Mepilex Ag group. Patients treated with	Both dressings are feasible and efficacious for the outpatient treatment of minor and selected moderate partial-thickness burns

		adult patients			Suprathel reported better overall scar quality.	
Wasiak et al. (2018). The Cochrane database of systematic reviews	I	To assess the effects of burn wound dressings on superficial and partial thickness burns.	Systematic reviews	30 RCTs	Silver sulphadiazine (SSD) was consistently associated with poorer healing outcomes compared to biosynthetic (skin substitute) dressings, silver-containing dressings, and silicon-coated dressings.	Burns treated with hydrogel dressings heal more quickly than those treated with usual care
Rashaan et al. (2017) Usability and effectiveness of suprathel® in partial thickness burns in children.	I	To evaluate the usability and effectiveness of Suprathel in the treatment of partial thickness burns in children by conducting a prospective, observational study in 3 hospitals in The Netherlands.	Prospective, observational study	21 Burn patients (children)	Of the 21 patients, three patients needed a split skin graft. There were 7 (33 %) patients with wound colonization before application of Suprathel®. This increased to 12 (57 %) patients during treatment. One patient developed a wound infection.	Suprathel® provided potential advantages regarding pain and scar formation, but extensive wound debridement is needed to achieve adequate adherence.
Schiefer et al. (2021) Journal of Clinical Medicine	III	Long term scar-evaluation to compare Dressilk with the often-used and more expensive Suprathel in treatment of superficial burns	Observational Cohort study	20 patients with superficial partial thickness burns	Both dressings showed mostly equivalent results in subjective scar evaluations. The wounds treated with Dressilk showed faster return to qualities of non-injured skin	Bothe wound dressings let to esthetically satisfying scar recovery without significant differences from normal uninjured skin after 12 months
Schriek et al. (2021) European Burn Journal	II	Evaluate the frequency and effect of Caprolactone membrane (Suprathel)	15 yr. Retrospective study	2084 pediatric patients suffering from mixed superficial and deep dermal 2 nd degree burns	The study group (N=1153) Control Group (n=930). 91.74% of study group were	Caprolactone dressing were found to be beneficial for children with mixed

		usage in children admitted to the hospital between 2002 and 2016 with mixed second-degree burns			treated conservatively compared to 76.05% of control group, meaning 8.26% (n=101) study group needed skin grafting compared to 23.95% of control group.	superficial and deep dermal burns. They reduced the need for skin transplantation, the number of dressing changes under general anesthesia and treatment costs.
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Summary of Literature

Via a retrospective chart review Blome et al. (2021) sought to assess the complications and outcomes using a new biodegradable and absorbable synthetic membrane used to treat second degree burns in adults and children. This study encompassed a 4-year period, from September 1st, 2013, to May 31st, 2017, with patients treated for acute burns at the Regional Burn Center at LVHN between September 1st, 2013, and December 31st, 2016. In total, 229 burn patients, of whom 138 were pediatric, with superficial and deep second-degree wounds treated with the absorbable synthetic membrane (Suprathel) were included in the study. Patients were treated under anesthesia or moderate sedation to prepare the wound with dressing. The wound was assessed every one to four days, changing only the outer dressing, depending on exudate to closely follow the wound. The focus was on the need for subsequent grafting, healing time, pain, scarring, and infection. As a result of their research the authors found that all the wounds treated with Suprathel healed without grafting; the average TBSA was 8.9% (1%-60%); average healing time was 13.7 days for >90% epithelialization with 11.9 days for pediatric patients versus 14.7 days for adults; the average pain was 1.9 on a 10-point scale; and the average length of stay was 6.9 days. 27 patients developed hypertrophic scarring (11.7%), the rate of infection was 3.8% (8/229), and failure or progression to full thickness in part of the

wound was 5.2% (12/229). Concluding that when treating 2nd degree burns wounds, Suprathel provides a simple, effective solution alternative with good outcomes, less pain than previously studied treatments, and fewer dressing changes. Resulting in easier overall management of burn wounds.

Rashaan et al. (2017), evaluated the usability and effectiveness of Suprathel in the treatment of partial thickness burns in children by conducting a prospective, observational study in 3 hospitals in The Netherlands. They evaluated the adherence to of Suprethel to the wound bed, re-epithelialization time, grafting, wound colonization and infection, pain, dressing changes, length of hospital stay, and scar formation. All consecutive patients <18yrs old with partial thickness burns, treated within 48hrs, between November 2011 and January 2013 were eligible for this study. Excluding those with facial burns only, if they were previously treated elsewhere, or if they were expected to be non-compliant with treatment (for example due to profound language barrier). Twenty-one children (median age 2.4 years, range (5 months–14 years) with a median total body surface area (TBSA) of 4 % (range 1–18) were included. Median LOS was 10 days (range 3–20). Median outer layer dressing changes was 3 (range 1–14). Suprathel® was only adherent in wounds debrided with Versajet®. Median re-epithelialization time was 13 days (range 7–29). Three patients needed a split skin graft. There were 7 (33 %) patients with wound colonization before application of Suprathel®. This increased to 12 (57 %) patients during treatment. One patient developed a wound infection. Median visual analog scale (VAS) scores for background and procedural pain in patients >7 years were 3.2 (range 2–5) and 3.5 (range 2–5), respectively. In younger patients, median background and procedural COMFORT-B scores were 13.8 (range 10–23) and 14.8 (range 13–23, p = 0.03), respectively. Patient and Observer Scar Assessment Scale (POSAS) scores were

favorable after 3- and 6-months post burn. The authors found that Suprathel® provided potential advantages regarding pain and scar formation, but extensive wound debridement is needed to achieve adequate adherence.

Porcine xenografts have over the years been used in partial thickness burn treatment. When they disappeared from the market, new effective and efficient alternatives were sort after. Haller et al. (2021) examined the synthetic epidermal skin substitute Suprathel as a substitute for treating partial thickness burns. They conducted a systematic review using PRISMA guidelines that included 16 Suprathel and 12 porcine xenograft studies. The findings indicated that Suprathel had a nearly six times larger TBSA and a significantly lower necessity for skin grafts and lower infection rate compared to Porcine Xenografts. However, no significant differences were noted in the healing time and number of dressing changes needed till complete wound healing. In addition, both products reduced pain with Suprathel having a more impressive performance on a qualitative level. Based on these findings, the authors concluded that Suprathel is an effective replacement for porcine xenografts.

Nanofibrillar cellulose (NFC) has gained attention because of its renewable nature, good biocompatibility, and excellent physical properties. Hakkarainen et al. (2016) investigated the potential of a wood-based NFC wound dressing in a clinical trial on burn patients. They tested NFC wound dressing in split-thickness skin graft donor site treatment for nine burn patients in clinical trials. After NFC dressing has been applied to split-thickness skin graft donor sites, they eventually dehydrate and attached to the donor site during the first days. From patient 5 forward, NFC dressing was compared to commercial Suprathel dressing. The findings indicated that epithelialization of the NFC dressing-covered donor site was faster compared to Suprathel. Based on the findings, NFC dressing seems to be promising for skin graft donor site treatment

since it is biocompatible, attaches easily to the wound bed, and remains in place until the donor site has renewed, and detaches from the epithelialized skin by itself.

SUPRATHEL has shown good usability and effectiveness for wound healing and patient comfort. Bacterial nanocellulose (BNC) has also become popular for the treatment of wounds. Epicitehydro, which consists of BNC and 95% water, is a promising product. Schiefer et al. (2022) aimed to compare epicyte hydro to SUPRATHEL in the treatment of partial-thickness burns. Twenty patients with partial-thickness burns affecting more than 0.5% of their total body surface area (TBSA) were enrolled in the clinical study. After debridement, the wounds were divided into two areas where one was treated with SUPRATHEL and the other with epicitehydro. All wounds showed minimal exudation, and patients reported decreased pain with the only significant difference between the two dressings. No infection or bleeding were noted in any of the wounds and no significant differences were noted in scar evaluation. These findings indicated that epicitehydro can be used as an alternative to SUPRATHEL for the treatment of partial thickness burn wounds.

Partial thickness burn treatment often follows the paradigm of less frequent dressing changes for undisturbed reepithelialization of the burn wound. Hundeshagen et al. (2018) compared Mepilex Ag (M), a silver-impregnated foam dressing, and Suprathel (S), a DL-lactid acid polymer, in the outpatient treatment of partial-thickness burns in pediatric and adult patients. They enrolled 62 patients in a randomized, controlled, prospective clinical trial. They monitored treatment cost, wound pain, time to re-epithelialization, and discomfort during dressing changes. The findings indicated that time to re-epithelialization was not different between the groups, pain ratings were significantly reduced in the Suprathel group, and viscoelasticity of burned skin was elevated. Both dressings were found to be feasible and

efficacious for the outpatient treatment of minor and selected moderate partial-thickness burns.

Extensive burns produce systemic consequences, including local tissue damage. Wasiak et al. (2018) sought to assess the effects of burn wound dressings on superficial and partial-thickness burns. They evaluated randomized controlled trials (RCTs) that studied the effects of burn wound dressings on the healing of superficial and partial-thickness burns. The findings indicate silver sulphadiazine (SSD) was consistently associated with poorer healing outcomes than biosynthetic (skin substitute) dressings, silver-containing dressings, and silicon-coated dressings. Burns treated with hydrogel dressings appear to heal more quickly than those treated with usual care.

Methods

Interventions

For this intervention, a retrospective chart review was conducted of patients screened and identified from the Burn Registry from January 1, 2022, to December 31, 2022, to examine the efficacy of Suprathel artificial wound and burn dressing in reducing patients' length of stay, opioid use, pain score, cost effectiveness, and patient outcomes. Since there is limited, published data comparing the two interventions, cases will be examined to determine the difference if any between the two approaches. Patients who have been treated using the Suprathel artificial wound and burn dressing will be compared to those treated using the standard procedure (polysporin, xeroform and gauze or Santyl).

Accessing the medical records containing patients' personal data concerning this project was limited to the primary investigators. After identifying the evidence-based project and obtaining the buy-ins of the UC San Diego Health Regional Burn Center Leadership, A review of medical records of patients who have already undergone wound care and/or treatment was

conducted to collect retrospective data. Data was collected using a secured UC San Diego Health Hillcrest Hospital workstation. Downloaded data was protected and used solely for this project.

A partial HIPAA waiver was requested from the primary investigators. The investigators provided the Burn Registry programmer and analyst with a list of data points needed and the collection time interval. This information will be accessed and obtained using the secured UCSD encrypted intranet using a password-protected workstation. A current CITI Program training in Biomedical Research was also required.

Burn Wound Dressings

An important part of burn wound healing is the application of some form of dressing, developed to cover the wound and aid in re-epithelialization. Wound dressings also prevent wound infection, skin desiccation, and continued skin damage (Roshangar et al., 2019). According to Wang et al. (2018), the wound dressings can be categorized into four main approaches: biological, conventional, biosynthetic, and antimicrobial. Biological dressing, the first category, involves temporary wound coverage using cadaver allograft skin, human amnion, or xenograft.

Although they enhance wound quality for skin grafting, they are unsuitable as permanent skin replacements due to limited supply, inconsistent quality, immunological disparities, and the risk of pathogen transfer. Conventional dressing, the second approach, does not contain antibiotics or medications. Examples include Vaseline gauze and silicone sheets used temporarily during wound epithelialization. However, they tend to adhere to the wound surface, necessitating frequent changes that can delay healing by traumatizing the newly epithelialized surface.

Biosynthetic dressing, the third approach, uses materials that simulate the skin's function. They

replace either the epidermis or dermis or both, facilitating wound healing. Finally, the fourth category of antimicrobial dressing was designed to minimize bacterial colonization and prevent wound infection. This dressing often contains silver, honey, or cadexomer iodine, which reduces the incidence of sepsis and death caused by burn wounds (Wang et al., 2018). The dressings compared in this study are detailed below.

Suprathel

Suprathel is a fully synthetic, absorbable, microporous, non-animal-derived wound dressing. This alloplastic temporary skin substitute imitates the protective properties of the human epithelium by adhering to the wound bed at body temperature (Herbert Haller & ZM Rashaan).

Suprathel has scientifically proven advantages when used; these include reduced need for pain medication, reduction of the need for autografting, reduction of healing time, and reduced workload, to name a few. Furthermore, it is suitable for all ages, with additional advantages in pediatric patients. FDA certification is for use on abrasions, exfoliative skin, donor sites, superficial and partial-thickness burns, and partial-thickness wounds with areas of full thickness. (Herbert Haller, white paper).

Xeroform

Xeroform Gauze Dressing is a fine mesh gauze occlusive dressing impregnated with petrolatum and 3% Xeroform (Bismuth Tribromophenate). Xeroform is made for use on low exudating wounds. Non-adherent primary dressing maintains a moist wound environment. Clings and conforms to all body contours. This product is available in a variety of sizes. For use as a primary dressing on low to non-exudating wounds, including donor sites, lacerations, burns, abrasions, and skin graft sites (xeroform, 2023).

SANTYL

SANTYL ointment, the only FDA-approved biologic enzymatic debrider, is indicated for chronic dermal ulcers and severely burned areas. Enzymatic debridement removes necrotic tissues in an active, ongoing, and selective manner. SANTYL Ointment debrides by cleaving necrotic tissue at seven specific sites along the denatured collagen strand, creating bioactive peptide byproducts. These collagen byproducts induce a cellular response associated with the proliferative phase of healing (santyl.com, 2023).

Eligibility Criteria

To determine the eligibility of the subjects, the EHR will be accessed, and the charts of those found to be eligible will be reviewed to obtain the following independent variables (Patient demographics, location of injury, and TBSA) and outcome variables (Length of hospital stay, use of opioids or morphine equivalents, pain score, cost effectiveness, and patient outcomes).

A total of 195 patients were admitted to the hospital during the study period, of which 193 were eligible for our data analysis. The number of human subjects to be included in the study was determined from a preliminary power analysis. The study falls under 45 CFR 46.404: the research is not greater than minimal risk. In addition, data from minors below the age of 18 years will be included in the study.

The inclusion criteria consist of patients of all genders, aged 0 to 94 years who sustained 2nd degree partial thickness flame, scald, flash, chemical/corrosion, contact, electrical, or other burn with less than 20% of their total body surface area (TBSA) who were admitted to the hospital.

Exclusion criteria included patients with burns graded 3rd degree or greater, those who

sustained burns that were more than 20% TBSA due to the complex management involved in their care, patients who were admitted to the hospital for wounds other than burn, patients transferred to another hospital for follow-up care, patients who died during admission or initial hospitalization, and patients with a history of accidents.

Data Collection

All the data collected during the study was kept anonymous and confidential. No written reports or publications will link the subject data with a name or personal protected health information. All protected health information will not be disclosed or re-used for other purposes. The retrospective chart review of patients admitted into the UC San Diego Health Regional Burn Center was conducted to examine the efficacy of Suprathel artificial wound and burn dressing in reducing patients' length of stay, morphine milligram equivalent use, pain scores, and cost-effectiveness. The intervention was compared to standard dressing using polysporin or Santyl, and gauze on burn wounds which required daily dressing changes. The charts sampled patients under and above the age of 18 years who underwent treatment at the facility with second-degree partial thickness burn wounds with TBSA <20% were included for data collection. This patient cohort represents a significant portion of the burn patient population, their inclusion helped achieve more conclusive findings.

Data Collection included the following factors: Age, Gender, Type of Burn, TBSA, Length of Stay, Pain score, Opioid medications, Complications/Outcomes, and Treatment costs. The pain score was evaluated utilizing the Wong Baker (0-8yrs old) and the Visual Analog Pain Scales (8yr +). The Wong-Baker Faces Pain Rating Scale is a method for someone to self-assess and effectively communicate the severity of pain they may be experiencing. The scale contains a series of six faces ranging from a happy face at 0 to indicate "no hurt" to a crying face at 10 to

indicate "hurts worst." (Castiello & Morales, 2022). The visual analog scale (VAS) is a validated, subjective measure for acute and chronic pain. Scores are recorded by making a handwritten mark on a 10-cm line that represents a continuum between "no pain" and "worst pain" (Delgado et al., 2018). Evaluation of treatment costs calculated the direct material costs of (Suprathel and "Conventional" Dressing), cost of dressing change performed, and costs of the pain medication while admitted.

Analysis

A regression analysis was used to determine the mean length of stay, mean opioids or morphine equivalents, and mean pain score in relation to the use of Suprathel wound dressing.

Ethical Considerations

This retrospective data analysis and screening intervention was approved by the Institutional Review Boards at both University of California San Diego Medical Center (2/2023) and the University of San Diego (3/23). There was no cost due to the unfunded academic nature of this project. Additionally, the authors had no conflicts of interest to disclose with this project.

Demographics

A total of 195 patients were admitted to the hospital during the project period, of which 193 were eligible for our data analysis. A total of 76 patients (n=76, comprising 46 males, 30 females, and 49 pediatric patients) with a mean age of 16 years (less than one-year-old to 64 years) were included in the project, as shown in Table 1 below. Twenty sheets of the synthetic membrane were applied to second-degree burns (superficial and deep). The average burn size was 2.8 % (range 0.1 to 20% TBSA).

This project involved a total of 76 patients, 19 Suprathel patients who received a single

application of Suprathel wound dressing requiring dressing changes every three to five days and 57 non-Suprathel patients who underwent standard dressing procedures that typically involved the use of either polysporin ointment, xeroform, and gauze or Santyl with daily dressing changes.

Table 2

Characteristics of all 76 patients included in the project.

Demographics	Non-Suprathel pts	Suprathel pts
<i>Sex</i>		
Male	33	13
Female	24	6
<i>Age</i>		
0-17	37	12
18-64	20	7
<i>Race</i>		
Asians/others	20	8
Black	4	1
Hispanic	19	8
White	14	2

Results

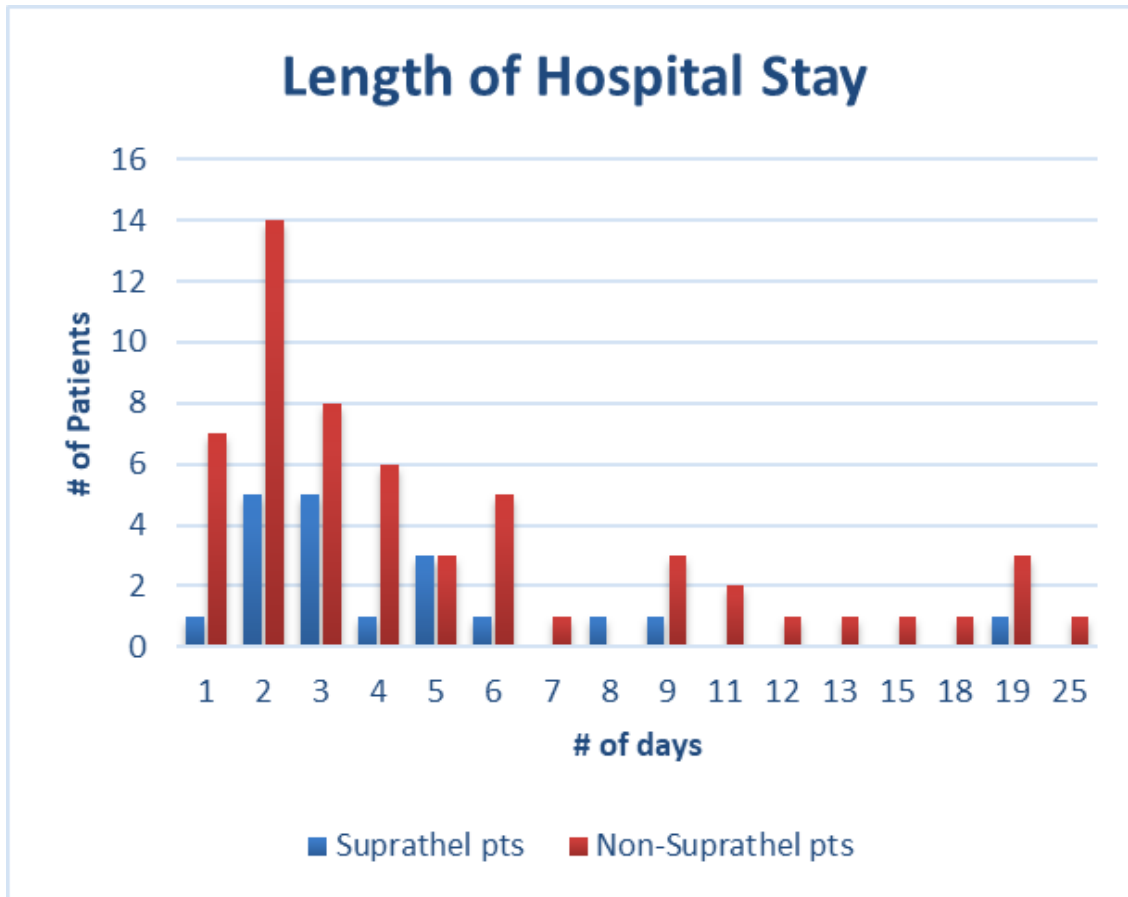
Length of Stay

A comparison of the hospital length of stay (LOS) for both groups was performed. The result depicts a significant increase in length of stay in the non-Suprathel group due to complications such as wound infections, sepsis, graft loss, bacteremia, pressure ulcers, cellulitis, etc. The length of stay as illustrated in Figure 2 below describes the range of LOS to be from one to 25 days. However, the mean length of stay in the Suprathel and non-Suprathel groups are four days and five days respectively. In the Suprathel group, most of the 19 patients spent two to three

days in the hospital, were discharged home, and then followed up as outpatients.

Figure 2

Comparison of the overall length of stay



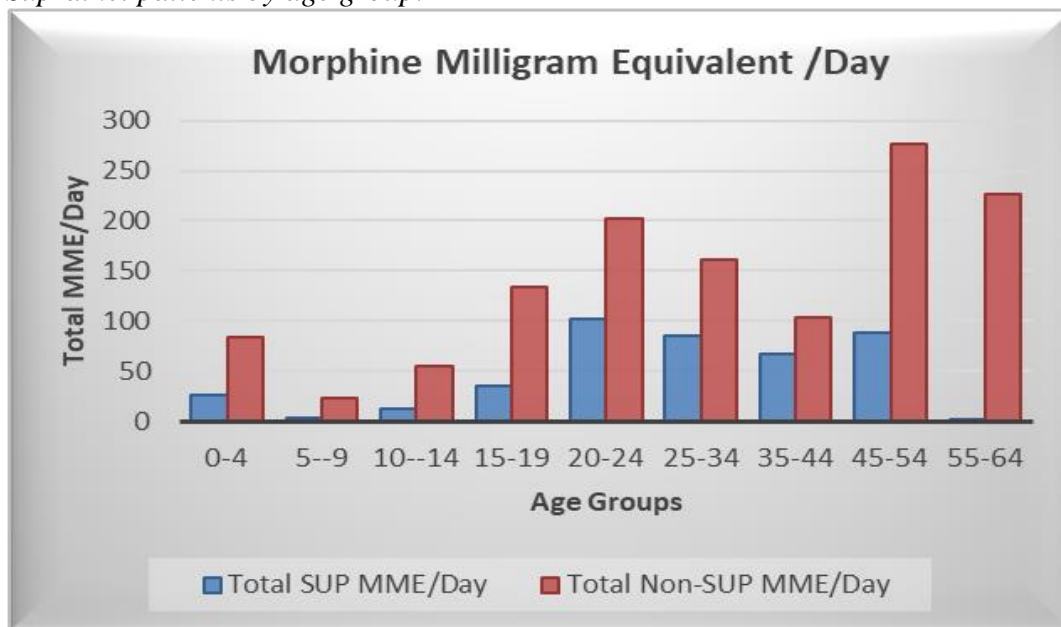
Opioid Medications

While treating burn wounds can be a challenge due to the high pain levels associated with daily dressing changes and unpredictable healing times, an ideal treatment should enhance treatment and provide comfort to the patient during the healing process. When comparing the Suprathel and non-Suprathel patients' morphine milligrams equivalent (MME) use, we found that the non-Suprathel patients used more MME per day. Figure 3 below shows the distribution of MME per day according to age groups.

The graph illustrates a significantly higher use of opioids and opioid derivatives among non-Suprathel patients. Although the average MME among both groups was 22.19 for the Suprathel patients and 22.2 for the non-Suprathel patients, which can be attributed to the small sample size (19 Suprathel and 57 non-Suprathel patients). The Suprathel patients receive a dressing change every 3-4 days after applying the Suprathel wound dressing and non-Suprathel patients receive daily dressing changes. The non-Suprathel group must be pre-medicated before the excruciating daily dressing changes done to mitigate the infection rates.

Figure 3

Comparison of Morphine Milligrams Equivalent use per day amongst both Suprathel and Non-Suprathel patients by age group.



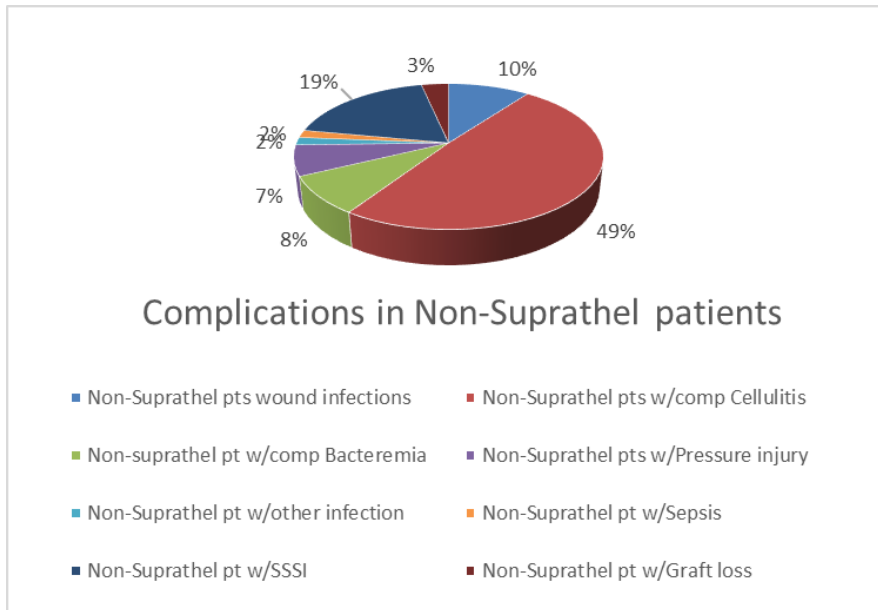
Complications

The facility's burn registry assessed for a variety of complications in each population. The complications range from acute renal failure to UTI. However, for this comparison project we assess the following complications that are specific to the wound and its healing. These complications include wound infections, cellulitis, bacteremia, pressure injury, sepsis, skin soft

tissue infection (SSSI), graft loss, and other infections. In the Suprathel population (N=19) there were not complications observed. As depicted in Figure 4 below, in the non-suprathel patients (N=57) there were multiple complications noted; 3 wound infections, 13 cellulitis, 2 bacteremia, 3 Pressure injury, 1 sepsis, 4 SSSI, 2 graft loss. These results show a strong implication that Suprathel dressing not only offers a decrease in reported pain scores, opioid medication use, and length of stay, it also shows a significant decrease in reported complications.

Figure 4

Complications in Non-Suprathel patients. 0% complication was found amongst those treated with Suprathel wound dressing.



Pain Scores

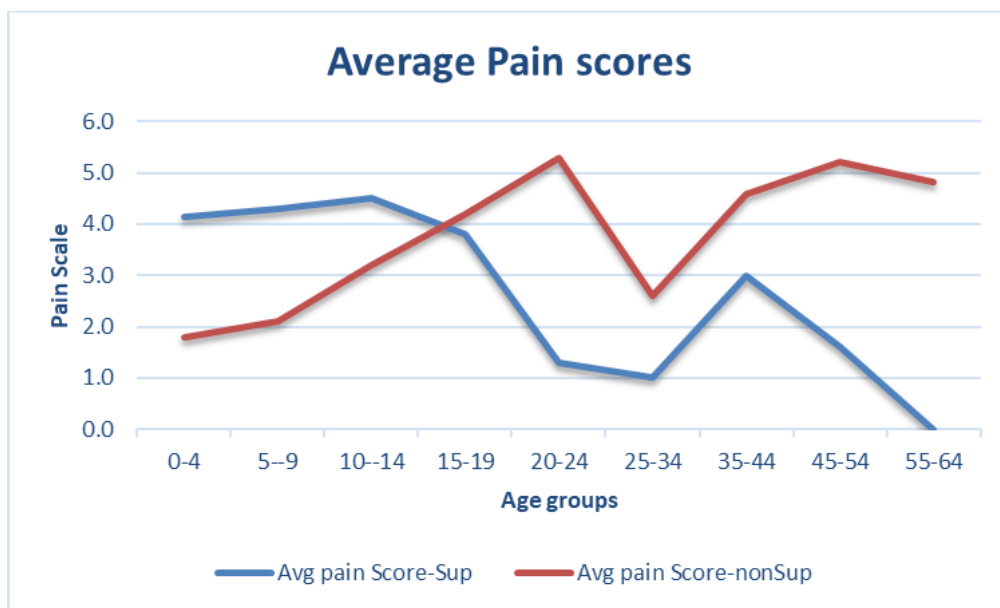
Suprathel proved to be effective in decreasing pain, allowing assessment of the healing process, limiting dressing changes, accelerating healing, and preventing infections. In terms of long terms impacts, Suprathel can halve longer-term outcomes and aid in saving on treatment

costs. Being a biosynthetic dressing, Suprathel fits closely to the wound bed, is highly flexible to allow for an exchange of water vapor and creates a barrier against contamination and bacteria.

The dressing is also easy to handle with a simple application process, transparent to recognize infections easily, and produces acceptable cosmetic results. As seen in Figure 5 below, the average pain score varied with different age groups due to the sample size. However, a significant increase in average pain scores was noted in the 15-19 through the 55-64 age groups.

Figure 5

Comparison of Avg pain score by age group.



Cost Analysis

To determine the cost of the two dressing changes we had to identify the constants in each group such as the Staff requirements, time spent performing the task, and the cost conversion of intravenous morphine per milligram to calculate the cost based off the MME used. The actual cost of morphine to the facility was unavailable at the time of the comparison so the

cost of morphine was calculated at the high and low wholesale rates. Once that was complete, the requirements needed for standard non-suprathel dressing change were identified and cost calculated (Table 3). The non-suprathel cost for dressing supplies consists of xeroform gauze, xeroform overwrap, kerlex gauze roll, Gauze sponge, net dressing, burn dressing, tubular retain dressing, and Santyl gel.

Table 3

Cost Analysis on Non- Suprathel dressing materials.

Non-Suprathel Patients (N=57)			
	Cost	Explanation	Total
Dressing Supplies	\$456.75	Supply Cost * 5 days of dressing changes	\$2283.75
RN	\$60.00/per hr.	Hourly salary*5 hrs.	\$300.00
CNA	\$25.00/per hr.	Hourly salary*5 hrs.	\$125.00
Morphine Low (1mg/ml) \$0.44/mg		22.20*\$0.44 (MME*low morphine cost)	\$9.77
Morphine High (1mg/ml) \$3.88/mg		22.20*\$3.88 (MME* high morphine cost)	\$86.14
Total Cost of Dressing Change (Low)			\$2718.52
Total Cost of Dressing Change (High)			\$2794.89

In the Suprathel group we used the same constant information (Salary per hour and Morphine conversion rates), however, the calculations were slightly different being that the patient (during their inpatient stay) only receive an initial standard dressing application until placement of Suprathel the next day in the OR under sedation. Furthermore, Suprathel only receives, and outer dressing change every 3-5 days. Being that the average length of stay for this population is 4 days, there would only be one outer dressing change while impatiant. The summation of costs is detailed below in Table 4.

Table 4*Cost Analysis on Suprathel Dressing*

Suprathel Patients (N=19)			
	Cost	Explanation	Total
Dressing Supplies	\$405.35 +\$456.75	Suprathel dressing cost +Traditional dressing cost x1 dressing change	\$862.10
RN (per hr.)	\$60.00	\$60*2 (RN hourly rate x 1 hrs. for dressing change)	\$120.00
CNA (per hr.)	\$25.00	\$25*2 (CNA hourly rate x 1 hrs. for dressing change)	\$50.00
Morphine Low (1mg/ml) \$0.44/mg		22.19*\$0.44 (MME*low morphine cost)	\$9.76
Morphine High (1mg/ml) \$3.88/mg		22.19*\$3.88 (MME* high morphine cost)	\$86.10
		Total Cost of Dressing Change (Low)	\$ 991.86
		Total Cost of Dressing Change (High)	\$1118.20

Costs per patient were considerably lower in the Suprathel group when compared to the non-Suprathel group (Table 5). The difference between cost resulted in an average surplus of \$1726.66 to \$1676.69 per patient for the initial burn resuscitation dressing placement, Suprathel dressing application, and outer dressing changes in the Suprathel population as compared to the cost of non-suprathel standard dressing application and daily dressing changes. It is important to note that the Suprathel figures do not reflect the amount of reimbursement received per application of Suprathel making the cost savings even greater.

Table 5

Evaluation of Cost

Evaluation of Cost	Low	High
Non-Suprathel Cost	\$2718.52	\$ 2794.89
Suprathel Cost	\$ 991.86	\$ 1118.20
Difference in Cost	+\$1726.66	+\$1676.69

Discussion

Limitations

The sample size for the Suprathel group was limited due to having a smaller sample size of patients that received the Suprathel wound dressing from January 2022 to December 2022. The small sample size diminished the significance and clinical relevance of this project. Therefore, there is a need for further evaluation with a much larger sample size to prove there is a significant clinical relevance in using the Suprathel wound dressing on burn patients.

Conclusions

Suprathel wound and burn dressing is a biosynthetic wound dressing that conforms to the wound surface when applied, absorbs the moisture from the wound bed, and aids wound healing. Preliminary results indicate that the Suprathel artificial wound and burn dressing resulted in a mild significant change in patients' length of stay due to the small sample size. However, there was a notable decrease in complications, as well as the elimination of the need for multiple painful dressing changes. Additionally, it expedited wound healing and improved patient outcomes. The

average length of stay for patients treated with Suprathel was four days and five days for those who did not receive this treatment.

Furthermore, Suprathel patients did not experience any significant complications compared to those who did not receive Suprathel wound dressing. The result indicates a mild difference in MME use per day among the Suprathel and non-Suprathel groups. The average MME use per day in the Suprathel and non-Suprathel patients are 22.19 and 22.2, respectively. Again, this can be attributed to the limited sample size of the Suprathel group when compared to the non-Suprathel.

Average pain scores among the Suprathel and non-Suprathel patients were higher among the 0-14 age group but significantly lower among the 15-64 age group. On the other hand, the non-Suprathel group showed a significant increase in pain score in the 15-64 age group and decreased avg score in the 0-14 age group. This can also be attributed to the difference in sample size in both groups. The cost-effectiveness of using the Suprathel wound dressing compared to the standard dressing did show a significant increase in savings to the facility in addition to the hospital reimbursement received with the use of Suprathel. After comparing the hospital length of stay, average pain score, morphine milligrams equivalent use, and cost-effectiveness, it was determined that there is a need for further evaluation and assessment with a larger sample size to improve or maintain the sustainability of this project.

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