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Wounds Canada Virtual Conference OCT. 14-18, 2020

Pressure Injury Prevention

Abstract #003

Pressure Injury Knowledge, Attitudes and Context: A Pilot Study

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Covenant Health in collaboration with University of Alberta

Introduction

- One in ten hospitalized patients will have a pressure injury (Zhaoyu *et al* 2020).
- Although there exists a substantial amount of evidence related to pressure injury prevention (PIP) (EPUAP/NPIAP 2019), a deficit in knowledge can exist.
- Knowledge has been shown to have an impact on the attitude of nurses towards pressure injuries, which in turn is significantly correlated with how PIP strategies are implemented.
- Context has been found to be a potential mediator of the successful implementation and use of evidence in practice.
- It is therefore important to explore the interaction between knowledge, education, attitude and the context in which pressure injury prevention occurs.

Covenant Health | CLINICAL LEARNING

Methods

The study used a mixed method, prospective, repeated measure design. A purposive sample of providers from acute and continuing care were invited to participate in a 3-hour facilitated workshop on Pressure Injury Prevention (PIP).

Questionnaires were completed before the workshop, immediately afterwards and after six months. The questionnaires included the Attitude Towards PIP Instrument (Beeckman *et al* 2010) and the Pressure Ulcer/Injury Knowledge Assessment Test (PUKAT 2.0) (Manderlier *et al* 2017).

Six months after the workshop a focus group was conducted. The focus group was analyzed using Framework analysis.

Health Research Ethics Board approval was obtained (**# Pro0007544**). The study was conducted between October 2018 and April 2019.

Results

A total of 42 providers participated in the education program and completed the knowledge and attitude questionnaires. A total of 38 questionnaires were analyzed at baseline and post education as 2 results were not included due to missing data and 2 participants did not provide consent. After six months 15 individuals completed the same questionnaires.

Domain	Score Pre (All participants)		Score Post		Score 6 months post	
	Mean	% correct	Mean	% correct	Mean	% correct
Etiology (out of 6)	3.4	56.6	3.57	59.5	3.5	58.3
Classification (out of 4)	2.6	65	2.93*	73.3	2.5	62.5
Risk (out of 2)	1.75	87.5	1.65	82.5	1.4	70
Nutrition (out of 3)	1.6	53.3	2.12*	70.6	1.9	63.3
Prevention (out of 8)	3.58	44.8	4.6*	57.5	3.9	48.8
Groups (out of 2)	1.38	69	1.8*	90	1.7	85
Total (out of 25)	14.3	57.2	16.63*	66.5	14.9	59.6

Figure 1. Knowledge results * Indicates statistically significant

Domain	Mean Pre	Mean Post	Mean 6 month post
Personal Competency (max 12)	9.1	10*	9.6
Priority (max 12)	10.6	10.8	11
Impact (max 12)	9.5	10*	9.5
Responsibility (max 8)	7	7	6.7
Confidence (max 8)	6.4	6.6	6.4
Total (Maximum score (52)	42.6	42.6	43.2

Figure 2. Attitude results

Knowledge gaps in PIP were revealed but there was a positive attitude to the clinicians role in PIP
The focus group consisted of 2 Registered Nurses, 1 Clinical Safety Coordinator and 2 Health Care Aides. A total of five themes were identified: Knowledge and Education, Awareness, Communication and Collaboration, Barriers, and Resident/Patient and Family Centered Care were identified. There were an additional twenty-seven sub-themes.

Discussion

- Our study highlighted that education can improve knowledge but that this was not sustained at the six month follow-up period.
- The results of the focus group identified contextual factors affecting pressure injury prevention including organizational, provider and patient challenges. These findings prompt further investigation to gain understanding of barriers and facilitators to PIP.
- Our results align with six key concepts differentiating sites with improving and declining pressure injury care performance including: structures through which the change effort is initiated, organizational prioritization, alignment and support, improvement culture, clarity of roles and responsibilities, communication strategies and staffing and clinical practices (Hartmann *et al* 2016).
- Covenant Health has dedicated resources to develop, implement and evaluate a PIP program to include education and strategies to influence context including leadership and facilitation. The results will be incorporated into the organization wide PIP program that will be guided by the Promoting Action on Research Implementation in Health Services (PARiHS) framework.

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Pressure Injury Prevention

Abstract #004

Assessment and Recommendations for Pressure Injury Prevention in Perioperative Services Throughout the Surgical Continuum of Care: a Quality Improvement Project

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Marlene Varga MSc, Covenant Health Professional Practice Clinical Nurse Specialist for Pressure Injury Prevention

Covenant Health

Introduction

The projects aim was to assess Covenant Health's perioperative services' current state of pressure injury prevention in the surgical program continuum of care and make recommendations for improvement based on current available evidence

5 Covenant Health Surgical Sites Collaborating on Pressure Injury Prevention (PIP) Across the Patient's Entire Surgical Journey

Misericordia Community Hospital

Grey Nun Community Hospital

Bonnyville Health Centre

Camrose - St. Mary's Hospital

Banff Mineral Springs Hospital

PRESSURE SHEAR MOISTURE

Method

The surgical leadership team initiated a province wide working group to review the current literature, standards, guidelines and organizational policy for pressure injury prevention. Local and international expert opinion was obtained. The group conducted a current state assessment of the surgical processes for pressure injury prevention. Information was collected from five different Covenant Health surgical sites. The group performed a literature review and practice gap analysis to determine opportunities for improvement. A proposed future state was developed to bridge the gap between evidence and practice. Improvement opportunities were identified and recommendations offered towards a collaborative approach across the Covenant Health Perioperative Services to optimize pressure injury prevention for our surgical patient population.

Current State Assessment

Gap Analysis

Future State Design

Improvement Opportunity Strategy

Identified PIP Quality Improvement Opportunities along the Patient's Entire Surgical Journey

*skin and risk assessment and individualized intervention plan

Pre-op Surgical Patient and Family Engagement

*Pre-Admission Clinic *Same Day Admit *Emergency

communicate assessed risk and intervention plan

Intra Op – Surgical Suite

*Surgical Operating Room

communicate assessed risk and intervention plan

Post Surgical Patient and Family Engagement

*Post Anesthetic Recovery Room *Inpatient Surgical Units

Discussion

The Pressure Injury Surgical Bundle is a standardized approach that will be piloted across each of Covenant Health's 5 Surgical sites. A standard education program will be developed to support the integration of the bundle into practice.

- **S** Skin Inspection and Surface Selection
- **K** Keep Moving / Turning and Repositioning
- **I** Incontinence / Moisture / Heat / Humidity and injury management
- **N** Nutrition and Hydration optimization

Results

The Current state identified opportunities for improved practice standardization for the following:
- standardized timing of patient skin and risk assessment at identified intervals along the entire patient's surgical journey
- standardized communication about assessed skin condition and individualized patient risk status between interdisciplinary care teams
- recommended application and communication of individualized interventions and prevention protocols along each area of the surgical pathway

The group gained an awareness of the potential correlation of intraoperative pressure injury risk factors and how these can contribute to actual hospital acquire pressure injury development. Patient and family engagement and participation in pressure injury prevention education was seen as an improvement opportunity. The group developed a standardized pressure injury prevention care pathway and PIP surgical SKIN Bundle approach focusing on integrating evidence and improving clinical outcomes. Highlights of this bundle include interdisciplinary team engagement related to standardized risk and skin assessment, education, communication and collaboration. Patients and families will partner in this quality improvement opportunity to provide input and feedback. A front line champion model will support the translation of new knowledge into practice. Results of the pilot will be used to develop standards of care for the organization with the potential to inform electronic health record systems.

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Poster developed by Kelly Martial on March 13th, 2020
For further information on this project, please contact Kelly Martial – Program Manager for the Misericordia Community Hospital (MCH) Orthopaedic Program, Covenant Health, Alberta at Kelly.martial@Covenanthealth.ca

ELECTRICAL STIMULATION FOR THE TREATMENT OF PATIENTS WITH PRESSURE INJURIES IN THE COMMUNITY

Lyndsay Orr, PT, PhD • Pamela Houghton, PT PhD

BACKGROUND

The use of electrical stimulation (E-Stim) in the treatment of pressure injuries has a high level of research evidence and is recommended by multiple best practice guidelines, however uptake of this treatment for patients living in the community is lacking.

Following participation in **the E-Stim Collaboration Project (2014 to 2017)** with Western University, the South West Regional Wound Care Program (SWRWCP) developed evidence–based strategies and processes in an effort to advance the number of patients provided with E-Stim as a pressure injury treatment option.

AIM

To increase and improve the delivery of E-Stim therapy in the community for patients with pressure injuries to increase the speed of healing.

METHODS

As part of the research project, an inter-professional team developed **practice enablers** to support the implementation of E-Stim in the community.

These resources were provided to home and community care coordinators and health care providers to help **simplify the process for the delivery of E-Stim treatment in the community**.

Supporting documents: E-Stim Request for Assessment; E-Stim Referral Algorithm; Standard Operating Procedure; E-Stim Equipment Order Form; E-Stim Guideline; and a listing of E-Stim providers.

Evidence informed E-Stim education sessions were provided at no cost to care coordinators and community providers involved with community-based wound care in the South West region.

The program also offers clinical inquiry support and virtual consultation as part of the model of care.

RESULTS

- **Twenty-one** health care providers working in home and community care, including nurses and physiotherapists, attended education sessions.
- Customized in-services were delivered to clinician groups at contracted service provider agencies responsible for resourcing wound care clinicians in the region.
- In 2017, prior to practice enablers **9 E-Stim units** were rented for therapeutic use for an average of 110 days.
- In 2019, after the practice enablers were rolled out, the number of E-Stim units rented for therapeutic use **doubled to 18** with an average use of 108 days.

x2

- While this increase is encouraging, the overall level of utilization is low; only **24.8 percent** of eligible home and community care patients were provided with E-Stim as a treatment option.

IMPLICATIONS & OPPORTUNITIES

The South West is currently the only region in the province where E-Stim is on formulary for home and community care providers.

The program will continue to support sustainability of the practice enablers by way of education, awareness efforts, ongoing clinical inquiry support and virtual consultation.

Similar programs across the province have reached out to the SWRWCP about the care model and have begun implementing the best practice supports.

CONCLUSIONS

Despite the enablers, an increase in awareness building and educational opportunities, a low number of patients who could potentially benefit from E-Stim were provided the treatment over the two year period. Exploration as to the rationale for the low uptake should be considered.

Additional work needs to be done across the province to ensure patients living in the community with pressure injuries are receiving evidence-based care to minimize their time to healing.

South West Regional Wound Care Program
Western
Ontario
South West Local Health Integration Network

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MARCH 2020

Cost of Pressure Ulcer Care for Individuals Living in the Community with a Mobility Impairment

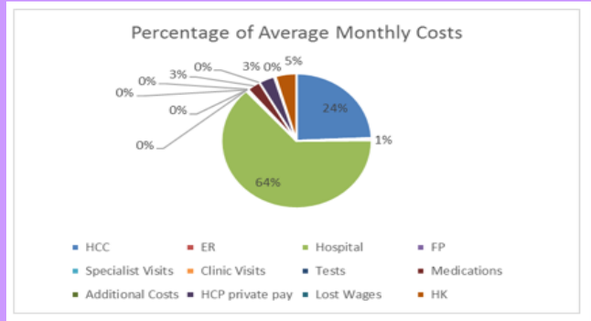
Lyndsay Orr, PT, PhD; Pamela E Houghton, PT, PhD

AIM:
- The objective of this study was to determine the cost of PrI care in a sample of individuals living in the community with a mobility impairment using patient level data

METHODS:
- The population cohort was obtained as part of a multi-year knowledge mobilization project called the E-Stim Collaboration Project
- We used cost diaries to follow patients who had been living with a chronic PrI allowing for a cost estimate of "real life" practice
- All data collected was based on participant recall during a face to face interview conducted by the same lead author
- Costs were evaluated from an Ontario ministry of health and long-term care (MOHLTC) and societal perspective

Table 1: Demographics

Age Mean (SD)	58.4(15.5)
Male/Female (%)	Male: 68.2; Female: 31.8
Injury (%)	
• Upper SCI (cervical spine injury)	27.0
• Lower SCI	55.0
• Catatonic Depression	4.5
• Below Knee Amputation	4.5
• Cerebrovascular Accident	4.5
• Parkinson's Disease	4.5
Years with SCI Mean (SD); n=18	13.8 (11.5)
Months with PrI Mean (SD)	21.2(24.2)
Wound Surface Area in cm² Mean (SD)	6.6(7.6)
Wound Site (%)	
• Ischial Tuberosity (n=11)	50.0
• Coccyx (n=4)	18.2
• Buttock (n=3)	13.6
• Other (n=4)	18.2
Stage of PI (%)	
• Unstageable (n=1)	4.5
• Deep Tissue Injury (n=1)	4.5
• Stage III (n=9)	40.9
• Stage IV (n=11)	50.0



HCC-home and community care; ER- emergency room; HCP- health care provider; FP-family physician; HK-housekeeping

Figure 1: Percentage of Average Monthly Costs

Table 2: Home and Community Care Service Utilization per Participant per Month

	Visiting Nurse	Enterostomal Therapist	Physiotherapist	Occupational Therapist	Registered Dietitian
Median	17	1	0	1	0
Range	5-34	0-2	0-3	0-4	0-2

RESULTS:
- Twenty-two participants were included in the study (Table 1)
- The average age was 58.5 years (+/-15.5) and 68.2% (15/22) were male
- Eighty-two percent of were individuals who had a SCI for an average of 13.8 (+/-11.5) years, with majority (55%) having only lower extremity involvement (paraplegia)
- Mean wound duration for the cohort was 21.2 (+/-24.2) months with a mean surface area of 6.6 (7.6) cm2
- Total average monthly costs for a person with limited mobility living in the community with a PrI were estimated to be $8,247.48 (+/-16,549.35) in 2017 Canadian dollars
- Hospitalization costs accounted for 64% of total costs with seven of the 22 study participants' having been hospitalized within six months prior to completing the cost diary
- All study participants received community based wound care services which accounted for 24% of total costs

Table 3: Average Costs per Patient Per Month

Average Costs of Individuals with Mobility Impairment and Pressure Ulcers (N=22)		
	Average Cost per month per person	(Range)
Ministry of Health and Long-Term Care Costs		
HCC Purchased Services	$1478.55	($402.27-4,155.00)
HCC Purchased Items	$506.40	($157.00-1,807.00)
Emergency Room Visits	$43.51	($0-59.82)
Hospital Admissions	$5,173.88	($0-75,040.00)
Family Physician Visits	$9.88	($0-25.57)
Specialist Visits	$23.04	($0-107.70)
Clinic Visits	$3.78	($0-38.35)
Tests and Lab	$8.93	($0-44.93)
Government Subsidized Costs		
Medications	$236.46	($0-1,384.84)
Patient "out of pocket" Costs		
Additional Costs	$1.15	($0-8.33)
Health Care Providers-Private Pay	$367.27	($0-3,040.00)
Lost Wages	$23.71	($0-521.60)
Homemaking Time Lost	$370.93	($0-3,129.60)
TOTAL COSTS	**$8247.49**	**$559.27-89,362.74**

Table 4: Average Monthly Costs with Sensitivity Analysis

Variable Changed	Average Cost per month per person (SD)
No costs for unpaid time lost for homemaking, volunteering and primary caregiver	$8,054.37 ($16,619.16)
Equipment purchased assumed to be within the last 6 months	$9,178.22 ($16,368.19)
No cost for Alternate Level of Care beds	$7,086.54 ($16,002.06)
No cost for private Health Care Providers	$7,880.21 ($16,624.48)
Minimum HCC costs	$6,996.62 ($16,452.61)
Maximum HCC costs	$11,510.53($16,452.61)

IMPLICATIONS:
- Cost per month for an individual in the community suffering with a PrI is $8247.48 from a societal perspective
- Costs that participants specifically attributed to PrI management were $3107.73/month
- This is considerable since the average wound duration was over 21 months
- Patients with PrIs require high HCC resource utilization for PrI management
- Given the significant costs associated with long term PrIs, early intervention using best practices to maximize healing rates is encouraged

Covenant Health: Grey Nuns Community Hospital – MERCI Program

Under Pressure : Dance like Queen and Keep the Patients Turned and Relieved

Situation

Health care professionals turn, transfer, and reposition patients several times during their work day. They do this as a standard of care to aid in comfort, redistribute pressure, and to move patients when they themselves cannot move. It is important that healthcare professionals have the equipment in place to safely move patients while preventing harmful forces that can damage patient's skin during movement. They also need appropriate equipment that will minimize the stress and strain to themselves in order to provide safe patient handling.

Background

- Site seeking a system to allow health professionals to follow both safe patient handling and skin integrity principles with one product.
- Pressure Injury Prevalence Rate in 2017 was 33.3% of patients
- In 2017, 16 musculoskeletal injuries (MSD) were related to repositioning in bed

Assessment

- Evaluate the benefits of air assisted turning and repositioning system
- Ensure staff satisfaction with product
- Assess the impact of healthcare worker injuries while repositioning patients
- Measure pressure injuries reduced with air assisted turning and repositioning system
- Reduce cost in pressure injuries, health care worker injuries and cost to treat occurrences

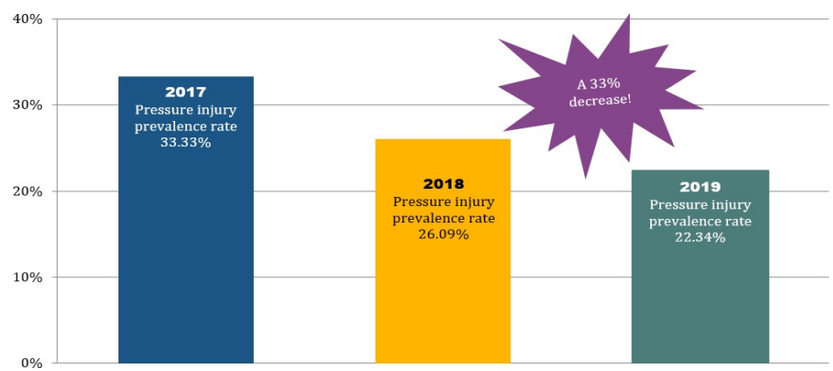
Support

In collaboration with Clinical Nurse Educators (CNE) and Industry Professionals:

- Trained over 350 MERCI program staff (Medicine, Emergency, Critical Care)
- Rounded bi-weekly for first six months and monthly for last six months while providing continual training and education
- Supported program wide pressure injury prevalence and incidence audits in January 2018 and 2019 within a 24 hour time frame.

Outcomes

- Pressure injury prevalence rate decreased from 33.33% in 2017 to 26.09% in 2018 and 22.34% in 2019 resulting in a 33% decrease from 2017 to 2019.
- Hospital-acquired Pressure Injuries were reduced from 31 to 24 according to January 11, 2018, and January 10, 2019 Prevalence and Incidence Audits; with a cost avoidance of $307,510.
- Covenant Occupational Health and Safety reports that: "There has been a decrease in repositioning in bed related injuries by 11% in 2018, since the implementation of the air assisted turning and repositioning system.



Recommendation

To align with best practice guidelines of turning and repositioning patients we recommend the continued use of air assisted turning and repositioning system, which helps to minimize risk factors associated with friction, shear, moisture and pressure. This resulted in both pressure injury and patient handling injury decreases. The air assisted turning and repositioning system will allow health professionals to follow both safe patient handling and skin integrity principles with one system that is easy to use. Its increased utilization will also help to prevent harmful events in a healthcare setting. Cost avoidance to the program was approximately $307,510 for pressure injury reduction and $114,480 for healthcare worker injury reduction totaling over $421,990 in cost efficiencies.

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Covenant Health Grey Nuns

Compression with a Hook-and-Loop Fastened System in Long Term Care; A Case Study

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Aim

Evaluate the effectiveness and patient safety considerations for the use of a hook-and-loop fastened inelastic compression system in a long term care setting.

Background

A venous leg ulcer is a lower leg wound caused by chronic venous insufficiency and venous hypertension[1]. Venous leg ulcers are often recurrent and impact patient quality of life. Recurrent venous leg ulcers also have socio-economic burdens to the patient and the health care system[1]. The Standard of care for venous leg ulcers includes compression[1]. The use of compression therapy in venous leg ulcers reduces reoccurrence when patients comply with treatment[2].

The Edmonton General does not currently utilize compression wrap dressings within the long term care units, due to the high number of licensed staff who would require competency training.

Case Study

- 83 year old female.
- Residing in the long term care facility for 1 year.
- Peripheral vascular disease with related skin changes: dryness, pruritus, stasis dermatitis, lipodermatoscrlosis, and hemosiderin staining.
- Recurrent cellulitis, non-resolving erythema.
- Non-healing venous leg ulcer, with weeping, despite trial of numerous dressing materials including, silicone, silver, iodine, and zinc oxide/ icthammol.
- Multiple co-morbidities including congestive heart failure, obesity, chronic kidney disease, and immobility.
- Prior to admission the resident had tried pressure gradient stockings; both the resident and staff report difficulties in donning.
- Since admission the resident had been using a pull on tubular elastic style compression; minimal results due to leg shape causing an inconsistent compression level.
- Resident goals: heal wound, reduce pain, and prevent pruritus.

Procedure

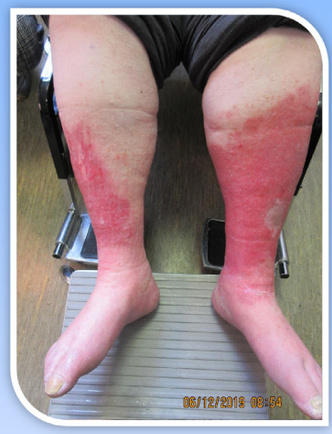
- Consideration and review of available compression options in the long term care setting; including alternative products such as: pressure gradient stockings, tubular bandage, compression stockinet, and compression wrapping.
- A variety of reusable hook-and-loop fastened compression products are available on the market that use either overlapping or interlacing wrapping techniques[3].
- Assemble the team[1]: NP, CNE, OT, Unit RN/ Manager, LPNs, HCAs, and product vendor.
- A review of the literature supporting hook-and-loop fastened compression systems provided limited results.
- Appraisal of available hook-and-loop fastened compression systems for greatest patient safety and usability for staff application onto a patient.
- Initial ABI measurement and re-evaluation prior to increasing compression level.
- Initial and weekly morning foot to calf measurements using standard locations for measurement with a paper measuring tape and consistent staff to measure (NP, OT, or CNE).
- Education and follow up with the unit RN and LPNs on application and adjustment of the system. Application every morning and removed every evening.
- Product information, instructions, and room posters were developed.
- Dressings to open areas continued with the use of the system until the areas closed.
- Gradual increase in compression level starting at 20-30mmHg and increasing to 30-40mmHg bilaterally.

Results

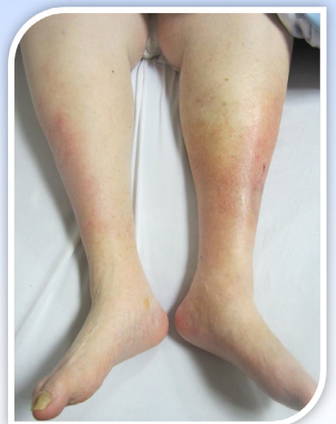
- Reduction in bilateral lower limb circumference measurements ranging from 9% to 36% reduction in 5 months
- Complete closure of venous stasis ulcers.
- Improved skin condition including dryness, pruritus, stasis dermatitis, and lipodermatosclerosis.
- Increased patient satisfaction with wound and edema management: “I Love My Socks”.
- Observed competency in application by licensed practical nurses.
- Additional residents now using the same hook-and-loop fastened system with similar results and satisfaction.

Implications

- A highly adjustable compression system that can be used as an alternative to other compression options currently used in long term care settings.
- Further quality evidence is required to evaluate hook-and-loop fastened compression against other means of compression[3].
- Accessible funding for hook-and-loop fastened compression is in the process of changing for patients who qualify under *Alberta Aides to Daily Living*.



June 2019: Initial appearance and circumference:
15 cm above lateral malleolus: L: 37.5cm R: 39cm
30 cm above lateral malleolus: L: 55cm R: 49.5cm



November 2019: Appearance and circumference during trial:
15 cm above lateral malleolus: L: 24cm (-36%) R: 27.5cm(-30%)
30 cm above lateral malleolus: L: 45cm (-18.) R: 45cm (-9%)

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Covenant Health
Edmonton General
Continuing Care Centre

Negative Pressure Dressings in Long Term Care
A Case Study

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Aim

Evaluate the effectiveness and patient safety considerations for the use of a negative pressure dressing in a long term care setting.

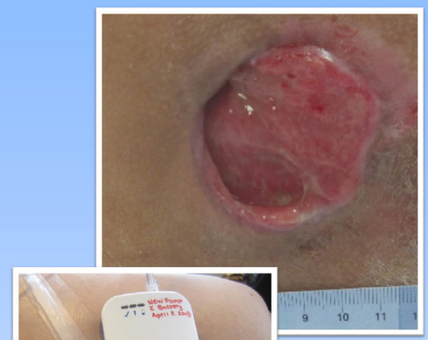
Background

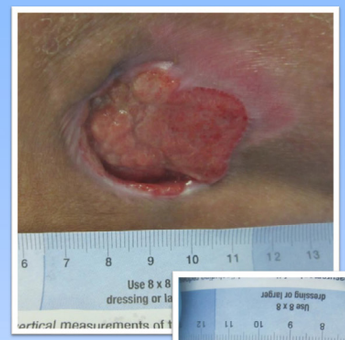
Pressure injuries can cause patients pain, loss of function, and loss of mobility[1]. The impact of a pressure injury is not just what is visible on the surface; there is also an impact on the overall quality of life and wellbeing of the patient[1]. Negative pressure wound therapy is the use of vacuum suction as part of the wound dressing[2]. Negative pressure wound therapy is used as an advanced therapy option for many wound etiologies including pressure injuries. Unfortunately in the Edmonton Zone, long term care patients can only access traditional negative pressure wound therapy at one facility; thereby leaving their home facility. Another option for these patients could be a negative pressure dressing. A negative pressure dressing self contains wound exudate within its dressing material as opposed to moving exudate into a separate canister. The comparison chart further compares traditional negative pressure wound therapy and negative pressure dressings.

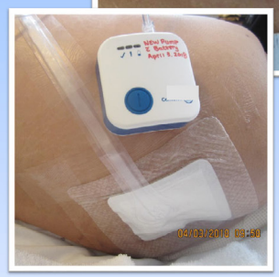
Case Study

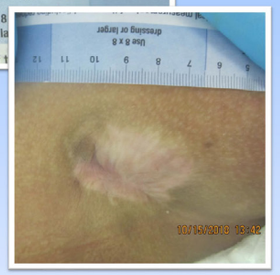
Through a case study the feasibility, safety, and effectiveness of a negative pressure dressing is explored as an alternative to traditional negative pressure wound therapy.

- Young female resident in long term for 2.5 months
- Admitted with stage 4 pressure injury to the sacrum
- Co-morbid conditions: anoxic brain injury, contractures, and enteral feeding
- Wound stalled in the healing process following treatment of deep compartment infection
- No further response to dressing protocols
- Family requested to keep resident at the Edmonton General, therefore traditional negative pressure wound therapy was not an available option









April 4, 2018, trial initiation: 5.3cm x 3.9cm with 0.5cm depth and 2.1cm undermining in 1:00 direction

April 23, 2018, post trial: 3.5cm x 3.0cm with 0.4cm depth and 0.7cm undermining in 1:00 direction

Following the trial, the wound continued to respond to routine wound care and was fully closed by October 2018

Traditional Negative Pressure Wound Therapy[3]	Negative Pressure Dressing[3]
Adjustable negative pressure at 25 to 200mmHg	Manufacturer pre-set negative pressure at 80 to 140mmHg
Continuous or intermittent pressure	Continuous pressure
Used for multiple wound etiologies; including complex wounds with depth, undermining, and tunneling	Less evidence for use in multiple wound etiologies. Limitations on wound depth, length of tunneling, and exudate amount
Contraindicated in wounds with high bleeding, malignancy, untreated osteomyelitis, unexplored fistulas, and necrotic tissue	Same contraindications as traditional negative pressure wound therapy. Maximum wound depth 2-3cm. Maximum drainage up to 300ml per dressing
Reusable	Single-use disposable pumps, changed every 7 to 30 days
Exudate stored within a drainable canister Up to 1000ml canisters	Exudate stored within the dressing material Up to 300ml
Carry case and canister weight: 2-3 lbs	Pocket size pump average weight: 4oz
Requires education and competency maintenance	Reduced education and training requirements
Removal can be painful due to foam adhering	Pain consistent with standard dressing materials
Audible alarms for low battery, leaks, and full canister	Visible alarms for battery and leaks
Dressing change every 48-72 hours. Dressing must be changed within 2 hrs of dressing/ pump failure.	Dressing duration up to 7 days. Dressing can remain in place in case of dressing/ pump failure (where foam is not in use)
Rechargeable battery that requires daily charging (plug in)	Battery operated

Procedure

- Safety considerations were reviewed comparing traditional negative pressure therapy to the negative pressure dressing
- Patient selection based on wound size, exudate, location, and wound bed condition
- Initial dressings applied by the NP or CNE
- LPNs taught to apply dressings by the NP and CNE
- Interim instructions and dressing protocol provided in case of dressing or pump failure

Results

- Following a 20 day utilization of a negative pressure dressing on a stalled sacral pressure injury the wound demonstrated improved granulation and reduced wound measurements; including depth and undermining
- Following use of the negative pressure dressing the wound progressed to complete closure
- LPN competency in dressing application was observed
- No adverse effects to wound progression noted during dressing or pump failure
- During pump failure, the dressing could remain in place until a trained staff member was available
- During a dressing failure staff could reinforce the draping or utilize an alternative protocol until a trained staff member was available to re-apply the negative pressure dressing

Implications

The use of a negative pressure dressing is a safe option as an advanced therapy option in the long term care environment. Limitations in exudate management would limit a negative pressure dressing as a replacement to traditional negative pressure therapy.

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1. Gorecki, C., Brown, J.M., Nelson, E.A., Briggs, M., Schoonhoven, L., Dealey, C., Defloor, T., & Nixon. (2009). Impact of pressure ulcers on quality of life in older patients: a systematic review. Journal of the American Geriatrics Society, 57, 1175-83.
2. Dumville, J.C., Webster, J., Evans, D., & Land, L. (2015). Negative pressure wound therapy for treating pressure ulcers. *Cochrane Database of Systematic Reviews*, 2015, 5. Doi: 10.1002/14651858.CD011334.pub2.
3. Manufacturer recommendations and product monographs (CovaTec, Smith & Nephew, and KCI)

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The Evil Soaker Pad… Changing Products and Practices as Part of Pressure Injury Prevention

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Aim

Implement a change in practice and utilization of absorbent bed pads as part of a pressure injury prevention quality improvement initiative.

Background

Pressure injuries can cause patients pain, loss of function, and loss of mobility[1]. The impact of a pressure injury is not just what is visible on the surface; there is also an impact on the overall quality of life and wellbeing for the patient[1]. The use of absorbent bed pads, especially where the pad becomes folded, adversely affects a mattresses' pressure redistribution properties[3]. Historically, health care workers are trained to make a hospital bed with a cloth absorbent bed pad. Cloth absorbent bed pads do not lock in moisture and therefore remain moist to touch, or moist and in contact with the skin. The presence of moisture can accelerate the formation of pressure injuries[4]. Guidelines suggest minimizing linen layers between patients and surfaces and using disposable products compared to cloth incontinence management products[2]. The Edmonton General is a large continuing care facility that was using cloth absorbent bed pads for all patient beds.

Procedure

- The opportunity for quality improvement was identified
- Guidelines and literature were reviewed
- Staff interviews revealed a dual purpose of the cloth absorbent bed pad for protecting bed linens and for repositioning patients
- Staff discussions were held to allow staff to question their current practice and to identify opportunity for change
- Alternate repositioning equipment was already available that reduced friction
- Alternative disposable absorbent bed pads were investigated and compared to each other and to the cloth absorbent bed pad
- Literature suggestions and a price comparison of products was presented to administration and to unit managers
- Staff education was provided on the alternative repositioning equipment; including reinforcement of proper patient handling with low friction sheets
- Demonstrations comparing the cloth absorbent bed pad and a disposable bed pad were provided
- Review of individual patient incontinence needs; including those who had uncontrolled incontinence leakage with current briefs
- Education was provided to introduce a practice change to limit the use of absorbent bed pads to only those patients whose incontinence was uncontrolled by incontinence briefs, or who had other moisture management needs (such as wound drainage or perspiration)
- A building wide removal of cloth absorbent pads from linen supplies was implemented on a single implementation date

Results

- Sustainable change in practice with no further use of cloth absorbent bed pads
- Practice change for making beds: only those patients identified in the care plan have a disposable absorbent bed pad available
- Reduced absorbent bed pad usage by approximately 75%.
- At the time of implementation cost comparison:
  - Cost per single use (laundry fee) of a cloth absorbent bed pad: $0.856/ pad
  - Disposable absorbent bed pad: $0.797/ pad
- As part of other pressure injury prevention interventions the facility has seen a reduction in pressure injury prevalence:
  - Facility acquired pressure injury prevalence 2016: 13.2%
  - Facility acquired pressure injury prevalence 2018: 6.5%

Implications

- Other continuing care facilities within the organization are implementing similar changes
- Further evaluation of environmental impact is suggested
- Changes are needed for health care workers education on pressure injury prevention, incontinence management, and bed making
- More research is needed on identifying preferable absorbent bed pad features
- Review on the impact staff injury rates since implementation would be beneficial

References

1. Gorecki, C., Brown, J.M., Nelson, E.A., Briggs, M., Schoonhoven, L., Dealey, C., Defloor, T., & Nixon. (2009). Impact of pressure ulcers on quality of life in older patients: a systematic review. *Journal of the American Geriatrics Society, 57*, 1175-83.
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Patient-Administered E- Stim for Wound Healing

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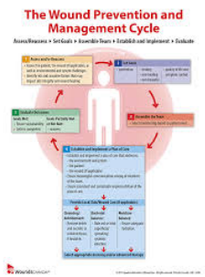
BACKGROUND

- Community Consult and Treat Team in Integrated Home Care, Calgary Zone, identified the need to develop a sustainable community E Stim program.
- The team identified barriers to providing E Stim to clients in the community, that once addressed, would directly impact client care (healing rates), quality of life and cost associated with dressings and home care visits.
- Barriers to E Stim included: Challenges with transportation to home care clinics, financial concerns with parking, time away from work, competing medical appointments, dependence on caregiver schedules, prolonged weight bearing through a wound while travelling to and from appointments and time intensive for the interventionist.

OBJECTIVES

- To develop an easy, cost effective, client driven E Stim program in the community
- To develop an E Stim Clinical Resource Tool for both staff and clients
- Trial E Stim on clients with chronic wounds with spinal cord injury, Cerebral Palsy, Multiple Sclerosis, and Diabetes.
- Incorporate Wounds Canada Wound Prevention and Management Cycle (WPMC) as basis for client management

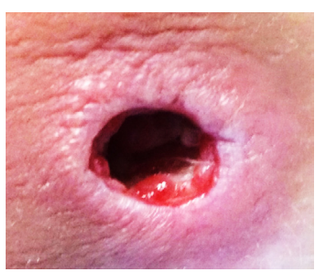


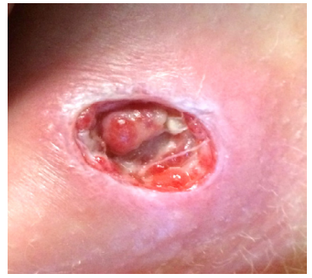
METHODS

Collaboration with Management Community CAT Team Members	• Explained reason and purpose of project. • Identified barriers to care and need for home E-Stim treatment • Obtained appropriate approvals for project • Outlined inclusion and exclusion criteria • Inclusion criteria: Home safe, client cognitive and able to understand treatment and risks. • Able to preform treatment independently.
Educate	• Identify cause of wound and address barriers to healing. • Collaboration with the multidisciplinary team. • E-Stim clinical resource tool • Client education • Handouts to clients • Best Practice Guideline that matched the wound type • Contact phone number for support
E STIM machine loan process to client	• Provided E Stim machine, 2 electrodes, saline and gauze to clients.
E Stim effectiveness	• Biweekly measurements of wound • BWAT
Client / care giver satisfaction	• Verbal report on satisfaction / ease of application of E Stim .

OUTCOMES

Client N=15	Co-Morbidities	Wound Location
2	Multiple Sclerosis	coccyx
1	Cerebral Palsy	Sacrum/IT
2	Diabetes	Lower leg
10	SCI	Sacrum/IT





Pressure Injury – Ischeal Tuberosity 0-2 weeks EStim

DISCUSSION

- By incorporating E-Stim as an adjunctive therapy into the client's home and teaching clients how to use E Stim, we have demonstrated improved wound outcomes and closure.
- Improved quality of life by limiting the need for transportation and cost to receive treatment in a clinic setting.
- Decrease number of HCP involved in care to provide therapy.
- Client remained in home (vs clinic) with appropriate offloading and equipment to reduce pressure
- Client and family engagement and focused care resulting in empowerment and control to heal own wound.
- Client focus of care was on the cause of the wound and not the dressing.
- Integrated new wound healing adjunctive therapy and learning for community team that followed best practice.

CONCLUSION

- Independent, client administered E Stim for wound healing in the home is an easy, cost-effective and efficient adjunctive therapy for clients with chronic wounds.
- Improved wound healing outcomes
- Improved quality of life for client's living with a wound

LIMITATIONS

- Required client motivation and engagement to heal wound.
- Maintaining hand hygiene and good technique for client and family members providing the care.
- Able to follow instructions.
- Willingness for client and team to address the cause of the wound.
- This was not a formalized research study but evidence suggests further investigation of independent client E Stim modality in the home.

NEXT STEPS

- Educate and expand client driven E Stim Program in the Calgary Zone: Long term care, Assisted Living, Rural Home Care
- Collaborate with other programs / National E Stim Collaboration Group – estim4wounds

REFERENCES

- *Houghton 2017* [Chronic Wound Care Management & Research. 4 25–44.] A recent critical review written by Dr. Houghton provides a comprehensive list of all clinical trials and systematic reviews published since 1968 about the effects E Stim on healing rates of various types of wounds. Critical appraisal of existing research revealed that systematic reviews that had higher quality (per PRISMA guidelines) and included a greater proportion of available research were more likely to find E Stim can improve healing outcomes of pressure injuries, diabetic foot wounds, and venous leg ulcers
- Orsted HL, Keast D, Forest-LaLande L, Kuhnke J, O'Sullivan-Drombolis D, et al. Best practice recommendations for the prevention and management of wounds In: Foundations of Best Practice for Skin and Wound Management. A supplement of Wound Care Canada; 2017 [cited 2017 Jan 31]. 668 p. Available from:https://www.woundscanada.ca/health-care-professional/education-health-care-professional/advanced-education/12-healthcare-professional/110-supplements.
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Lower leg harvest site complications from coronary artery bypass graft (CABG) procedures: a literature review

Smart, J

BACKGROUND

Coronary Artery Bypass Graft (CABG) surgery is intended to increase the blood flow to the heart. This is done after the arteries that supply the heart with blood become occluded or narrowed. It in intended to lower the risk for a heart attack in the future.

During the surgery, it is common to use blood vessel from the leg to help correct the flow of blood in the heart. This is commonly known as the harvest site.

However, harvest site complications can cause a burden to the health care system through surgical site infections (SSIs), antibiotic treatment, and longevity of dressing changes to these sites. Patients present with increasingly complicated medical histories with can further complicate treatment and results.

In practice the harvest site can be overlooked as the chest or sternal wound can result in more fatal complication. This can lead to neglect and misrepresentation for reporting surgical site complication to the harvest site, and only reporting complications to the sternal incisions.

Alberta Health Services reported CABG surgical site infections at 1.54%. However there do not differentiate between harvest site and sternal site. They are only reporting complex SSIs. This is an infection that occurs within 90 days, involves deep tissues, purulent drainage, dehiscence, and/or abscess is present.

OBJECTIVES

The aim of this study was to do a comprehensive review the empirical literature to gain insight on problems and to note what complications can result to the harvest site on the lower leg from this surgical procedure and compare it to Alberta Health Services data that is available.

METHODS

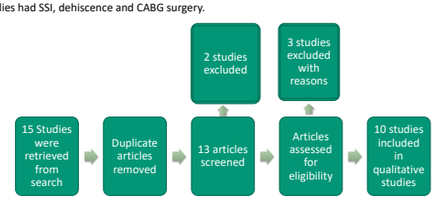
CINAHL and PubMed databases were searched with the inclusion criteria

Eligibility criteria: harvest site, surgical site infection (SSI), dehiscence, CABG surgery, transplant, and published in English. Any study format accepted eg. Randomized, surveillance study, clinical audit, etc..

Exclusion criteria: No indication of how many surgical site infections, or dehiscence to lower leg. Not CABG surgery. No indication on lower leg complications, only sternal wound complications. No conflicts of interest.

Findings:

- 10 Studies met inclusion criteria
- 4 Randomized and 6 non-randomized including 3 audits or reviews
- 19,847 total subjects
- All studies had SSI, dehiscence and CABG surgery.

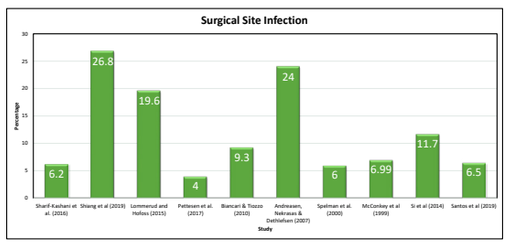


Summary of Studies

Study Author/Year	Aim/Design	Subjects	Findings
Sharif-Kashani et al. (2016)	Review the incidents of graft site infections between Smoking (S) to Non-smoking(NS) patients between 2007 and 2013.	810 subjects total. 405 in each group	36/405 (0.8%) smoker - 85 had post-op complications. 14/405 (0.3%) non-smoker - 57 had post-op complications
Shiang et al (2019)	Review the incidents of graft site complications between conventional(CVH) vs minimal invasive vein harvesting(MIVH) of patients between March 2016 -May2017.	127 subjects. 68 in CVH and 59 in MIVH	Total Incidents(34/127) 26.8%; 12/59 in the MIVHT (20.3%); 22/68 in the CVH (32.4%)
Lommerud and Hofoss (2015)	Convenience non-randomized trial in comparing two ward in the same hospital in the post-operative treatment of donor sites. One used compression stockings (15-18mmHg) and the other didn't.	377 total subjects; 254 with compression; 123 without	Total Incidents 74/377 (19.6%); 49/254 (19.3%) Compression; 25/123 (20.3%) Non-compression
Pettesen et al. (2017)	Single Centred randomized Control study to compare different vein harvesting and what the outcomes would be.	100 total subjects. 51 in the conventional group. 49 in pedicled vein group. Follow up at 6 weeks	Conventional 2/51 (4%) Pedicled Vein 2/49 (4%)
Biancari & Tiozzo (2010)	Cochrane review comparing the outcomesstaples vs sutures for closing harvest sites	323 total subjects	Infections 30/323 (9.3%) Dehiscence 22/245 (9%)
Andreasen, Nekrasas & Dethlefsen (2007)	Randomized control study comparing surgical techniques of endoscopic and open harvesting	132 total subject	Overall, 30 days, n (%) (cellulitis, purulent infection, dehiscence and skin necrosis) 31/129 (24%)
Spelman et al. (2000)	Clinical review over wound complications and risk factors	693 total subjects	42/693 (6%)
McConkey et al (1999)	Review of database and infection to lower leg wounds.	2231 total subjects	156/2231 (6.99%)
Si et al (2014)	10 year review of sugcial complications	14,546 total subjects	1702/14,546 (11.7%) - 860 happened post discharge
Santos et al (2019)	Patients underwent saphenectomy in CABG surgery were included in a prospective, randomized, double-blind trial from February/2011 to June/2014.	508 total patients; 251 in the treatment group; 257 in the control	33/508 (6.5%)

RESULTS

- 19,847 total patients who received a CABG procedure
- SSIs or dehiscence to the harvest site on their lower leg ranged from 0.3% to 26.8% throughout the 10 studies.
- However, combined the average was 2178 or 10.9% of patients.



Patient Characteristics

Study Author/Year	Age	Male	BMI	Diabeties	Hypertension	Smoking	PVD
Sharif-Kashani et al. (2016)	(S)56.40 +/- 13.32 (NS)58.02 +/-14.1.	(S)332 (82%) (NS)316 (78%)	(S)28.52 +/-2.19 (NS)28.36 +/-2.00	(S)152 (37.5%) (NS)144 (35.5%)	(S)279 (69%) (NS)260 (64%)	X	(S)91 (22.5%) (NS)72 (18%)
Shiang et al (2019)	55 +/- 8	118 (93%)	26	42.50%	X	X	X
Lommerud and Hofoss (2015)	(Total) 316 (83.8%)	(Total)68.1 (377)	(Total)27.3 (374)	(Total) 78 (20.7%)	(Total) 177 (46.9%)	(Total) 94 (24.9%)	X
Pettesen et al. (2017)	64.2 +/-7	87 (87%)	27 +/- 3	3 (3%)	X	43 (43%)	X
Andreasen, Nekrasas & Dethlefsen (2007)	65 SD +/- 9	111 (86%)	>30 = 30 (23%)	25 (19%)	X	16 (12%)	X
Spelman et al. (2000)	X	510 (74%)	Obesity - 121 (17%)	183 (26%)	349 (50%)	445 (64%)	60 (9%)
Si et al (2014)	66 years	78.40%	X	X	X	X	X
Santos et al (2019)	61.2years3 55 (69.9)	355 (69.9)	>26 = 297 (58%)	204 (40%)	X	X	excluded

CONCLUSION

The literature shows that there might be a higher incident rate of SSIs to the harvest site. With patients having more medical complexities like diabetes, obesity, congestive heart failure, there is a higher chance for issues postoperatively. Post op edema can last up to 3months. By controlling the edema and other health factors, will that provide better outcomes for SSIs to the harvest site. Further research is needed to evaluate if there is other techniques to decreasing harvest site infections.

CLINICAL RELEVANCE

This indicated that there are approximately 10-11 of every 100 CABG procedures that have some sort of furthering complications. As according to Wounds Canada Best Practice Guideline for Surgical Site Infections the researcher would like to be able to use compression wrap therapy, as it an effective method to reduce edema to the lower legs which could be contributing to further complications to the harvest site. This will help researchers to evaluate the effectiveness of decreasing edema and lower limb complications post coronary artery bypass graft procedures.

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#17

Exploring a proteomics approach to antimicrobial mechanistic study

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Aim

Through traditional mechanistic studies have described molecular targets and biochemical interactions of drug substances. This study investigates the potential for utilising proteomics as a complimentary approach towards elucidating pharmacological effects of drug substances on bacterial physiology.

Methods

Bacteria were treated with antimicrobials to induce a response that was measured by proteomics and compared against known mechanisms of action. Quadruplicate bacterial cultures of Pseudomonas aeruginosa (PAO1, 107 CFU/ml, 40 ml) were grown in the presence of minimum inhibitory concentrations (MICs) of silver nitrate or gentamicin. Bacteria grown without antimicrobials served as controls. After two hours of growth, cells were harvested, frozen and lysed. Proteins were then precipitated and digested with trypsin/LysC. The resulting peptides were purified on a C18 column and analyzed by mass spectroscopy. The Normalized Spectral Abundance Factor (NSAF) was calculated. Unsupervised hierarchical clustering was carried out using Perseus (v.1.6.2.2) using z-standardized NSAF data. Protein annotations were retrieved from the UniProt and Pseudomonas genome databases. The statistical significance of differential protein abundance was determined using Perseus by applying Student's t test (two-sample comparison, $p < 0.05$) to logarithmized (normally distributed) NSAF values.

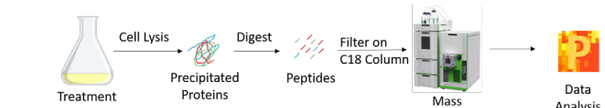

Figure 1 Proteomics Work Flow.

Results

MIC values for silver nitrate and gentamicin against PA01 were determined to be 9.77 μM Ag and 1 μg/mL respectively. Time kill curves, Fig. 2, exhibited similar profiles for silver nitrate and gentamicin where silver nitrate was observed to effect a more rapid and potent kill over each MIC concentration series. Similar bacterial response profiles were observed at a time point of 2 h at 1 x MIC and so this condition was selected to proceed with proteomic studies as outlined in Fig. 1. A total of 2414 differentially abundant proteins were identified. Principal component analysis, Fig. 3, indicated discrete proteomic responses between silver nitrate, gentamicin, and control samples.

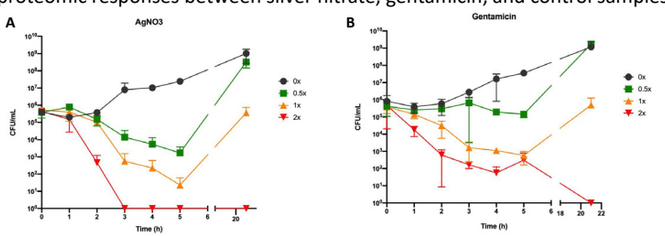

Figure 2 Growth curves of *Pseudomonas aeruginosa* PAO1 treated with 0.5x, 1x and 2x minimum inhibitory concentration of $AgNO_3$ **(A)** and Gentamicin **(B)**. Cultures normalized to 10^6 CFU/mL were challenged with antimicrobial over a 22 hour time course in biological triplicate and technical quadruplicate. Aliquots of culture were removed at 0,1,2,3,4,5 and 22 hour timepoints, serially diluted and spot plated onto TSA. Colony counts were performed after overnight incubation at 37°C.

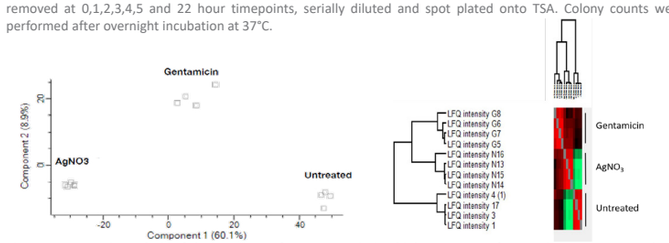

Figure 3 Proteomic analysis of the response of PAO1 to antimicrobial treatment. A) Principle component analysis plot based on the $\log_{10}$ LFQ intensities of 4 controls and 8 treated samples. **B)** Heatmap of the $\log_{10}$ (log2??) ratio of LFQ intensities

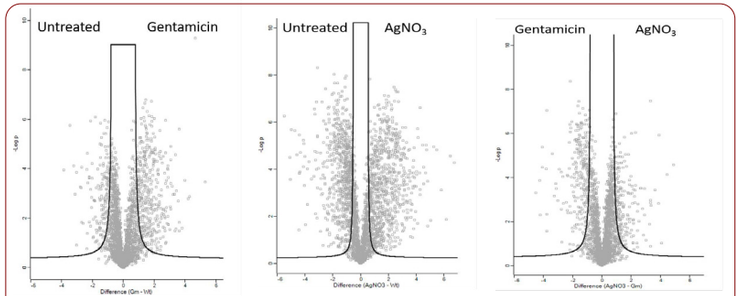

Figure 4 Volcano plots showing protein expression in treated and untreated cultures of *P. aeruginosa* PAO1. Volcano plots of the $\log_2$ ratio of mean antimicrobial treated to control LFQ intensities plotted against the negative $\log_{10}$ ratio of the *p*-value calculated using a *t*-test and 2-fold significance on the x-axis. *P*-value <0.05, S0=1.0

A total of 1683 differentially abundant proteins were observed between silver nitrate nitrate-treated bacteria and the control cultures, while 731 differentially abundant proteins were observed between gentamicin-treated and control samples. Significant proteomics responses were observed in biological processes associated with oxidative stress, ribosomal activity, efflux, copper homeostasis, and quorum sensing.

Table 1: Gene Ontology Biological Process proteins upregulated and downregulated upon treatment with antimicrobials

Gene Ontology Biological Process	$AgNO_3$ vs WT No. of proteins	Gentamicin vs WT No. of proteins	Significance
Oxidative Stress	↑ 12	↑ 5	Greater upregulation of proteins implicated in oxidative stress
Ribosome	↓ >50	↓ 1	Greater downregulation of proteins implicated in ribosome response
Efflux	↓ 8	No significant changes	Greater downregulation of proteins implicated in efflux response
Copper Homeostasis	↑ 7	↑ 1	Greater upregulation of proteins implicated in copper homeostasis
Quorum Sensing	↑ 20	↑ 10	Greater upregulation of proteins implicated in quorum sensing

Implications/Applications

Proteomics may be used as a tool to investigate protein abundance changes in microbial species in response to antibiotic treatments. Discrete proteomics responses may result from cumulative, multifactorial effects, in-line with known pharmacological effects.

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Acknowledgements

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Use of an Advanced Collagen Matrix Dressing on Patients with Complex Chronic Lower Extremity Ulcers: A Case Series

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YORK DERMATOLOGY CLINIC & RESEARCH CENTRE

Background:

- Chronic wounds are a clinically challenging and financially burdensome healthcare issue.
- Collagen dressings are a category of dressing with the ability to decrease the matrix metalloproteinase (MMP) burden while providing a scaffold for healing and maintaining a moist wound environment. MMPs, pro-inflammatory enzymes, have been found to be elevated in non-healing chronic wounds, therefore contributing to a complex wound environment.
- The aim of this case series is to study the clinical effectiveness of an advanced collagen matrix wound dressing which contains collagen, carboxymethylcellulose and ethylenediaminetetraacetic acid (EDTA), with or without silver (Ag) in advancing the healing of challenging chronic wounds.

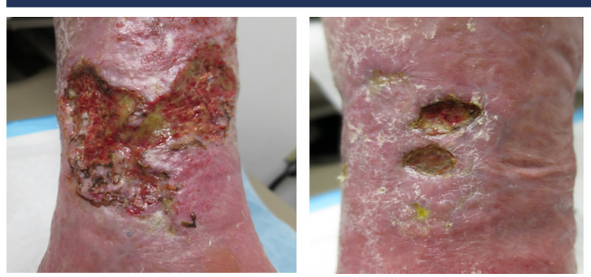
Methodology:

- The study was conducted at an outpatient community dermatology and wound clinic and approved by independent ethics review board.
- A total of 10 patients with an average age of 73.5 and a chronic lower extremity wound were included in this case series. In addition to the collagen contact layer, patients received standard of care for compression therapy or offloading when indicated. Use of silver was based on clinician judgement if indicated.
- The contact layer was cut to the size of the wound and placed directly onto the wound bed following necessary debridement procedures. Study visits were completed at weeks 2, 4 and 8 following enrollment and initial baseline measurements were taken at week 0.

Results:

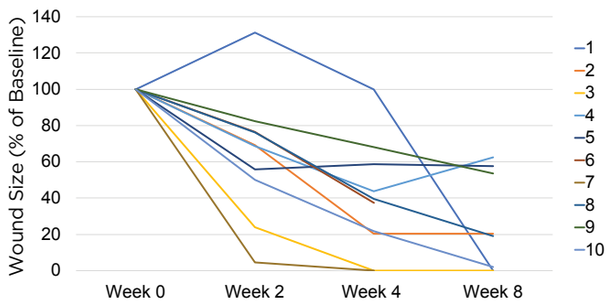
Patient ID	Diagnosis	% Healed at 4 Weeks	% Healed at 8 Weeks
1	Neuropathic Foot Ulcer	0	100
2	Venous Leg Ulcer	80	80
3	Venous Leg Ulcer	100	100
4	Venous Leg Ulcer	55	37.5
5	Venous Leg Ulcer	41	42
6	Venous Leg Ulcer & Pyoderma Gangrenosum	63	Lost to Follow up
7	Venous Leg Ulcer	100	N/A
8	Arterial Leg Ulcer	60	81
9	Venous Leg Ulcer	32	46
10	Mixed Venous/Arterial Leg Ulcer	78	94

Week 0 Week 8



Results:

Figure 1: Wound Healing Over Time



- An average decrease in wound size of 76% was achieved across patients at week 8, with complete healing in 3 patients. All wounds, despite their challenging nature, reduced significantly in size over the duration of the 8-week study. The intervention was easy to use and well tolerated by patients.

Conclusion:

- The results of this case series show that treatment with the advanced collagen matrix dressing is associated with marked wound improvement over an 8-week period, suggesting that when used in combination with standard of care this intervention may decrease the time to healing of chronic lower extremity ulcers. Further investigation is needed to evaluate efficacy in a larger randomized clinical trial with focus on cost-effectiveness and impact on patient's quality-of-life.

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#19

Concomitantly localised oxygen and Ag(III) generation conducive to combating infection containing biofilm while facilitating wound healing

Carla J. Spina Ph.D.[1], Johanny Notarandrea B.Sc.[1], Stephen C. Davis, MD, PhD[2], Jie Li, Joel Gil[2], Jose Valdes[2], Michael Solis[2], Alex Higa[2], Carlie Goodall B.Sc.[3], Rod Precht[3]

Aim

Wound healing necessitates heightened metabolic processes, the requirements for which include oxygen. Combating infection during the course of healing poses additional challenges, harmonising efficacy and healing. This study investigates in-vivo and in-vitro response to an Ag(III)/oxygen scaffold gel (AOSG) towards resolving this efficacy-healing balance.

Methods

In-vivo porcine deep partial thickness wound healing and burn infection models. Wound Healing: forty-eight (48) wounds were made on two female pigs then randomly assigned to three treatment groups: AOSG, carrier gel, and untreated control. Incisional biopsies were taken on Days 2, 4, 6, and 8 in quadruplicate.

Infection: *Pseudomonas aeruginosa* ATCC 27312 inoculated (25 µl of 10^6 CFU/mL) on second degree burns for 24 h to allow biofilm formation on one female pig (pilot study). Sets for wounds were treated with AOSG or left untreated. Bacterial biopsy quantification was performed at baseline (24 hr after inoculation), days 3 and 6 post treatment.

In-vitro studies: X-ray diffraction and spatial-temporal quantification of silver and oxygen from the gel scaffold over a 7-day period in aqueous and simulated media at 21 and 37 °C.

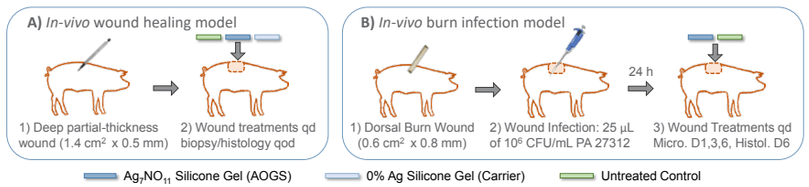

Figure 1 A) *In-vivo* wound healing model. Within 20 minutes of the preparation of forty-eight (48) deep partial thickness wounds prepared using an electrokeratome, **B)** *In-vivo* burn infection model. Following the formation and blister removal of second-degree burn wounds using a heated brass rod, a 25 µl challenge of *Pseudomonas aeruginosa* ATCC 27312 (PA 27312) 10^6 CFU/mL in normal saline was inoculated into each wound. Wounds were then covered with a polyurethane (PU) film for 24 hours to allow biofilm formation. Twenty-four hours after inoculation (Day 1) sets of eight (8) wounds were treated with 300 µl AOSG daily or left untreated. All wounds were covered with (PU) film.

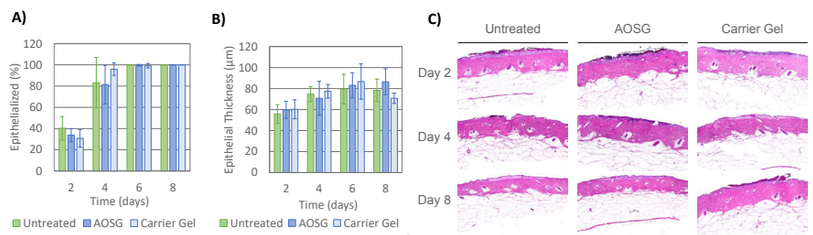

Figure 2 *In-vivo* wound healing results. Quantification of **A)** percentage of wound epithelialized (%) and **B)** epithelial thickness (cell thickness x 12 um) over the course of daily treatment with AOSG, carrier gel, or untreated control. Results representing the average of eight samples (n=8), error bars indicated represent standard deviation. **C)** Representative histological images of deep partial thickness wound healing wounds on days 2, 4 and 8.

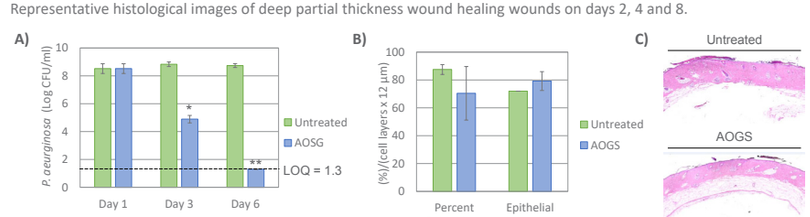

Figure 3: *In-vitro* burn infection results. **A)** PA 27312 bacterial counts (n =3) on day 1 (24 hour after inoculation) and day 3 and 6 following daily treatment with AOGS or untreated control. Statistical significance was recognised at a p value < 0.05, from a two-tailed unpaired equal variance Student's t-test where (*) denotes a significant reduction day 1 and (**) denotes a significant reduction from previous day. **B)** Quantification of percentage of wound epithelialized (%) and epithelial thickness (cell thickness x 12 um) on day 6 following daily treatment with AOSG or untreated control. Results representing the average of duplicate data (n=2), error bars indicated represent standard deviations of the triplicate measurements. **C)** Representative histological images of burn infection wounds on day 6.

Results

No impairment to the rate of wound healing were observed following treatment with the AOSG with 100 % epithelialization observed within 6-days *in-vivo*. *In-vivo P. aeruginosa* was reduced by 3.94 ± 0.27 Log CFU/mL by day 3 with 7.41 ± 0.0 Log reduction by day 6. Solid state evaluation of the Ag(III)/oxygen scaffold gel demonstrate a continuous release profile for both silver (140 ± 16 ppm Ag/day) and oxygen (≥ 17.2 mL $O_{2(g)}$/mL gel, 1 atm).

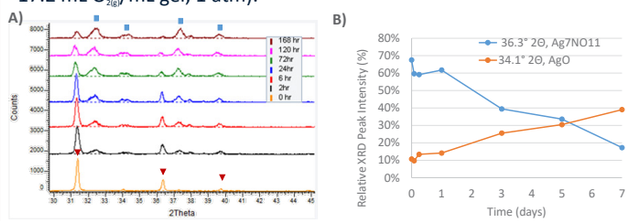

Figure 4 Solid state crystallographic characterization of AOSG over time in aqueous solution. **A)** X-ray diffraction patterns of AOGS over 7 days in aqueous media in ambient temperature at a ratio of 0.5 g/25 cm^2/10 ml. Standard diffraction patterns for solid state silver compounds identified: silver oxynitrate (inverted red triangle) , argentic oxide (blue square). **B)** Percent silver oxynitrate determined by powder X-ray diffraction, calculated as a relative percent relative main peak height of silver oxynitrate (31.2 °2Θ, COD Card 2310073) versus the main impurity and solid-state degradation products: AgO (32.4 °2Θ, COD Card 1509488).

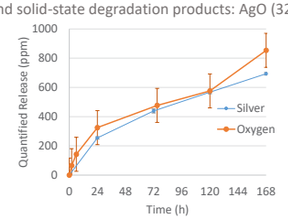

Figure 5. Silver and oxygen profile for AOSG over time in aqueous media in ambient temperature at a ratio of 0.5 g/25 cm2/10 ml. . Silver quantification performed in triplicate via Optima 7300 DV ICP AES (University of Toronto, Analest Facility). Oxygen quantitation performed in triplicate using single oxygen sensor green using QuantaMaster 80 Spectrofluorometer (SickKids SBS Facility, Toronto).

Implications

Effective reduction of planktonic and biofilm associated bacteria without impairment of wound healing are necessary for optimal wound management. These studies suggest that the AOSG can reduce microbial load without being detrimental to the healing process.

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Nutritional Interventions in Patients with Chronic Wounds

George Payne, B.Sc. M.Sc, Lucas Castellani, MD FRCPC
Northern Ontario School of Medicine

Objective

The objective of our study is to determine if dietitian involvement improves clinical outcomes in patients with chronic wounds; particularly - length of stay, rate of wound healing, readmission rates, and mortality.

Background

The evidence for the presence of nosocomial malnutrition is strong, and research behind the particularly beneficial effects of countering malnutrition with nutritional interventions finds both patient and system-oriented outcomes to be improved[1]. Much of the research surrounding malnutrition has been carried out in more general patient populations. Importantly, malnutrition greatly increases risk for developing pressure ulcers and it has been found that proper nutrition can increase the rate of healing[2]. The body of evidence surrounding the effects of nutritional interventions in chronic wound healing is growing however does not address interprofessional roles in patient care. We propose to study patients with wounds, whose need for macronutrients (protein, carbohydrates, lipids) and micronutrients (vitamins and minerals) are increased, and thus are at higher risk for malnutrition, and who may benefit from interprofessional care.

Methods

A retrospective chart review was completed at our local regional hospital in Sault Ste. Marie, Ontario between January 1, 2017 and January 1, 2019.

Inclusion criteria included patients: over 18, with a chronic wound (visited our outpatient wound clinic, saw a specialized wound care (ET) nurse, or whose chart included wound related keywords. Exclusion criteria included patients who died within 48 hours of admission, who had acute/traumatic wounds, or whose stay was less than 48 hours. The treatment group was made up of those patients who saw a dietitian during their admission. The control group did not see a dietitian during their admission. Primary outcomes included length of stay, readmission rates, wound size (healing) and mortality. Data from 101 patients were collected and analyzed using Microsoft Excel (version 14.07237.5). Student's t-tests were performed to compare between group differences in our primary outcomes, except for mortality which was evaluated using a X2 test.

Results

There were no significant differences in length of stay, readmission rates or mortality between patient groups. Changes in wounds were not analyzed due to variable approaches to documentation. The entire population studied had an average length of stay of 51 days. 72% of our patients received dietetic interventions. 90.9% of patients received wound care consults by specialized nursing. 89.1% of patients were treated with antibiotics. Of the patients treated with antibiotics, 70.7% had positive culture results.

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Figure 1. Length of stay; Figure 2. Days of readmission

Table 1: X^2 Result[a] for association between dietetic consult and mortality rate

Dietetic Consult	Mortality n (%)	No Mortality (%)	n	P Value[a]
Yes	9 (32.1)	19 (68.9)	28	0.08
No	43 (58.9)	30 (41.1)	73	

Table 2: Antimicrobial use with culture results

Antimicrobial Use *Total % (n)*	Positive Culture *Total % (n)*
89.1% (*90*)	59.4% (*60*)

Discussion

This study identifies gaps in understanding of interprofessional approaches to wound care, particularly in nutritional interventions, and provides a basis for future research. Future areas of research could include studying the implementation of systematic wound reporting, focusing on improved interprofessional approaches for improved antimicrobial stewardship, and developing a standardized nutritional approach to patients with wounds.

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Pressure Injury Prediction by in Bed Pressure Monitoring

Nasim Hajari[1], Chester Ho[2], Irene Cheng[3]
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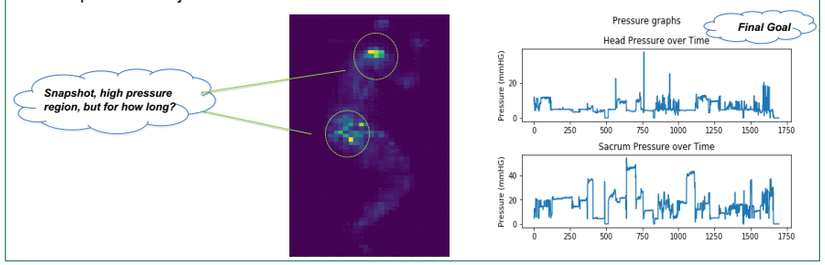
PROBLEM DEFINITION

- Pressure Injury (PI) is mainly developed due to prolonged interface pressure between the body and the support surface.
- Cause significant co-morbidities to patients.
- Costly to the healthcare system, yet mostly preventable[1,2].
- Effective monitoring of interface pressure can reduce the risk of PI development, especially for high-risk groups such as seniors and those with spinal cord injuries

- ***Limitations:***
1. Snapshot assessment
2. No longitudinal measurements and analysis
- ***Our Solution:***
1. Quantifies and analyzes longitudinal pressure measurements at high risk regions, even for noisy signals containing external objects.



NOVELTY and APPLICATIONS

- Although pose estimation and body part mapping is well studied in the area of computer vision, our in bed pose estimation and tracking from pressure data is novel.

- The developed software can be used with any pressure mattresses to effectively and accurately identify and track the high-risk body parts and alarm the care givers if the chance of developing PI is high, hence the position can be changed effectively.

PROPOSED METHOD

- Combined signal processing and pose estimation to design a novel mapping model.
- Estimate the in-bed posture and identify and track the body parts from pressure data over time.

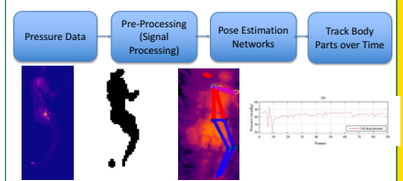


Fig.1 Steps of proposed method

DATA CAPTURING

- Optical and pressure data from different subjects, with various poses and different combination of external objects.
- The Xsensor ForeSite is used to record the interface pressure. However, the proposed system can work with any other pressure mattress.
- RealSense camera is used to capture optical data from top view.
- A manual synchronization method is used to adjust and match optical and pressure data.
- This is the first work that records the along with optical data [3].

Fig.2.Pressure mattress and external objects setup

SIGNAL PROCESSING

- Less amount of information and lower resolution comparing to optical data.
- Signal processing is used to enhance the data.

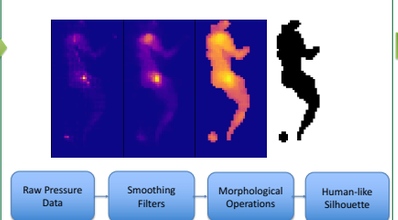


Fig.3 Pre-processing steps on pressure data

POSE ESTIMATION

- Pre-trained pose estimation networks was used to estimate the in-bed pose from pressure data.
- The existing networks are trained on RGB videos and images.
- Retraining the networks on pressure data requires big amount of labeled pressure data, which currently is not available

Fig.4 Pre-trained pose estimation model and results

ACKNOWLEDGEMENT and REFERENCES

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GLENROSE
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Improving the Benefits of Disposable NPWT with Methylene Blue/Gentian Violet Antibacterial PVA Foam Dressings

Amanda Loney BScN, RN, NSWOC, WOCC(C), IIWCC.

INTRODUCTION: Negative Pressure Wound Therapy (NPWT) is an established wound closure technique available in both canister and disposable formats.[1] Despite its many benefits, disadvantages remain with the traditional canister type units including; cost, complexity of application, patient reported pain and reduced quality of life.[2]

OBJECTIVE: This case review examines early stage evidence that Methylene Blue Gentian Violet (MBGV) polyvinyl alcohol (PVA) foam can augment the clinical benefits of disposable NPWT (dNPWT) by increasing the scope of use to include wounds with depth, undermining or tunneling, biofilm, devitalized tissue and where antibacterial treatment, or improved exudate management would prove beneficial.

METHOD: Eight patients with clinically challenging wounds that would not historically fit the criteria for use of dNPWT: two were started on dNPWT and six were transitioned from canister-based NPWT. MBGV foam was applied to part of the wound bed or over the entire wound bed and then was covered with the standard dNPWT.

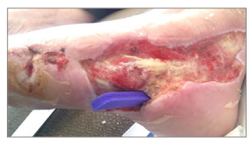
RESULTS: The absorption and wicking properties of the MBGV foam dressing provided optimum moisture balance in wounds ranging from low to high exudate levels as well in low evaporative environments.[3] MBGV foam holds exudate up to 12x its own weight allowing for the combination of MBGV and dNPWT to manage a great amount of exudate.
Using MBGV to address undermining and tunneling situations permitted the use of dNPWT when it would not have been possible otherwise. In addition, it aided in the disruption of biofilm and debridement without causing trauma to exposed bone or tendon, and high-risk patients remained free of deep tissue infection.[4] While being treated with this combination, patients reported a decrease in pain, odor and increased mobility, while nurses reported less complexity of care and no urgent visits related to loss of seal.

COST SAVINGS†

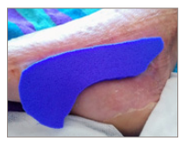
	Canister NPWT		dNPWT		Savings using dNPWT
Parameters	#'s	Cost	#'s	Cost	
Nursing visits/month ($70/visit)	12	$840	4 to 8	$560	**$280**
NPWT Dressing kits Estimate at $60/each	12	$720	4 x $240**	$960	
Other supplies needed*	12 x $15	$180	8 x $4	$32	
Canister - $20	12	$240	0	–	
Total Cost Supplies	–	$1,140	–	$992	**$148**
Rental ($60/day)	–	$720	0	0	**$720**
Total Cost Nursing + Supplies + Rental		$2,700		$1,552	**$1,148**

†Assumptions for one month of treatment

CASE 1: Diabetic Foot Ulcer: Fifth digit amputation complicated with Severe Arterial Disease

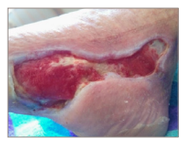


Dec 12: Transition from canister NPWT to GVMB and dNPWT.
Wound size: 13 x 6cm, depth 2.5cm. The 2.5cm tunnel was addressed with GVMB as the base was was still necrotic and tunneled to bone.
Pain: 5/10 Tramadol/Acetaminophen ii q4hrs

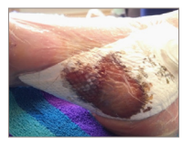


Jan 20: MBGV was used under dNPWT to address depth, provide antibacterial treatment and to aid in absorption and wicking of the large amount of discharge that the dNPWT would not be able to manage on its own.

Jan 20: No signs or symptoms of infection occurred during the treatment with MBGV and dNPWT.

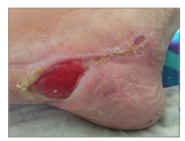


Jan 30
Wound Size: 11cm x 4.4cm x .3cm.
Tunnel started at 2.5cm, now 1.1cm. 42% healing in surface area at week 6.5 with MBGV & dNPWT
Pain: 1/10. All pain medication was discontinued



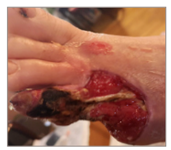
Feb 13: MBGV wicked exudate into the dNPWT dressing that manages exudate via evaporation. On average 80% of the wound fluid is evaporated.[5]

Feb 13
Wound Size: 9.8cm x 3.3cm x 0.3 cm and the tunnel is closed.
Treatment continues dNPWT with MBGV foam, changing 2x/wk.

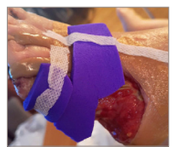


March 21
Wound Size: 3.4cm x 2.5cm x 0.2cm.
Discontinued dNPWT and continued treatment with MBGV PVA foam and cover dressing until wound closure.

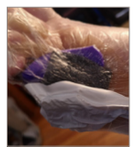
CASE 2: Diabetic Foot Ulcer: Patient returned home from a two-week hospital stay following a fifth digit amputation related to severe infection and necrosis. IV antibiotics and traditional negative pressure wound therapy were initiated in hospital.



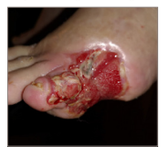
Feb 26
Wound Size: 9 x 7cm.
Wound bed: 40% necrotic, 60% red granular.
Drainage: moderate sero-purulent. Periwound intact.



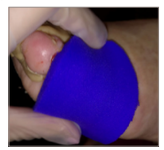
Feb 26: MBGV foam used on the necrotic tissue and to cover the tendon. This is used where you might typically use the denser white foam or a mesh dressing to protect the tendon.



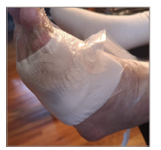
Feb 26: Traditional canister NPWT used for approximately 3 wks.

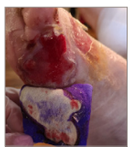


Apr 4: Initiated MBGV PVA foam and dNPWT. Dressing was changed every 3-4 days.

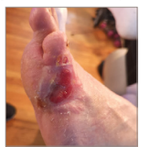


Apr 4
MBGV PVA foam was used in combination with the dNPWT to aid in moisture balance (through absorption and wicking action), debridement, and decreasing the risk of infection. To aid in maintaining a seal for 3-4 days strip paste was used between the toes.



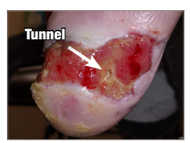


May 6
Wound size:
5 x 4cm x 0.3cm
Percentage of healing: 39% at 4.5wks after initiating MBGV and dNPWT.

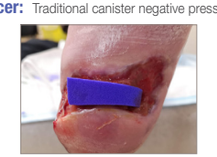


July 18
Wound size: 2.5 x 1.5 x .2cm.
A 94% reduction in wound size over 16 weeks.
Drainage: Small to moderate sero-sanguineous.

CASE 3: Diabetic Heel Ulcer: Traditional canister negative pressure wound therapy was initiated following surgical debridement of heel down to the calcaneus bone. Patient was residing in the community during treatment period.

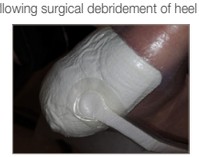


Dec 6
Wound size: 9 x 4 x 2cm.
Drainage: moderate to large sero-purulent. Transitioned to MBGV & dNPWT.

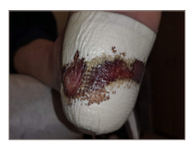


Dec 20
Wound size: 9 x 3.3 x 1.5cm
Base: 85% pink, 15% slough. The PVA foam provided a means to address the tunneling to the bone.

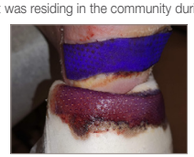
Dec 20: PVA foam in combination with the dNPWT allowed the dressings to manage a greater fluid capacity than dNPWT would on its own, providing optimal moisture balance to the wound bed.



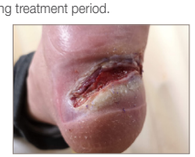
Dec 20
With traditional canister NPWT it was not uncommon for nurse to receive emergency call in the night due to loss of seal. Guideline states that black foam needs to be removed once NPWT has stopped for > 2-4 hours. MBGV dressing in combination with dNPWT can be left up to 3 days even if seal is lost resulting in NO emergency calls. MBGV provided broad spectrum antibacterial protection to a high risk patient[6]. During treatment with dNPWT and MBGV, the wound did not show any signs or symptoms of infection.



Feb 4



Feb 4



Feb 19
Wound size: 6.5 x .8cm x .3cm
50% healing in surface area. Discontinued dNPWT and continued on with MBGV and cover dressing. Wound went on to heal without incident.

CONCLUSION: The higher absorption and continuous wicking properties of the MBGV foam enabled an earlier transition to dNPWT from a traditional canister system. The dNPWT / MBGV dressing combination led to improvements for the patient, clinician and healthcare payer. The dNPWT system is quicker and easier to apply, saves in nursing time and costs 30-45% less than the traditional canister NPWT.

Through this review, the author shows the dNPWT/MBGV dressing combination should be considered for further evaluation in wound care treatments.

References:
1. Hurd T, Rossington A, Trueman P, Smith J. A Retrospective Comparison of the Performance of Two Negative Pressure Wound Therapy Systems in the Management of Wounds of Mixed Etiology. Adv Wound Care (New Rochelle). 2017;6(1):33-37.
2. Isaac AL. Addressing Complications With Negative Pressure Wound Therapy Use. Podiatry Today. 2019;32(7), 44-49.
3. Solano-Kiedaisch S, Jeff C, Ramsay S, Aust D, Roche E. Activity against wound pathogens and absorbency for silver dressings and a PVA sponge containing organic pigments. Presented at WUWHS Congress, 2008.
4. Edwards K. New Twist on an Old Favorite: Gentian violet and methylene blue antibacterial foams. Adv Wound Care 2016;5(1):11–8.
5. Malmsjö, M., Huddleston, E., & Martin, R. (2014). Biological effects of a disposable, canisterless Negative Pressure Wound Therapy system (in-vitro). Eplasty, 14: e15.*
6. Woo KY, Heil J. A prospective evaluation of methylene blue and gentian violet dressing for management of chronic wounds with local infection. Int Wound J. 2017; doi: 10.1111/iwj.12753

* Other Supplies required: For one dressing change for Traditional NPWT - 2 thin hydrocolloid dressings, normal saline, dressing tray, skin, prep wipes, sterile gloves (estimate $15).
For one dressing change for dNPWT - normal saline, dressing tray, skin prep and sterile gloves (estimate $4).
** 2 dressings per kit plus one pump, all disposable, 4 kits/month

Presented at SAWC in Las Vegas Oct/19 and Wounds Canada in Calgary Apr/20.

28-2019