

Developed by the BC Provincial Interprofessional Skin & Wound Committee in collaboration with Occupational Therapists, Physiotherapists, and NSWOCs / Wound Clinicians from:



High Voltage Pulsed Current Wound Therapy: Guideline/Procedure

Endorsement Health Authority & Yukon	<ul style="list-style-type: none"> • Endorsement done: FHA, IHA, VCH/PHC. • Endorsement pending: FNHA, ISLH, NHA, PHSA & Yukon. Until endorsement has been provided by your HA, please use your HA's current document.
Indication for Use of DST	<ul style="list-style-type: none"> • Use this guideline/procedure to guide the assessment of indications/ precautions/ contraindications for High Voltage Pulsed Current (HVPC) and the application of the therapy. • Clients (adults/children) undergoing HVPC require an interprofessional approach to provide comprehensive, evidence-based assessment and treatment; this document focuses on the Physiotherapists (PTs) and nurses determining the need for and providing HVPC wound therapy.
Practice Level British Columbia & Yukon	<p>British Columbia</p> <ul style="list-style-type: none"> • In accordance with health authority/agency policy, physiotherapists (PTs) and nurses who have taken additional education (see below) to gain knowledge and skill in determining the need for and the setting of the therapy parameters of HVPC therapy. • All other nurses can support the on-going wound therapy, as per the care plan, by attaching/disconnecting the electrical lead to the gauze dressing and turning on/off the pre-set device. <p>Yukon</p> <ul style="list-style-type: none"> • Physiotherapists, Registered Nurses, Registered Psychiatric Nurses and Licensed Practical Nurses refer to organizational policy/practice in accordance with regulatory bodies.
Education Requirements	<ul style="list-style-type: none"> • As determined by the health authority/agency education requirements, (e.g., Provincial Interprofessional Skin & Wound Committee's HVPC Wound Therapy Education Requirements & Competencies (TBC). <ul style="list-style-type: none"> ◦ Education consists of successful completion of basic wound care session(s) and a HVPC education session, (e.g., HA approved program or Western University Masters in Wound Healing) as well as demonstration of competency in determining and setting the HVPC therapy. • Each PT and nurse is responsible and accountable for maintaining their level of competency for this wound therapy.
Background	<ul style="list-style-type: none"> • HVPC, also referred to as Electrical Stimulation, E-stim, EST, or ES, is an electro- physical medical device used to stimulate cells to promote wound healing or wound circulation. Each type of cell in the wound bed carries a charge, which is affected by the polarity of the electrical current, see Appendix B. • HVPC using monophasic high voltage pulsed current has been demonstrated to have a high level of effectiveness for wound healing and can be used on a wound which has no more than 20% necrotic tissue. Monopolar technique accelerates wound healing by: <ul style="list-style-type: none"> ◦ Increasing local circulation, oxygen and nutrient delivery. ◦ Promoting antimicrobial effects (with appropriate polarity) to reduce wound bioburden. ◦ Increasing galvanotaxis/electrotaxis (directional migration of cells in an electric field). ◦ Increasing granulation tissue. ◦ Improving cross-linkage of collagen fibers. ◦ Reducing pain and edema. • HVPC using bipolar high voltage pulsed current is effective in stimulating blood circulation, (e.g., to an incision area). • Conductive agents are silver-plated dressings, (e.g., Silverlon) or normal saline moistened gauze coated with a hydrogel such as Intersite Gel.

Note: This is a **controlled** document. A printed copy may not reflect the current, electronic version on the CLWK Intranet (www.clwk.ca). Any document appearing in paper form should always be checked against the electronic version prior to use; the electronic version is always the current version. This DST has been developed as a guide to support nursing and physiotherapist practice in British Columbia, however it is not a substitute for education, experience & the use of clinical judgment

Bookmarks	Assessment: Indications/Precautions/Contraindications Determination for the Need/Appropriateness for HVPC Therapy Interventions Equipment and Supplies Procedure Client/Family Teaching/Resources Client Clinical Outcomes Quality Assurance Indicators Documentation Definitions References/Bibliography Document Management Appendix A: HVPC Kit/Recommended Supplies List Appendix B: Electrotaxis in direct current (DC) & pulsed current (PC) electrical fields Appendix C: Electrode Configurations
Related Documents	HVPC Wound Therapy: Education Requirements & Competencies (TBC) HVPC Wound Therapy: Client Health Education Resource Wound Management: Guideline Wound Cleansing: Procedure Wound Assessment: Learning Module

Assessment: Indications/Precautions/Contraindication

1. Indications:

- HVPC may be used for the following wounds given that the wound bed has no more than 20% necrotic tissue:
 - Pressure injuries
 - Arterial, venous, and mixed ulcers
 - Diabetic foot ulcers
 - Surgical incisions/flaps, skin grafts healing by secondary intention
- Goal of care is to facilitate healing using moist wound healing methods.
- Clients with adequate nutritional status, appropriate glucose balance, optimal pressure re-distribution.
- Clients who are willing to participate in their care/able to direct their own care.
- The client (adult or child) must be able to understand, communicate and give consent to the treatment.

2. Precautions:

- Impaired sensation in location of the wound; an alternate method is required to determine the intensity of the current.
- Impaired cognition; client is unable to understand, communicate or give consent to treatment.
- Mild/moderate peripheral vascular disease; Ankle Brachial Pressure Index (ABPI) 0.5-0.9.
- Anticoagulants/coagulopathy or potential hemorrhagic area.
- Autonomic dysreflexia.
- Dressings/products containing metal or charged particles (see dressing selection below).
- Wound infection once treatment with antibiotic treatment has started can proceed with HVPC.
- Osteomyelitis, once treatment with antibiotic treatment has started can proceed with HVPC.
- Systemic infection, (e.g., sepsis, tuberculosis), once antibiotic treatment has started can proceed with HVPC.
- Over an active epiphysis (bone growth plate) for a child less than 16 years of age.
- Skin disease in the area to be treated e.g., eczema.
- Wound is in the area of treated tuberculosis.

3. Contraindications:

- Wounds of unknown etiology.
- Wounds near an implanted electronic device, (e.g., cardiac pacemaker).

Note: This is a **controlled** document. A printed copy may not reflect the current, electronic version on the CLWK Intranet (www.clwk.ca). Any document appearing in paper form should always be checked against the electronic version prior to use; the electronic version is always the current version. This DST has been developed as a guide to support nursing and physiotherapist practice in British Columbia, however it is not a substitute for education, experience & the use of clinical judgment

- Severe arterial insufficiency present; ABPI less than 0.5.
- Wounds due to inflammatory, (e.g., vasculitis, pyoderma).
- Untreated or unsuccessfully treated wound infection.
- Untreated or unsuccessfully treated osteomyelitis.
- Untreated or unsuccessfully treated systemic infection, (e.g., sepsis, tuberculosis).
- Active bleeding or untreated hemorrhagic disorders.
- Wounds on the chest with unstable cardiac arrhythmia/heart conduction or heart failure.
- Wounds in the area of neck or head for clients with seizure disorders.
- Over an active deep or superficial vein thrombosis not yet managed by pharmacological agents.
- For pregnant women, application over the lower back, pelvis, abdomen or acupuncture points that could induce labour.
- In an area of known or suspected malignancy or fungating wound.
- History of radiation treatment in the area of the wound within the past 6 months.
- Application near or over the eyes, carotid sinus, anterior neck.
- Application near or over the reproductive organs/genitalia if potential for reproduction.
- Placement of electrodes trans-cranially, near the heart or over the phrenic nerve.

Determination for the Need/Appropriateness for HVPC Therapy

Physiotherapist/Physician/NP/NSWOC/Wound Clinician determines the appropriateness of HVPC therapy based on:

- The client's wound, incision, or skin graft meets the indications for use.
- The client's current clinical condition is able to support HVPC Therapy.
- The amount of eschar, slough/necrotic tissue is no more than 20% of the wound bed.
- Tissue perfusion at the site is adequate to support healing.
- The client's sharp and dull skin sensation is intact (if any deficits, an alternate method is required to determine the intensity of the current).
- Precautions have been investigated and addressed.
- No contraindications to HVPC are present.
- Client and/or family-centered concerns are addressed.
- The client and/or family consent to, is willing and able to engage in the HVPC therapy care plan.

Consent to Treatment

Explain to the client/family the benefits, risks and evidence of HVPC Wound Therapy. Explain the procedure including frequency, length of treatments, expected outcome and address any client concerns. Obtain the client's informed verbal consent for the procedure.

Interventions

1. Wound dressings containing **metal or charged particles should be discontinued, where possible, for 3 days prior** to application of HVPC; examples include zinc, nanocrystalline or ionic silver dressings, calcium alginate, hypertonic saline, chlorine, iodine, petrolatum or methylene blue/gentian violet to minimize any interference with the high voltage pulsed current of the treatment. Presence of metal or charged particle during the treatment may trigger autonomic dysreflexia (AD) in persons living with spinal cord injury (SCI).
 - If unable to discontinue the dressing, then ensure the wound is irrigated well with at least 100 mL of normal saline prior to the application of HVPC to flush the ions from the wound. During the treatment, monitor the client for signs of pain or AD.
2. Wound bed is at least 80% free of necrotic tissue; consult with NSWOC/Wound Clinician if debridement is indicated.
3. Consult with Physician/NP for excision of rolled wound edges (epibole) prior to starting HVPC therapy.
4. Determine HVPC stimulation parameters as per Electrophysical Agent Protocol (EPA) for High Voltage Pulse Current (HVPC):

- Frequency: High at 100 Hz; machine settings range from 50-120 Hz; most machines are pre-set at 100Hz, check the manufacturer's manual.
 - Intensity: mild tingling (pins/needles) around the wound; no sign of muscle twitching (sub-motor level).
 - Polarity selection:
 - Start with the polarity based upon the phase of wound healing and the charge the cells.
 - Start with negative polarity and switch polarity weekly or every 3 treatments.
 - Switch polarity if the wound is not responding as expected.
 - Treatment time:
 - Approximately 45-60 minutes of stimulation produces best results; stimulation should not be less than 30 minutes.
 - Treatment frequency/duration:
 - Daily treatment is best practice but can be modified to 3-5 times a week based on resources.
 - Apply for 4-6 weeks or until wound closure.
 - Electrode placement:
 - Monopolar for wound with depth, with or without undermining/sinus/tunnel.
 - Bipolar for wounds with superficial depth, closed incisions, or skin grafts.
5. HVPC therapy should be continued until wound closure as the wound may regress if treatment is discontinued.
6. Consider alternate treatment options, in consultation with the multidisciplinary team, if no improvement is noted in three weeks. Note: improvement may not be seen for up to 3 months for 'older' wounds.
7. Testing of HVPC machines is required under College of Physical Therapists of British Columbia regulations. Test carbon electrodes annually or when electrodes are worn/dull, using an ohm meter.

Equipment and Supplies: (also see [Appendix A](#))

- HVPC Kit: HVPC electrical stimulator device, leads, AC adaptor or batteries
- Electrodes - carbon-impregnated rubber electrodes (reusable) or self-adhesive electrodes (single-client use only); ensure dispersive electrode is at least 2x the size of the wound
- Electrode gel
- PPE as required
- Clean gloves
- Sterile dressing tray
- Normal Saline for cleansing
- Conductive dressing:
 - Silverlon dressing or packing ribbon and if needed, sterile water for wetting dressing **or**
 - A hydrogel, (e.g., Intrasite Gel) and gauze and/or gauze packing ribbon
- Paper measuring ruler
- Sterile cotton tipped applicator/foam tipped applicator/metal probe
- Camera
- Sterile scissors
- Abdominal pad for temporary dressing during application
- Wash cloth/warm water
- Paper tape
- Cover dressing as per care plan
- Plastic re-sealable bag
- Pen/marker
- Timer

High Voltage Pulse Current Wound Therapy: Procedure	
Steps	Key Points/Rationale
1. Set up the workspace: <ul style="list-style-type: none"> Gather equipment and supplies. Test HVPC equipment; inspect electrodes for signs of wear. Position client for the procedure. Wash hands; don clean gloves. Set up dressing tray. Remove dressing. Remove gloves, perform hand hygiene. Apply clean gloves. 	<p>Check device manual to confirm which of the leads is the “active” one.</p> <p>Use ohm meter to test carbon electrode’s conductivity.</p> <p>Ensure optimal positioning for offloading and pressure redistribution to enhance local blood flow. Ensure client comfort in order to maintain the position for the full session.</p>
2. Cleanse and assess the wound: <ul style="list-style-type: none"> Cleanse wound and peri-wound skin with at least 100ml of normal saline. Pat the peri-wound skin dry. Assess the wound: <ul style="list-style-type: none"> For initial assessment, do a full wound assessment including measurements and photos. For ongoing assessments: use the assessment to determine if change in polarity is needed based upon healing rate (see Appendix B). 	<p>Cleanse the wound as per Wound Cleansing Procedure. Cleansing/irrigation of wound will remove any residue, debris and any remaining metal or charged ions from previous wound dressings (see page 3 Interventions 1.)</p> <p>Full wound assessment should be done every 7 days assess for healing: decreased wound size, improved granulation tissue and decreased exudate. Switch the polarity if the wound is not responding as expected. Refer to Wound Assessment Learning Module.</p>
3. Prepare the wound dressing, choose either: <ul style="list-style-type: none"> Silverlon Hydrogel-coated gauze <p><u>Silverlon:</u></p> <ul style="list-style-type: none"> Cut sheet dressing to size of wound and/or packing ribbon to the length needed for the undermining/sinus tract. If needed, hydrate dressing with sterile water. <p><u>Hydrogel-coated gauze:</u></p> <ul style="list-style-type: none"> Mix equal amounts of Intersite Gel with normal saline to make a thin gel mixture, (e.g., 10mL saline with 10mL Intersite Gel). Unfold gauze dressing and/or cut packing ribbon to length needed for undermining/ sinus tract. Add gauze/ribbon into the gel mixture and ensure all pieces are well-coated with the gel mixture. If needed make additional gel mixture. 	<p>For undermining/sinus tract, cut one continuous piece of ribbon to fill the space(s). If using gauze for packing, tie gauze pieces together.</p> <p>Only use sterile water for hydrating the Silverlon dressing as normal saline will interfere with the dressings silver ions.</p> <p>The combination of the hydrogel and normal saline provides a good conductive environment.</p>
4. Fill/pack the wound: <ul style="list-style-type: none"> Loosely fill any undermining or sinus/tunnel space(s) with prepared packing ribbon. Loosely pack prepared dressing into the wound cavity, ensuring total contact with the wound. 	<p>Loosely fill the wound with the dressing; conductive dressing/packing must be in contact with all of the wound to support the HVPC therapy.</p>
5. Apply the HVPC, see Appendix C for setup. <u>Monopolar application for wounds with depth</u> <ul style="list-style-type: none"> Attach the active lead to the Silverlon dressing using the alligator clip <u>or</u> the gelled carbon electrode 	<p>Monopolar electrode placement stimulates the wound bed directly via the active lead.</p>

Steps	Key Points
<p>over the hydrogel-coated gauze.</p> <ul style="list-style-type: none"> • Attach the indifferent electrode (needs to be 2x size of wound) to the second lead (it can be self-adhesive or a standard carbon electrode with electrode gel) • Using warm water and cloth moisten (warm & wet) an area of intact skin 15-25cm proximal to the wound, this indifferent electrode completes the electrical circuit. • Cover wound with a temporary dressing, (e.g., abdominal pad); secure with tape. <p><u>Bipolar application for wounds with superficial depth, closed incisions or skin grafts</u></p> <ul style="list-style-type: none"> • Prepare two electrodes of the same type and size. • Apply electrode gel to the carbon electrodes. • Position each electrode on either side of the wound, no more than 2cm away for the wound edge. • Secure with tape. 	<p>The current density under the active lead should be higher, therefore the indifferent electrode should be at least 2x size of wound and placed 15 - 25 cm away.</p> <p>Self-adhesive electrodes are pre-gelled but with use the electrode can lose its gelled surface – apply gel as needed or use a new self-adhesive electrode.</p> <p>Warming & wetting the skin facilitates electrical conduction under an electrode. If warm water is not easily available then use normal saline to slightly moist the skin.</p> <p>Ensure there is at least the width of one electrode between the two electrodes.</p>
<p>6. Start the HVPC therapy:</p> <ul style="list-style-type: none"> • Turn machine on. • Slowly increase the intensity until client reports mild tingling or pins/needles. • Instruct the client to report any discomfort or change in sensation during the stimulation. 	<p>Avoid stimulating a muscle twitch when increasing the intensity.</p> <p>For clients with impaired sensation, use an area of intact sensation to determine intensity of stimulation. Set the wound site intensity to same intensity level.</p>
<p>7. Monitor the treatment:</p> <ul style="list-style-type: none"> • Ensure electrodes remain in place. • Assess client comfort; reposition if needed. • Treatment time should be 45-60 minutes. 	<p>Clients with SCI T6 or above, monitor for AD.</p> <p>Client may walk about during treatment if the setup can remain secure.</p>
<p>8. Post-treatment management:</p> <ul style="list-style-type: none"> • Turn machine off; remove the electrodes. • Check for adverse reaction: redness, rash or point tenderness. • Complete dressing as per treatment plan. 	<p>Periwound redness which persists for longer than four hours may indicate a chemical or electrical burn. This risk is low as the long inter-pulse interval prevents major changes in skin pH and temperature.</p>
<p>9. Clean up work area:</p> <ul style="list-style-type: none"> • For carbon electrode, gently wash with warm soapy water, rinse and air dry. • All equipment/supplies should be placed in a re-sealable plastic bag and labelled with the client's name and date. 	<p>Self-adhesive single-client-use electrodes can be used for the duration of a series of treatments or until they are not able to adhere to the skin.</p>
<p>10. Assess for effectiveness of treatment:</p> <ul style="list-style-type: none"> • A change in exudate to serosanguinous. • An increase in granulation tissue (beefy-red). • A decrease in the size of the wound. 	

Client/Family Teaching and Resources

Review with the client/family the information found in the [Client Health Education Resource \(CHER\)](#) to cover the following general points:

- The rationale for HVPC and the underlying mechanisms of therapy.
- That mild tingling (pins & needles) sensation at the wound site will be felt during the therapy.
- Therapy duration is 45-60 minutes daily; can be modified to 3-5 times/week as per available resources.

Client Clinical Outcomes

1. Intended:
 - a. The wound shows evidence of healing; reduction in size of wound with improved quality of the granulation tissue.
 - b. No complications occur, or if they occur, they are successfully treated.
 - c. There is no site infection, or if infection is present, it is successfully treated.
 - d. There is no procedural and/or wound pain, or if present, it is successfully treated.
 - e. The client participates in the HVPC therapy care plan.
2. Unintended
 - a. The wound does not heal; no reduction in size of wound with no improvement in the quality of the granulation tissue.
 - b. Complications occur.
 - c. Procedural and/or wound pain occurs and is not successfully treated.
 - d. The site becomes infected, or the existing site infection worsens.
 - e. The client is not able to participate in the HVPC care plan.

Quality Assurance Indicators

The following quality assurance indicators may be used by the Health Authority, agency or facility to ensure the quality of HVPC interventions put in place:

- An assessment for the appropriate use of HVPC is completed.
- The goal of the HVPC intervention is clearly identified.
- The goal of the HVPC intervention is successfully achieved.

Documentation

1. On the initial treatment, document client's verbal consent, the client's specific HVPC indications and precautions/plan for mitigation, note absence of contraindications, results of sensation testing, the initial wound assessment, analysis for determining the HVPC therapy parameters and the wound treatment plan.
2. With each HVPC dressing change, document on the appropriate paper or e-documentation tool:
 - a. The weekly Full Wound Assessment including measurements of wound size (length, width, depth).
 - b. Where available, photographs for the wound.
 - c. Update the wound treatment plan as needed; document rationale for change.
3. As appropriate, follow either the College of Physiotherapists of British Columbia (CPTBC) or British Columbia College of Nurses & Midwives (BCCNM) and health authority documentation guidelines.

Definitions

Client: generic term used to describe a recipient of care regardless of care setting; patient in the hospital, client in community; resident in long-term care.

Client/Family: Family is two or more individuals who come together for mutual aid. Families are self-defined, and family is 'who the client says their family is'. This is individualized.

Electrotaxis/Galvanotaxis: Movement of cells or any of its parts, in a particular direction in response to an electric current.

References/Bibliography

1. Barnes, R., Shahin, Y., Gohil, R., & Chetter, I. (2014). Electrical stimulation versus standard care for chronic wound healing: a systematic review and meta-analysis of randomized controlled trials. *Eur J Clin Invest*, 44(4), 429-440. doi: 10.1111/eci.12244.
2. Bellew, J. W., Michlovitz, S. L., & Nolan, T. P. (2016). Michlovitz's modalities for therapeutic intervention: Chapter 15 (6th ed.). F.A. Davis Company.
3. Wounds Canada. (2018). Best practice recommendations for the prevention and treatment of pressure ulcers: Update. <https://www.woundscanada.ca/docman/public/health-care-professional/bpr-workshop/172-bpr-prevention-and-management-of-pressure-injuries-2/file> p 42.
4. Wounds Canada. (2018). Best Practice Recommendations for the Prevention and Management of Wounds: Update. <https://www.woundscanada.ca/docman/public/health-care-professional/bpr-workshop/165-wc-bpr-prevention-and-management-of-wounds/file>
5. Wounds Canada. (2019). Best practice recommendations for the prevention, diagnosis and treatment of diabetic foot ulcers: Update. <https://www.woundscanada.ca/docman/public/health-care-professional/bpr-workshop/895-wc-bpr-prevention-and-management-of-diabetic-foot-ulcers-1573r1e-final/file>
6. Wounds Canada. (2006). Best practice recommendations for the prevention and treatment of venous leg ulcers: Update. <https://www.woundscanada.ca/docman/public/health-care-professional/bpr-workshop/671-prevention-and-treatment-of-venous-leg-ulcers-updated-2006/file> p 54
7. Houghton, P. E., Kincaid, C.B., Lovell, M., Campbell, K. E., Keast, D. H., Woodbury, M. G., & Harris, K. A. (2003). Effect of electrical stimulation on chronic leg ulcer size and appearance. *Physical Therapy*, 83(1), 17-28. <https://academic.oup.com/ptj/article/83/1/17/2857512>
8. Houghton P, Campbell KE, Fraser C, Hayes K, Potter P, Keast DH, Harris C, MG Woodbury. Electrical stimulation therapy increases healing of pressure ulcers in community dwelling people with spinal cord injury. *Archives of Physical Medicine & Rehabilitation*, 91(5): 669-678, 2010 (May).
9. Houghton, P. E., Nussbaum, E. L., & Hoens, A. M. (2010). Electrical stimulation therapy (TENS, NMES, & HVPC). In Electrotherapy agents contraindications and precautions: An evidence based approach to clinical decision making in physical therapy. *Physiotherapy Canada*, 62(5), 26-38. http://www.unboundmedicine.com/medline/citation/21886384/ELECTROPHYSICAL_AGENTS_Contra_indications_And_Precautions:_An_Evidence_Based_Approach_To_Clinical_Decision_Making_In_Physical_Therapy
10. Gould, L. et al. (2015). Chronic wound repair and healing in older adults: Current status and future research. *Wound Repair & Regeneration*, 23(1): 1-13. doi: 10.1111/wrr.12245
11. Kawasaki, L., Mushahwar, V. K., Ho, C., Dukelow, S. P., Chan, L. L. H., & Chan, K. M. (2014). The mechanisms and evidence of efficacy of electrical stimulation for healing of pressure ulcer: A systematic review. *Wound Repair & Regeneration*, 22, 161-173.
12. Kloth, L.C. (2014). Electrical stimulation technologies for wound healing. *Advances in Wound Care*, 3(2), 81-90. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3929255/>
13. Kloth, L.C. (2002). How to use electrical stimulation for wound healing. *Nursing 2002*, 32(12), 12-17. https://journals.lww.com/nursing/fulltext/2002/12000/how_to_use_electrical_stimulation_for_wound.9.aspx#print-article-link
14. Koel, G. & Houghton, P. E. (2014). Electrostimulation: Current status, strength of evidence guidelines, and meta-analysis. *Advances in Wound Care*, 3(2), 118-126. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3928827/>
15. McClure, I., & Rader, C. (2013). Physical therapy and wound care. Strategies for aggressive management and prevention. *Rehab Management: The Interdisciplinary Journal of Rehabilitation*, 26(8), 18-25. <http://www.rehabpub.com/2013/10/physical-therapy-and-wound-care/>
16. McCulloch J. M., & Kloth, L.C. (2010). Endogenous and exogenous electrical fields for wound healing. *Wound healing: Evidence-based management* (4th ed.) (pp. 450-513). FA Davis Company.
17. Ud-Din, S., et al. (2015). Angiogenesis is induced and wound size is reduced by electrical stimulation in an acute wound healing model in human skin. *PLoS ONE* 10(4), e0124502. doi:10.1371/journal.pone.0124502. <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0124502>
18. Wound Cleansing Procedure. <https://www.clwk.ca/buddydrive/file/procedure-wound-cleansing/>

Note: This is a **controlled** document. A printed copy may not reflect the current, electronic version on the CLWK Intranet (www.clwk.ca). Any document appearing in paper form should always be checked against the electronic version prior to use; the electronic version is always the current version. This DST has been developed as a guide to support nursing and physiotherapist practice in British Columbia, however it is not a substitute for education, experience & the use of clinical judgment

19. Wound Cleansing Online video: Magnifying Wound Cleansing Learning Module:
http://ccrs.vch.ca/onlinecourses/wound_management/wound_cleaning/lesson/lesson.asp

Document Management

This guideline is based on the best evidence-based information available at the time it was published and avoids opinion-based statements, where possible. It was developed by the British Columbia Provincial Interprofessional Skin & Wound Committee (PISWC) and has undergone provincial stakeholder review.

Created By	British Columbia PISWC in collaboration with the Occupational Therapists, Physiotherapists, NSWOCs and Wound Clinicians from across all Health Authorities.
Publication Date	2020 March
Revision Date(s)	2022 November, 2024 June
Update Date(s)	2025 June
Review Date(s)	

Appendix A: HVPC Kit/Recommended Supplies List

- High Voltage Pulsed Current (HVPC) machines are available through the Physiotherapy Department.
- Dressing supplies are available on the unit.

Supplies	Additional Information
High Voltage Pulsed Current (HVPC) machine*	<ul style="list-style-type: none"> • Models available: clinic (plug in) and portable (battery operated) • Identify the active and dispersive leads and label each
Electrodes: Carbon or self-adhesive	<ul style="list-style-type: none"> • Self-adhesive electrodes are single-client use • Carbon electrodes are reusable
Electrode Gel	<ul style="list-style-type: none"> • Carbon electrodes require use of electrode gel
Non-woven 5x5cm or 10x10cm gauze and/or gauze packing ribbon	<ul style="list-style-type: none"> • Rayon or rayon/ polyester
Normal Saline	<ul style="list-style-type: none"> • To clean and flush the wound • If using Intersite Gel, moisten gauze with normal saline: acts as a conductive medium in combination with Intracite Gel.
Silverlon Dressing/packing ribbon or Intersite Gel and non-woven 5x5cm or 10x10cm gauze and/or gauze packing ribbon	<ul style="list-style-type: none"> • To act as a conductive medium
Sterile dressing tray	<ul style="list-style-type: none"> • Wound cleansing prior to treatment and dressing post-treatment
PPE (gloves, gown/apron)	<ul style="list-style-type: none"> • Standard infection control measures; use clean gloves
Sterile scissors	<ul style="list-style-type: none"> • To cut silver nylon dressing or carbon electrode to size
Foam tipped applicator/ metal probe	<ul style="list-style-type: none"> • For packing if needed
Sterile cotton tipped applicator	<ul style="list-style-type: none"> • For applying the hydrogel
Med/surg tape (Transpore White 2.5cm)	<ul style="list-style-type: none"> • To secure dressings and electrodes
Alcohol wipes	<ul style="list-style-type: none"> • To clean equipment
Wash cloths/towel	<ul style="list-style-type: none"> • For warming/moistening the skin
Clock/watch	<ul style="list-style-type: none"> • To monitor timing of therapy
Temporary dressing (abdominal pad or 10x10 gauze)	<ul style="list-style-type: none"> • To keep alligator clip, electrode/leads in place during therapy • To absorb excess fluid
Paper Ruler	<ul style="list-style-type: none"> • For measuring the wound
Camera	<ul style="list-style-type: none"> • For taking wound photos
Plastic re-sealable bags	<ul style="list-style-type: none"> • To store single-client-use dispersive electrode
Stickers/labels	<ul style="list-style-type: none"> • To label client's electrodes for reuse
Marker	<ul style="list-style-type: none"> • To label plastic re-sealable bag
Cover Dressing	<ul style="list-style-type: none"> • As per Wound Treatment Plan

*Machines available in Canada:

- Sammon Preston GV350 High-Volt Stimulator (portable machine runs on batteries)
- Chattanooga Multi Atom (larger machine that is plugged into the wall)
- Prizm Medical Micro- Z Mini Galvanic Stimulator

When purchasing a new machine, check the machine's parameters to ensure it is monophasic and has the ability to switch polarity.

Note: This is a **controlled** document. A printed copy may not reflect the current, electronic version on the CLWK Intranet (www.clwk.ca). Any document appearing in paper form should always be checked against the electronic version prior to use; the electronic version is always the current version. This DST has been developed as a guide to support nursing and physiotherapist practice in British Columbia, however it is not a substitute for education, experience & the use of clinical judgment

Appendix B: Electrotaxis in direct current (DC) and pulsed current (PC) electrical fields

Phase of Healing	Biological Effects	Charged Cells	Polarity Selection Cells enhanced motility to:
Inflammatory	Phagocytosis/ Autolysis	Macrophage (negative) Neutrophil (negative) Activated neutrophil (positive)	Positive Positive Negative
Proliferative	Fibroplasia	Fibroblast (positive) Keratinocyte (positive)	Negative Negative
Remodeling	Wound contraction Epithelialization	Myofibroblast (positive) Epidermal (negative)	Negative Positive

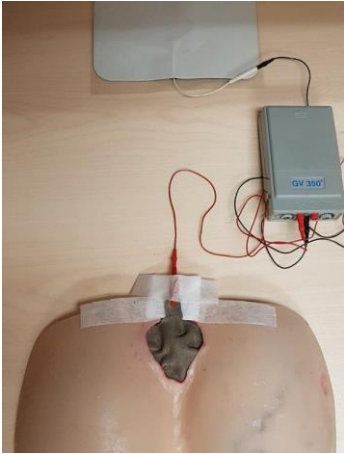
Adapted from Chapter 26 Endogenous and Exogenous Electrical Fields for Wound Healing p 456.
McCulloch, J. M. & L.C. Kloth, *Wound healing: Evidence-based management* (4th ed.). Philadelphia, 2010.

Determining Polarity

- Negative polarity is usually selected for the first two to three treatments to increase perfusion, activate nerves, and promote collagen formation
- Negative polarity attracts neutrophils and fibroblasts and promotes granulation
- Negative polarity also promotes keratinocyte (epidermal cells) migration, enhancing re-epithelialization in the proliferative phase
- Positive polarity attracts neutrophils and macrophages, producing greater antibacterial effects
- For bacterially infected wounds, use the same polarity as the organism that is colonizing the wound
- Switch polarity between positive and negative weekly or every 2-3 treatments, depending on treatment frequency
- Switch polarity if the wound is not responding as expected
- Avoid alternating polarity daily as it will inhibit epithelialization by 45%

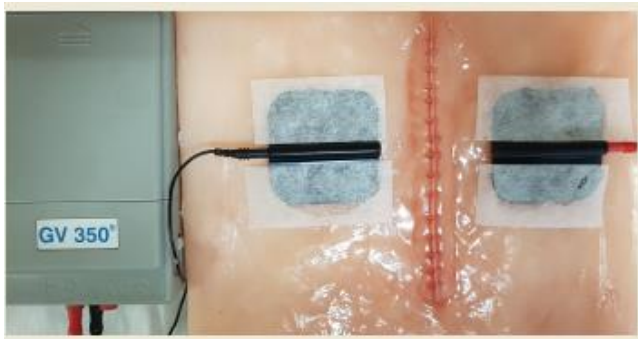
Appendix C: Electrode Configurations

Monopolar Set-up

	<p>The active electrode placed over wound</p> <p>For the purpose of the photo, consider that the dispersive electrode (~2x size of active electrode) would be placed on the client's trunk (not over the spine) 10-20 cm proximal to the wound.</p>
---	---

Note: This is a **controlled** document. A printed copy may not reflect the current, electronic version on the CLWK Intranet (www.clwk.ca). Any document appearing in paper form should always be checked against the electronic version prior to use; the electronic version is always the current version. This DST has been developed as a guide to support nursing and physiotherapist practice in British Columbia, however it is not a substitute for education, experience & the use of clinical judgment

Bipolar Set Up



Position each electrode on either side of the wound, the same distance away from the wound edge.