UNIT NO. 4

WOUND CARE

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ABSTRACT

Common chronic wounds encountered by Family Physicians in the home care setting include pressure ulcers, diabetic foot ulcers, venous ulcers and arterial ulcers. Wound care management starts with a comprehensive wound assessment to determine wound characteristics and identify risk factors for non-healing. This is followed by optimising the wound bed using TIME principles that emphasises judicious debridement, management of exudate, and resolution of bacterial imbalance. An appropriate wound dressing is then selected based on wound characteristics and dressing properties. Finally, it is important to remember that chronic wounds are part of a patient's multiple medical comorbidities, and interacts closely with the patient's social circumstances and functional status. The underlying aetiology and patient risk factors need to be addressed to optimise wound healing.

Keywords:
Wound Care, Home Care, Family Physician, TIME

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INTRODUCTION

Complex, chronic wounds are increasingly encountered by Family Physicians (FPs) as part of providing continuing care in the home or outpatient setting. These wounds in the home care setting include diabetic foot ulcers, which can be arterial, neuropathic or mixed in aetiology; venous ulcers; pressure ulcers; and post-operative wounds.

The objectives of this article are to provide an approach to wound care, and familiarise FPs with components of a wound assessment, TIME principles of wound bed preparation, and selection of an appropriate dressing for commonly encountered wounds in the home or outpatient setting.

Fundamentals of wound healing and progression of acute to chronic wounds

Not all wounds encountered by FPs in the transitional care period are complex, chronic wounds. Acute wounds such as lacerations, skin tears and abrasions can be encountered and managed with dressings, e.g. melolin, opsite, available in most outpatient settings. Acute wounds go through four coordinated and overlapping phases of healing: haemostasis, inflammation, proliferative/repair, remodelling/maturation, and are expected to heal readily. Progression to non-healing or a chronic wound occur when multiple local or systemic risk factors[1] such as ischaemia, diabetes (Table 1), etc., disrupt wound healing and prolong one or more phases of haemostasis, inflammation, proliferation or remodelling. A prolonged inflammatory phase is most common and creates a cascade of tissue responses in the wound that perpetuate a non-healing state.[2] Common chronic wounds would include pressure ulcers, diabetic foot ulcers, venous ulcers and arterial ulcers.

The approach to chronic wounds needs to be patient centred

It cannot be over-emphasised that chronic wounds are part of a patient's multiple comorbidities. While this article will focus on wound factors, "Look at the whole patient, and not just the hole in the patient!" A patient's medical comorbidities have a cause-and-effect relationship with the chronic wound.[1] The aetiology of the wound and patient risk factors need to be optimised to improve wound healing. In addition, the social circumstances, finances, function and care environment of the patient will affect who should do the dressing, where to do it and how frequently the dressing should be changed. For example, a functionally dependent patient without a caregiver may necessitate a less frequent wound dressing change or home nurses for dressing change.

WOUND MANAGEMENT

The critical first step in wound care management is always a comprehensive wound assessment to determine the characteristics of the wound and identify risk factors for poor healing.[3] Optimising the wound bed using TIME principles that emphasise judicious debridement, management of exudate, and resolution of bacterial imbalance follows this. An appropriate wound dressing is then selected based on wound characteristics and dressing properties. Finally, it is important to remember that chronic wounds are part of a patient's multiple medical comorbidities, and interacts closely with the patient's social circumstances and functional status. The underlying aetiology and patient risk factors need to be addressed to optimise wound healing.

A. Wound assessment

A comprehensive wound assessment is critical to determine the characteristics of the wound and identify risk factors for poor healing.[3] For simplicity, I have classified the components of the wound assessment under three headings.

i. Dimensions of the wound

a. Number;
b. Site;
c. Size (length, width, depth & circumference);
d. Shape (can trace the shape onto a transparent film); and
e. Stage of pressure ulcer if applicable.

ii. Wound and surrounding skin

a. Wound bed tissue (necrotic, sloughy, infected, granulating or epithelising, foreign body, exposed bone or tendon);
b. Wound exudate (type, colour, amount and odour);
c. Undermining or internal sinus track; and
d. Surrounding skin.

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Table 1. Factors Affecting Wound Healing	
Local	Systemic
Ischaemia Infection Foreign bodies Elevated tissue pressure/edema	Age and Gender Stress Sex hormones Alcoholism and smoking Diseases: diabetes, cardiovascular, respiratory diseases Obesity Medications: glucocorticoid steroids, non-steroidal anti-inflammatory drugs, chemotherapy drugs Immunocompromised conditions: Cancer, radiation therapy, Acquired immunodeficiency syndrome Nutrition

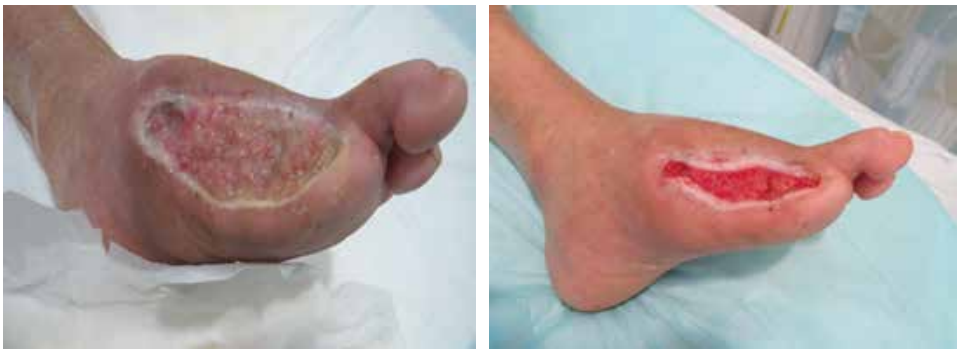


Figure 1: Picture on left shows Right Ray's amputation wound with presence of biofilm. Picture on right shows improvement in wound bed after cleansing with Prontosan solution.

iii. Aetiology and barriers to wound healing
a. Neurovascular status.

Serial photography is helpful for documentation and an important part of ongoing assessment for wound healing.

B. Wound bed preparation
The next critical step is to optimise the local wound bed using TIME principles that emphasise judicious debridement, management of exudate, and resolution of bacterial imbalance to remove local barriers to healing and accelerate endogenous healing. The "TIME" acronym was first developed in 2003 by an international group of wound healing experts to provide a systematic and practical assessment and management of all the critical components of a non-healing chronic wound.[4] The clinical components of wound bed preparation according to "TIME" [Tissue, non-viable or deficient; Infection or Inflammation; Moisture imbalance; Non-advancing or undermined epidermal margin or Edge] define the underlying pathophysiology of impaired healing, proposed wound bed preparation-based clinical interventions, outlined the effects of these interventions at a cellular level, and described anticipated clinical outcomes.

T (tissue, non-viable/deficient) — T is the presence of non-viable tissue such as necrotic tissue, eschar and slough on the wound bed. However, eschar overlying heel wounds should be left in place. The aim is to remove non-viable tissue through judicious debridement. Although different techniques such as sharp surgical, autolytic (hydrocolloid, occlusive dressings), mechanical (curettage, waterjet), enzymatic, biological (maggot debridement therapy) are available, autolytic or bedside surgical debridement are the only realistic options. Autolytic debridement using hydrocolloid or occlusive dressings is most commonly used if a slow, more conservative option is preferred. Sharp surgical debridement requires advanced surgical knowledge and depends on the comfort level of the FP.

I (Infection/ Inflammation) — I is for the presence of inflammation or infection, or both. Inflammation is a physiological response but excessive bacteria burden leads to a continued inflammatory response and overt wound infection. Signs of infection in chronic wounds include delayed healing, increased exudate, bright red discolouration of granulation tissue, friable and exuberant tissue, new areas of slough, undermining, malodour and wound breakdown. Deep infections manifest as erythema and warmth in the surrounding skin. Comprehensive wound care must include cleansing, debridement, and exudate management. A properly

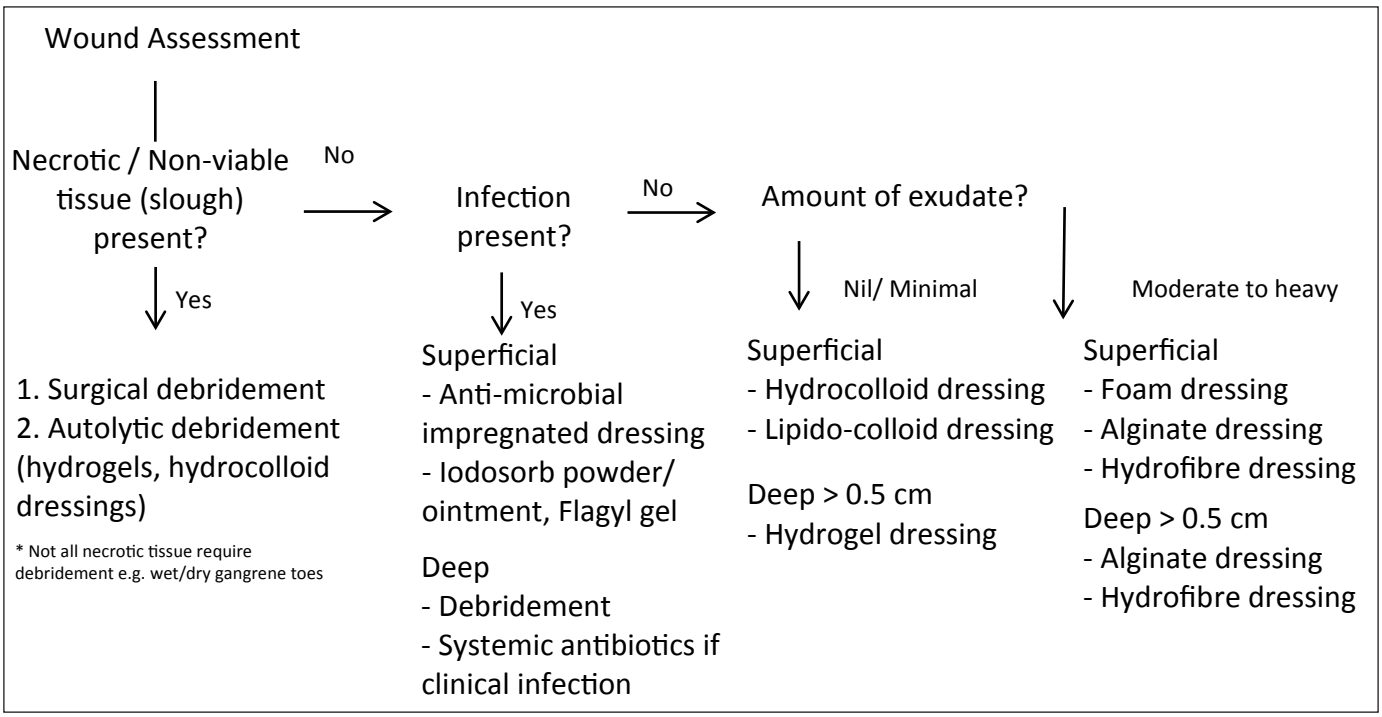


Figure 2: Schematic flowchart for dressing selection

obtained swab culture may be helpful to guide antibiotic therapy when clinical signs of infection are present.[5] Avoid doing routine superficial swab cultures as most chronic wounds are invariably colonised. If required, the proper way is to move the swab across the wound surface in a zig-zag motion,[4] at the same time as being rotated between the fingers. Take a sample of the pus if possible. A representative area (at least 1 cm^2) from both the wound bed and wound margin should be sampled.[5]

Systemic antibiotics with appropriate staphylococcal, streptococcal, coliform, and anaerobic coverage[6-8] should only be used in the treatment of sepsis, osteomyelitis, cellulitis, lymphangitis, abscess formation, and other signs of invasive tissue infection. Continued topical antimicrobial therapy is advised as systemic antibiotics may not reach therapeutic levels in the relatively avascular infected wound tissue. Biofilms should be considered if wounds fail to improve or degenerate despite a healthy appearance (Figure 2). The best way to disrupt and remove biofilm is by debridement. Once disrupted, the biofilm is more vulnerable to antimicrobials and use of a topical broad-spectrum antimicrobial such as silver or iodine or topical antiseptic solutions such as Prontosan® can also prevent biofilm reconstitution.[9]

M (moisture imbalance) — M describes the state of moisture balance, ranging from dessication to maceration. Appropriate wound moisture is required for the action of growth factors, cytokines and cell migration to optimise wound healing. Too little exudate leads to eschar formation and inhibits wound healing. Excessive wound fluid contains elevated levels of matrix metalloproteinases and pro-inflammatory cytokines. This increased proteolytic activity damages the wound bed, degrades the extracellular matrix and prolongs the chronic inflammatory response leading to non-healing.[10] The selection of an appropriate dressing to maintain an appropriate moisture balance will be discussed under the section "selection of an appropriate wound dressing".

E (edge of the wound, epithelium) — E refers to the wound edge, whether it is non-advancing or undermined, or the extent of re-epithelialisation. Epithelial edge advancement and an improved state of the surrounding skin is the clearest sign of healing. A 20-40% reduction in wound area after 2 and 4 weeks of treatment is seen as a reliable predictive indicator of healing and confirms either the effectiveness of the wound treatment being used or the need for re-evaluation. The TIM principles should be revisited if the wound is not epithelialising.

C. Selection of an appropriate wound dressing

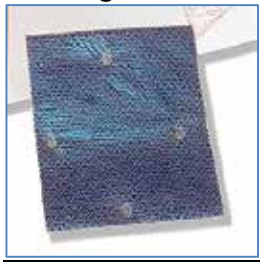
Selecting the most appropriate dressing remains a challenge for most doctors given the myriad of wound products available on the market. There is no single dressing that fits all wounds and the same dressing cannot be used from the beginning to the end. Dressings are selected according to wound characteristics; therefore when the wound evolves, a different wound product needs to be used. At each dressing change, the wound is reviewed to evaluate wound healing and the effectiveness of the previous dressing used.

After a wound assessment, the right dressing needs to match the wound's exudate amounts, depth and presence of necrotic tissue or infection. The principal considerations in the selection of an appropriate dressing are:

(a) Presence of infection/slough;
(b) Amount of wound exudate;
(c) Depth of the wound;

Table 2. Types of Common Wound Dressings

Types of Dressing	Indications	Special Considerations	Examples
Films 	• Superficial lacerations • "Difficult" anatomical sites, e.g., over joints • Dry or minimally exudative wounds including thin burn wounds, venous catheter sites, donor sites for split skin grafts or partial-thickness wounds • Can be primary or secondary dressings	• Skin around wound must be intact for a good seal • Can be used as a secondary dressing in combination with alginates or hydrofibres • Avoid in draining or infected wounds	• Tegaderm • Opsite
Non adherent dressings 	• Mainly used as a primary dressing on lightly exuding or granulating wounds • Painful or friable wounds • Wounds requiring application of topical medications	• May require secondary dressing • Strikethrough may occur with heavier level of exudates	• Primapore • Mepitel • Meloline
Hydrogels 	• Very dry and minimally exuding wounds • Necrotic wounds • Arterial ulcers • Dry venous ulcers • Warfarin-induced necrotic wound • Rheumatologic ulcers	• Gels may be squeezed directly into cavity and covered with a secondary dressing • Periwound skin may need protection from maceration (PP)	• Purilon • Duoderm hydroactive gel
Hydrocolloids 	• Dry and desiccated wounds • Abrasions • Necrotic eschars • Wounds with minimal exudates • Superficial or healing wounds	• Not recommended for highly exudative or infected wounds, diabetic foot ulcers and other wounds requiring frequent wound inspection • Beware fragile skin due to potential for maceration of surrounding skin • During application, foams size must be extended beyond wound edges to ensure good adherence • Silver can be applied under the hydrocolloid dressing centrally for antimicrobial effects	• Duoderm • Comfeel

Alginates 	• Recommended for highly exudative and deep wounds, e.g., chronic pressure ulcers • Can also be used for split skin graft donor site and • diabetic foot wounds • heavily exudative venous leg ulcers	• Users may experience foul odour but may be from seaweed rather than wound itself • Not recommended for use on dry wounds • Due to low tensile strength, avoid packing into deep sinuses • Can be used as part of a multilayer compression wrap on lower limbs	• Algisite • Algisorb • Seasorb • Kaltostat • Biatain Alginates
Hydrofibre 	• Moderate to heavily exudative wounds	• Not recommended for use in bleeding wounds, dry or necrotic wounds • Due to low tensile strength, avoid packing into narrow deep sinuses • Cost effective	• Aquacel • Aquacel-Ag • Aquacel-Ag rope
Foams (polyurethranes or silicone) 	• Wide range of moderate to highly exudative wounds • Wounds subjected to sustained or unrelieved pressure	• Occlusive foams without silver should not be used on infected wounds • Not suitable for dry or eschar covered wounds • May require secondary dressing to keep in place	• Allevyn, • Allevyn Gentle • Mepilex Ag • Mepilex Lite • Biatain Ag • Hydrasorb
Cademoxer iodine 	• Chronic exuding infected wounds • Infected diabetic ulcers • Pressure ulcers	• Beware hypersensitivity to iodine • May need systemic antibiotics if evidence of deeper tissue infection	• Iodosorb powder, ointment and paste
Silver barrier dressing 	• Infected wounds especially when antibiotic resistance is a concern	• May need systemic antibiotics if evidence of deeper tissue infection • Silver absorbed into the skin may cause argyria, which is a permanent depigmentation of skin	• Silver Nitrate • Silver sulphadiazine • Ionic silver available in acticoat

Gauze 	• Highly exudative wounds • Useful as a secondary dressing[1]	• May adhere to viable areas of wound bed and cause pain during removal	• Gauze • Vaseline gauze • Xeroform and • Telfa

(Source: Adapted from Lee M G et al. Wound Dressings: A primer for the Family Physician)

(d) Phase of wound healing;
(e) Characteristics of wound dressings;
(f) Frequency of application, change and removal;
(g) Need for secondary dressing; and
(h) Contraindications to dressing used, e.g., allergies.

Wound dressings are described as primary where materials are placed into wound beds and interact with the actual wound surface, while secondary dressings refer to those that cover and secure the primary dressings in place. The most fundamental step is to understand the properties of each category of wound dressing and therefore appreciate their indications (Table 2). To simplify the wound dressing selection process, a schematic flow chart that highlights the key elements of wound assessment, and matching dressing properties to the different wounds is presented in Figure 2.[11]

Dressings can be classified into six categories:

i. Film dressings
Examples are opsite and tegaderm which are familiar to many FPs. These dressings protect areas from friction and shear forces, and are impermeable to bacteria and contaminants. They are indicated for superficial lacerations; minimally exudative wounds, e.g., thin burn wounds; difficult anatomical positions, e.g., joints. They can also be used to secure and protect dressings, IV catheters and tubing. They should be avoided in draining or infected wounds.

ii. Simple island dressings
Examples are primapore and medipore + pad. These dressings contain a central pad of cellulose material to absorb any oozing, and are excellent over wounds closed by primary intention. They should not be used on open wounds.

iii. Non-adherent dressings
Examples are Urgotul, Melolin, Primapore, Opsite post-op, Mepitel One, Non-adhesive Allevyn. Composed of porous silicone or tulles, these dressings are designed specifically to not stick to drying secretions on the wound, minimise damage to newly formed surrounding skin, and be placed directly on the wound site for several days. They cause less pain and trauma on removal. For example, non-adherent dressings would be suitable for healthy venous leg ulcers. Other indications are for use on skin grafts, surgical wounds, partial thickness wounds, skin tears, traumatic wounds, abrasions, lacerations, vascular wounds.

iv. Moisture-retentive dressings
Examples of moisture-retentive dressings are hydrogel and hydrocolloid dressings. Hydrocolloid dressings are made of gelatin, pectin and carboxymethylcellulose (CMC) particles and develops gelling forms when they interact with wound exudates. Common brand names include Comfeel and Duoderm. Hydrogels are available as amorphous gels containing 60-75% water and can be spread over dry necrotic/sloughy wounds to provide a moist environment that promotes autolytic debridement. Common brand names are Purilon gel, Intrasite gel and Duoderm hydroactive gel. Moisture-retentive dressings are suitable for dry, minimally exudative, necrotic eschars, partial thickness wounds and granulating wounds.

v. Absorbent dressings
Examples of absorbent dressings are alginate, hydrofibre and foam dressings. Absorbent dressings are important in the management of moderate to heavily exudative wounds by absorbing exudates whilst minimally adhering to the wound bed.[12] They are available in sheets, ribbons, beads or pads. Alginates are composed of calcium or sodium salts of alginate (a brown seaweed component). When in contact with the wound, the calcium in the dressing is exchanged with sodium from the wound fluid creating sodium alginate gel that is able to absorb up to 20 times its own weight, hence it is suitable to be used on wounds with moderate to heavy level of exudate. The haemostatic properties of alginates also make them suitable for minor bleeds. Some have added silver for antimicrobial effects. Alginate dressings can be used to debride sloughy wounds or fill a cavity but should always be covered with a secondary dressing. Common brand names are Kaltostat, Algisite, Algisorb and Seasorb.

Hydrofibre dressings are made of sodium CMC fibres that absorb and lock in exudates and bacteria within the fibres and transform into a cohesive gel on contact with wound exudates that conforms to the wound surface. They are suitable for moderate to heavy exuding wounds and promote autolytic debridement of devitalised tissue. They are available as ropes/ribbons that can be packed into undermined areas.

Some have added silver for its antimicrobial properties. Common brand names are Aquacel and Aquacel Ag.
Foam dressings are semi-occlusive dressings manufactured as polyurethrane or silicone foams. They are non-adhesive and much thicker than most other dressings. Being soft and conformable, they can provide padding over bony prominences such as heel, ankle, sacrum and hip. Foams are also absorbent and can be used over mildly and moderately exudative wounds. They have an additional benefit of providing thermal insulation and moisture vapour and oxygen to the wound, allowing for enhanced rates of wound healing.[13] Some have added silver for antimicrobial effects and they can last up to seven days. Common brand names are Allervyn, Aquacel Foam, Mepilex Lite, Mepilex Ag.

vi. Antimicrobial dressings
Critically colonised or infected wounds have impaired wound healing. Antiseptic wound irrigation solutions such as Prontosan and Octenisept are effective antimicrobial agents to disrupt biofilm and wound debris for cleansing, rinsing and moisturising of acute and chronic skin wounds.

Cademoxer iodine has broad-spectrum bacteriostatic activity against organisms, including *Staphylococcus aureus* and *Pseudomonas aeruginosa*. One gram of Cademoxer iodine is able to absorb up to 7ml of fluid, making it a useful dressing for infected wounds. It is available in powder, ointment and paste form. Iodine may be absorbed systemically and should be avoided in patients with thyroid disorders.

Silver comes in many different forms including elemental, inorganic and organic silver, available in various formulations. It combines properties of broad-spectrum antimicrobial action, and toxin and odour control. Upon exposure to moisture, the inert metallic silver (Ag0) is converted to the reactive silver ion, Ag+, which is the active antimicrobial agent. Once it comes in contact with wound exudate, there is an exchange of Ag+ (dressing) with negatively charged particles such as DNA, RNA and chloride ions. Its broad-spectrum bactericidal action covers gram-positive, gram-negative bacteria, yeast and fungi, including *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Silver is not only of low toxicity to skin but rates of bacteria resistance to Ag+ have been found to be extremely low. Silver preparations are available in the form of silver nitrate and silver sulfadiazine and nanocrystalline silver technology. Whilst in the past silver nitrate preparations had to be applied up to 12 times a day to maintain its effectiveness, the newer preparations can exert effects that last up to seven days. A major disadvantage of silver product is its potential to cause discolouration or irritation to surrounding skin (argyria).

Topical antibiotics should not be used because they allow colonisation of wounds by resistant organisms and select for antibiotic resistance.[14]

Finally, it may not be cost-effective for FPs to stock many types of expensive dressings, if the demand is weak. One should stock dressings commonly used in his setting. For example, non-adherent dressings such as melolin would be a good choice if one manages mainly lacerations, abrasions and surgical wounds. Patients are often supplied with stocks of expensive dressings upon hospital discharge, and these should be consumed first.

CONCLUSION

It is essential for family physicians to be confident and competent in managing chronic wounds in their home care patients. The critical first step is always a good wound assessment to determine the characteristics of the wound and identify risk factors for poor healing. Management involves local wound bed preparation based on TIME principles and selecting the most appropriate wound dressing to enhance wound healing. No single dressing fits all wounds. The FP needs to constantly review the wound and use the most appropriate dressing as the wound evolves and heals.

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LEARNING POINTS

- **The approach to chronic wounds needs to be patient-centred. In addition to wound factors, the social circumstances, finances, function and care environment of the patient will affect wound healing and selection of wound dressing.**
- **Optimise the local wound bed using TIME principles that emphasise judicious debridement, management of exudate, and resolution of bacterial imbalance to remove local barriers to healing and accelerate endogenous healing.**
- **The right wound dressing needs to match the wound's exudate amounts, depth and presence of necrotic tissue or infection.**