Using the diabetic foot ulcer aetiology-specific T.I.M.E. clinical decision support tool to promote consistent holistic wound management and eliminate variation in practice

Authors:
Harikrishna K. R. Nair, Dr Gurpreet Kaur

The T.I.M.E. clinical decision support tool (CDST) (Moore et al, 2019; World Union of Wound Healing Societies, 2020) is based on the well-established T.I.M.E. wound bed preparation framework (Schultz et al, 2003). The tool has been further developed to help support clinicians decide the treatment plan for different wound aetiologies – namely venous leg ulcers, pressure ulcers/injuries, diabetic foot ulcers (DFUs) and dehisced surgical wounds. In this article, a non-wound care specialist (medical officer) used the DFU aetiology-specific T.I.M.E. CDST to help guide wound bed preparation, dressing selection and ongoing management. This article describes the experiences of using the DFU T.I.M.E. CDST among four patients treated in the wound care clinic at Kuala Lumpur Hospital, Kuala Lumpur, Malaysia.

Harikrishna K. R. Nair, *Head, Wound Care Unit, , Department of Internal Medicine, Kuala Lumpur Hospital, Malaysia;* ***Dr Gurpreet Kaur,*** *Medical Officer, Wound Care Clinic, Department of Internal Medicine, Kuala Lumpur Hospital, Malaysia.*

Inconsistencies in wound care practices have been highlighted in the literature (Guest et al, 2015). Suboptimal wound assessment contributes to a delay in healing and misused resources, while exposing patients to unnecessary risk (Johnson, 2015). Delays in wound healing can lead to a failure to recognise deterioration and/or seek timely advice, increasing the likelihood of poor treatment choices (Dowsett and Hall, 2019).

Tools that incorporate evidence-based wound management and provide a structured approach to wound care can assist accurate and comprehensive wound assessment, and would be beneficial to promote consistent holistic wound management and eliminate variation in practice (World Union of Wound Healing Societies [WUWHS], 2016).

T.I.M.E. clinical decision support tool

The T.I.M.E clinical decision support tool (CDST) was developed with input from an international group of experts to provide support to health care professionals making clinical decisions, while reducing variation in practice and helping to improve wound outcomes *[Box 1]*. Holistic wound care and the involvement of a multidisciplinary team are central features of the T.I.M.E. CDST.

In 2019, a multi-centre clinical evaluation of the T.I.M.E. CDST was conducted at four different centres: two in Australia (Swanson et al, 2019; Carville et al, 2019) and one in Canada (Woo, 2019) and Denmark (Jelnes et al, 2019). The wound care specialist at each centre asked non-specialists to use and evaluate the tool on five different patients over a 4-week period and report how the T.I.M.E. CDST influenced practice. The tool provided a structured wound management approach supporting non-specialists and encouraging consistency of care and better patient outcomes (Blackburn et al, 2019).

Development of aetiology-specific T.I.M.E. CDSTs

The T.I.M.E. CDST has since evolved into aetiology-specific tools, which retain the essence of the original T.I.M.E. CDST, but with specific management prompts for four different wound aetiologies – venous leg ulcers, pressure ulcers/injuries, diabetic foot ulcer (DFU) and surgical dehisced wounds.

All aetiology-specific tools follow the same principles of the original T.I.M.E. CDST tool by using an 'ABCD and E' approach to facilitate clinical decision-making:

A Assessment of the patient, wellbeing and wound

Box 1. Timeline of the T.I.M.E. clinical decision support tool

- T.I.M.E. concept developed to provide a structured approach to wound bed preparation – Tissue (non-viable or deficient), Infection/Inflammation, Moisture balance and Edges of wound non-advancing (Schultz et al, 2003)
- A survey of delegates at the 2018 European Wound Management Association conference identified that although T.I.M.E. is universally the most widely used assessment tool, 40% of respondents reported that they did not use any formal framework to guide wound bed preparation in practice (Ousey et al, 2018)
- The T.I.M.E. clinical decision support tool (CDST) evolved from the T.I.M.E. wound bed preparation concept with the aim to help guide an holistic patient–wound approach. The tool addresses the elements of holistic assessment and management and the importance of patient involvement to help eliminate variation in practice (Moore et al, 2019; WUWHS, 2020). The tool was developed and endorsed by an international group of experts.
- The aetiology-specific T.I.M.E. CDSTs for venous leg ulcers, pressure ulcers/injuries, diabetic foot ulcer and dehisced surgical wounds were developed in conjunction with input from tissue viability nurses from the United Kingdom and wound, ostomy and continence nurses in the United States of America.

B Bringing in a multidisciplinary team and informal carers to promote holistic patient care
C Controlling and treating the underlying causes and barriers to wound healing
D Deciding on the most appropriate wound treatment to implement and the desired wound management outcome
E Evaluation and reassessment of how the wound is progressing and if the wound management goals have been achieved.

The aetiology-specific T.I.M.E. CDSTs were developed in conjunction with input from tissue viability nurses from the United Kingdom and wound, ostomy and continence nurses in the United States of America. The purpose of the aetiology-specific T.I.M.E. CDSTs is to provide aetiology-specific content in sections A, B, C of the tools, to provide images of associated wound types and to include treatments that may be specific to wound aetiology in section D. There are two versions of the DFU aetiology-specific T.I.M.E. CDST: one that includes Smith + Nephew products *[Figure 1]*, and one that does not specify a particular product, which can be adapted to local formularies *[Figure 2]*.

Evaluating the DFU aetiology-specific T.I.M.E. CDST

Enabling non-wound care specialist staff to conduct wound care and treatment planning may promote consistent holistic wound management, as well as alleviate the burden on specialist staff in managing these patients.

Setting: Wound care clinic, Kuala Lumpur Hospital, Kuala Lumpur, Malaysia

This article focuses on the experiences of a non-wound care specialist using the DFU aetiology-specific T.I.M.E. CDST *[Figure 1]* in the management of four patients with DFUs at the Wound Care Clinic, Kuala Lumpur Hospital in Malaysia. In 2020, the unit cared for over 20,000 patients. The majority of patients are outpatient cases and the remainder are referred as inpatients from the various specialities, especially from the Department of Internal Medicine. The majority of cases seen by the Wound Care Clinic are DFU as diabetes mellitus occurs in 20% of the population above the age of 30 years (Hussein et al, 2015).

Non-wound care specialist

The non-wound care specialist involved in the evaluation was a Medical Officer (physician). They were offered the opportunity and volunteered to participate in the evaluation of the DFU T.I.M.E. CDST. The wound care specialist (HKRN) was available to discuss clinical decisions throughout the evaluation period, and the non-specialist received on-site training as well as practical teaching. Specialist nurses and doctors were on-hand to provide bed-side support in the clinic and the wards. The non-specialist was also provided with a reference guide on wound care dressings to refer to.

Protocol

Following diagnosis from the wound care specialist, the DFU T.I.M.E. CDST was used by the non-specialist at each review to guide wound bed preparation and dressing selection, alongside local protocols and guidelines. Where products listed in the tool were not available, the clinician used a product according to local protocol. Each patient was monitored

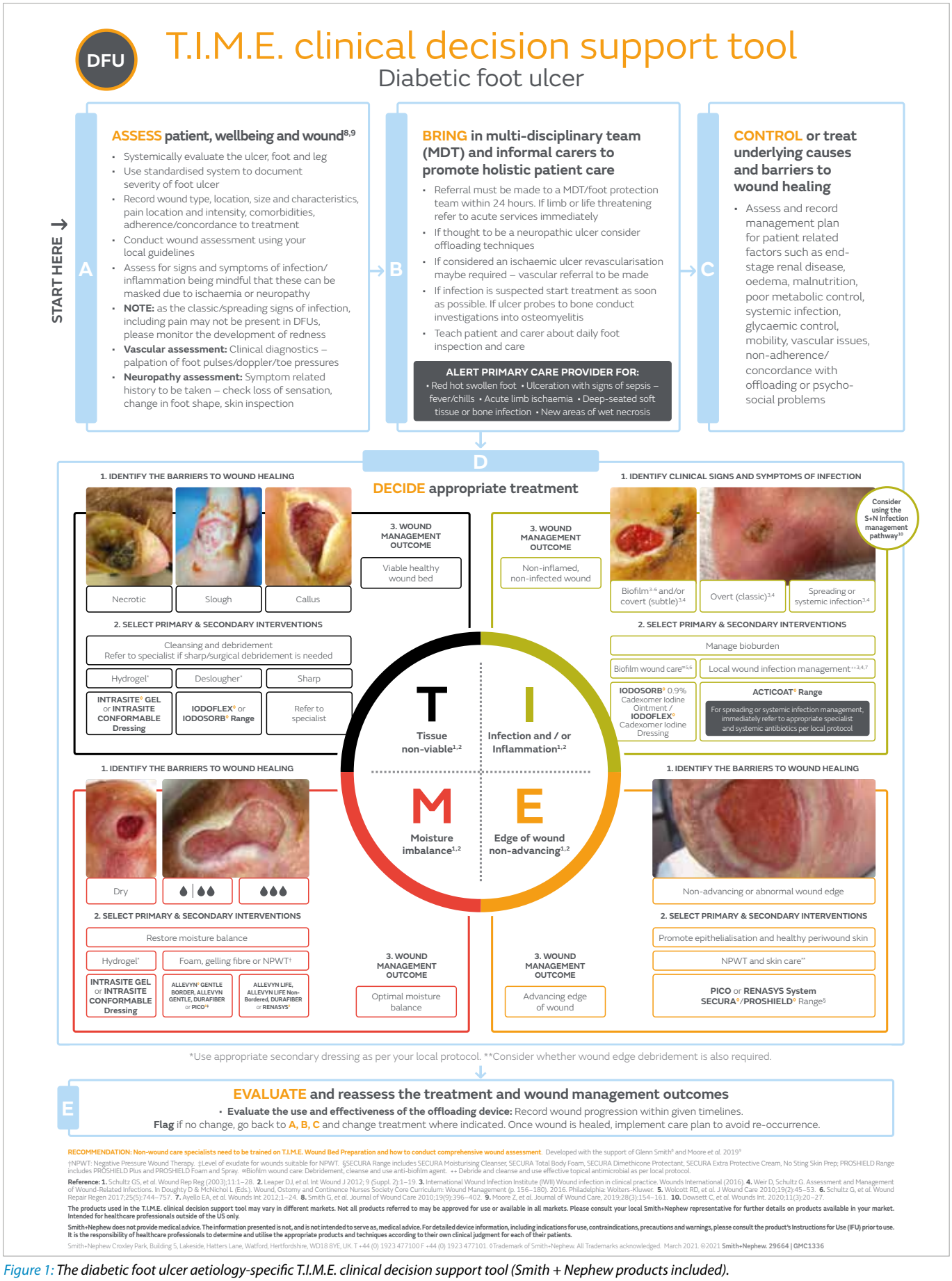

Figure 1: The diabetic foot ulcer aetiology-specific T.I.M.E. clinical decision support tool (Smith + Nephew products included).

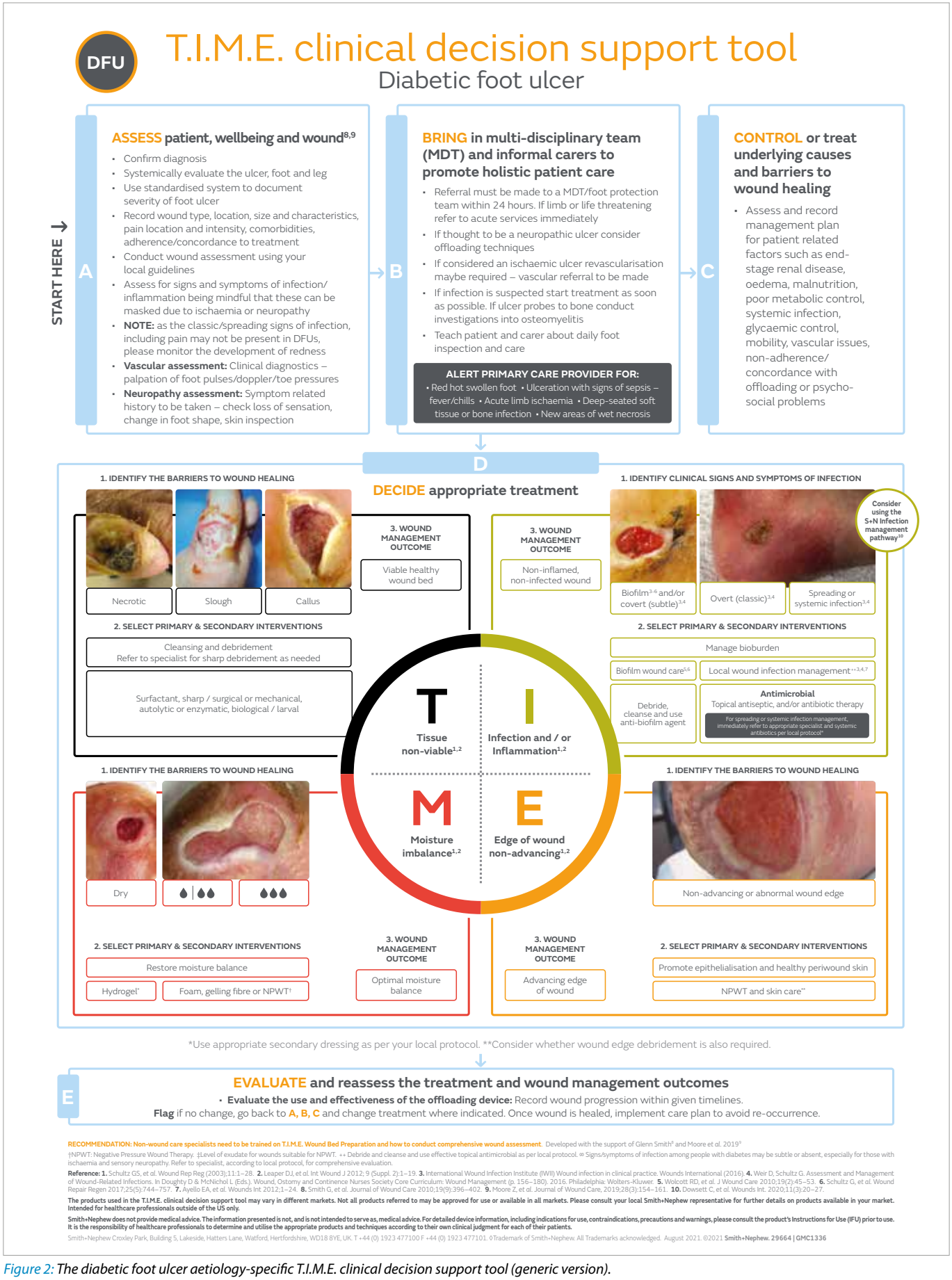

Figure 2: The diabetic foot ulcer aetiology-specific T.I.M.E. clinical decision support tool (generic version).

Case 1: Ulcer following post-traumatic blister and ray amputation of the fourth toe.

Figure 3: Baseline

Figure 4: End of week 4.

and reviewed for up to 4 weeks using the DFU T.I.M.E. CDST. Parameters of wound healing were recorded each week, such as wound size, condition of the wound bed, how the wound is progressing and the degree to which the wound management goals have been achieved.

Case 1: Ulcer following post-traumatic blister and ray amputation of the fourth toe

Assess patient, wellbeing and wound

The patient was a 49-year-old female with a history of type 2 diabetes. She presented with a ulcer on the dorsum of her left foot, following a post-traumatic blister and ray amputation of the fourth toe *[Figure 3]*. The results of a foot and skin assessment indicated a degree of neuropathy; the patient rated pain at 2 out of 10 on a visual analogue scale (VAS; 0 = no pain and 10 = unbearable pain) and was taking paracetamol. An ankle-brachial index (ABI) of 1.0 and 0.9 was recorded for the left and right foot, respectively, which eliminated the presence of peripheral arterial disease. The wound measured 7.5cm (length) x 5.5cm (width) and was classified with a University of Texas (UT) Staging System for Diabetic Foot Ulcer (Lavery et al, 1996) score of 2A *[Table 1]*. She was able to carry out activities of daily living using a walking stick for support.

Bring in multidisciplinary team and informal carers to promote holistic patient care

To promote holistic care, follow-up was planned at the general health clinic. The patient was also referred to the orthopaedic clinic to access appropriate footwear after ray amputation. The patient and carer were also taught about wound care and how to conduct daily foot inspections. The patient was referred to the dietician to help support their nutrition.

Control or treat underlying causes and barriers to wound healing

The aim of treatment was to manage and treat the underlying causes and barriers to wound healing via diabetes management and dietary support.

Decide appropriate treatment

Using the DFU aetiology-specific T.I.M.E. CDST, the main barriers to healing that needed to be addressed were non-viable tissue and non-advancing edges.

T = The wound bed comprised 80% granulation tissue and 20% slough
I = No signs of infection were present
M = Moderate level of exudate
E = Edges were non-advancing.

The aims of wound care were to remove the non-viable sloughy tissue and promote wound edge advancement. The wound was sharp debrided with a scalpel to physically remove slough and cleansed with sterile water and a multi-purpose moisture barrier cream was also applied around the wound edges. An enzymatic debriding ointment was applied and the wound bed was covered with a low-adherent absorbent dressing.

Evaluate

At the end of the 4-week period, the wound had reduced in size – 4.8cm (length) x 2cm (width) – and was on a healing trajectory as the level of slough had reduced. The wound bed comprised 90% granulation tissue and 10% sloughy tissue, there was moderate exudate and the wound edges were advancing *[Figure 4]*. The wound care plan and management of diabetes continued as before (including daily foot inspection and self-monitoring of blood glucose at home). The patient was provided with custom-fit shoes with modified insoles to support healing and offloading of the ulcer area.

Case 2: DFU on the dorsal aspect of the right first toe

Assess patient, wellbeing and wound

A 38-year-old female presented with a history of type 2 diabetes, hypertension and iron-deficiency

Table 1. TEXAS Foot Score Classification (Lavery et al, 1996).

		Grade			
		0	1	2	3
Stage	A	Pre-ulcerative lesions No skin break	Superficial wound No penetration	Wound penetrating or tendon capsule	Wound penetrating bone or joint
	B	With infection	With infection	With infection	With infection
	C	With ischemia	With ischemia	With ischemia	With ischemia
	D	With infection and ischemia	With infection and ischemia	With infection and ischemia	With infection and ischemia

Case 2: Ulcer on the dorsal aspect of the right first toe.

Figure 5: First presentation

Figure 6: End of week 4.

anaemia. She had an ulcer at the dorsal aspect of her right first toe following the incision and drainage of an abscess 11 days previous. The wound measured 8cm (length) x 1.5cm (width) with superficial depth and was classified with a UT score of 1A. The wound had previously been treated with iodine, hence the yellow discolouration of the wound *[Figure 5]*.

The patient rated her wound pain relatively low (3 out of 10 on a visual analogue scale; 0 = no pain and 10 = unbearable pain), which suggested a neuropathic element to the wound aetiology. The patient was not taking analgesia.

Dorsalis pedis artery (DPA) and the posterior tibial artery (PTA) were palpable, and a Doppler triphasic wave was recognised for the left foot. An ABI of 1.2 and 1.1 were recorded for the left and right foot respectively, indicating that there was no presence of peripheral arterial disease. She was able to conduct activities of daily living independently.

Bring in multidisciplinary team and informal carers to promote holistic patient care

The patient was referred to the diabetes clinic for ongoing diabetes support and to the dietician's department for dietary support. In addition, the patient and carer were taught about daily foot inspection and care.

Control or treat underlying causes and barriers to wound healing

The aim was to control and treat the underlying causes and barriers to wound healing. This included ensuring good diabetes management (i.e. an HbA_{1c} of less than 6.5% [48mmol/mol]), a nutritional diet, daily foot inspection, skin and toenail care and frequent exercise. Shoes with modified insoles were provided.

Decide appropriate treatment

Using the DFU aetiology-specific T.I.M.E. CDST, the main barriers to healing that needed to be addressed were infection and moisture balance.

T = Tissue was viable, the wound bed comprised 80% granulation tissue and 20% slough

I = Biofilm/covert (subtle) infection was suspected due to wound breakdown and enlargement and delayed healing (International Wound Infection Institute, 2016)

M = Moisture of the wound was rated moderate

E = Edges of the wound were advancing and mildly thickened.

To manage the clinical signs of biofilm, an antimicrobial selected according to local protocol, a sterilised medical-grade Manuka Honey gel, was applied to promote autolytic debridement, remove the biofilm and slough and ensure adequate moisture balance. An absorbent, atraumatic polyurethane foam dressing was applied as a secondary dressing.

Evaluate

To aid final wound closure and encourage wound edge advancement, the wound was cleansed with sterile water and a hydrogel consisting of modified collagen and glycerine was applied to expedite wound edge advancement for wound healing. The management plan included continuous blood glucose monitoring, follow-up with the dietician for dietary support, daily foot inspection and toenail care, daily exercise and wearing of shoes provided.

At the end of the 4-week period, the wound had reached full wound closure *[Figure 6]*.

Case 3: Neuropathic ulcer following second toe amputation

Assess patient, wellbeing and wound

A 73-year-old female patient with a history of type 2 diabetes and hypertension presented with an neuropathic ulcer on the left foot that had developed following ray amputation of the second digit. The toe had been amputated due to necrotising fasciitis with wet gangrene.

A foot assessment identified peripheral diabetic neuropathy bilaterally. There was no foot deformity or changes to the skin condition. DPA and the PTA were palpable, and an ABI of 1.0 was recorded for the left foot and 1.1 for the right. The wound measured 15cm (length) x 5cm (width) x 1cm (depth) and was classified with a UT score of 1B *[Figure 7]*. The patient rated their wound pain at 3 out of 10 on a visual analogue scale (VAS; 0 = no pain and 10 = unbearable pain) despite evidence of neuropathy and was taking paracetamol.

The patient had been able to live semi-independently and used a walker.

Bring in multidisciplinary team and informal carers to promote holistic patient care

The patient was referred to the diabetes specialist for diabetes management support (HbA_{1c} 10% [86 mmol/mol]).The patient and carer were taught about daily foot inspection and care and to also consider offloading the foot.

Control or treat underlying causes and barriers to wound healing

To control and treat the underlying causes and barriers to wound healing, the patient was

Case 3: Neuropathic ulcer following second toe amputation.

Figure 7: Baseline before cleaning

Figure 8: End of week 4

supported to manage their diabetes and given dietary supplementation (a high protein diet and vitamin C). They were educated to conduct daily foot inspections and conduct foot skin and toenail care. They were also provided with appropriate and protective footwear, i.e. a shoe with customised insoles and a filler.

Decide appropriate treatment

Using the DFU aetiology-specific T.I.M.E. CDST, the main barrier to healing that needed to be addressed was moisture balance and non-advancing wound edges.

T = Tissue was viable; the wound bed comprised 80% granulation tissue and 20% slough
I = There were signs of new wound pain, indicating the presence of infection
M = Moderate moisture was present
E = The wound edge was non-advancing, and the periwound skin was macerated.

The wound was sharp debrided with scalpel and a moisture barrier cream was applied to the wound edge for protection. A prophylactic non-adherent wound contact layer with honey was applied to the wound bed, followed by a secondary low-adherent absorbent dressing (Melolin, Smith + Nephew).

Evaluate

At each dressing change, over the wound was mechanically debrided and cleansed with sterile water. At week 4, the honey dressing was changed to a soft-adherent foam dressing containing a protease inhibitor. A moisturising lotion containing high concentrations of modified collagen and glycerine was applied to the periwound skin to protect the skin and reduce maceration.

Follow-up at the wound care clinic, dietician and health care clinic were recorded on the management plan, along with blood glucose monitoring at home, daily foot inspection and bilateral lower limb physiotherapy, which was introduced at week 3.

At the end of the 4-week period, the wound had reduced in size and there were improvements to the composition of the wound bed. The wound measured 11cm (length) x 2cm (width) with superficial depth *[Figure 8]*. The wound was also no longer painful and the patient was able to continue activities of daily living.

Case 4: Neuropathic ulcer on the plantar aspect of the left foot

Assess patient, wellbeing and wound

A 30-year-old male with type 2 diabetes presented with a neuropathic ulcer that had begun as a corn 9 months previously on the plantar aspect of the left foot. The wound now measured 2cm (length) x 0.5cm (width) x 1cm (depth) and was classified as a UT score of 1A *[Figure 9]*.

A previous neuropathy assessment identified numbness towards the forefoot and hind foot; however, the patient rated wound pain at 4 out of 10 on a visual analogue scale (VAS; 0 = no pain and 10 = unbearable pain), which indicated new pain. An ABI of 0.9 was recorded for the both the left and right foot; and the DPA and the PTA were both palpable.

The patient was wearing orthopaedic footwear for the past 2 years to continue his active job, and was prescribed insulin for glycaemic management.

Bring in multidisciplinary team and informal carers to promote holistic patient care

The patient was referred for further diabetes support at the diabetes clinic and to the dietician for nutritional advice. A specialist nurse sharp debrided the wound with a scalpel. The patient and carer were educated about foot, skin and toenail care, daily foot inspection and offloading.

Control or treat underlying causes and barriers to wound healing

To control and treat the underlying causes and barriers to wound healing, this included aiming for an HbA_{1c} of less than or equal to 6.5% (48mmol/mol), offloading with a suitable insole shoe.

Decide appropriate treatment

Using the DFU aetiology-specific T.I.M.E. CDST, the main barriers to healing that needed to be addressed were non-viable tissue, presence of suspected biofilm and edges non-advancing.

T = Tissue was viable, 90% yellowish callus and 10% red granulation tissue was identified
I = Biofilm/covert (subtle) infection was suspected due to delayed healing and new pain.
M = Moderate moisture present
E = Non-advancing edges due to thick callus around the ulcer.

The first step was to debride the callus; the wound care specialist nurse used a scalpel to sharp debride the wound. A multi-purpose moisture barrier cream was applied around the edges. The wound was cleansed with saline and an antimicrobial dressing was applied to manage the infection, along with a synthetic padding bandage for offloading.

Case 4: DFU on the plantar aspect of the left foot.

Figure 9: Baseline before debridement

Figure 10: 4-week review before debridement

Evaluate

Over the 4-week evaluation the wound continued to be sharp debrided by a specialist nurse and cleansed with sterile water. The wound was dressed with a collagen dressing and a synthetic padding bandage was applied to offload the wound.

After 4 weeks, the wound had reduced in size and now measured 1.3cm (length) x 0.4cm (width) x 0.2cm (depth) *[Figure 10]*. The wound bed tissue comprised 80% callus and 20% granulation tissue, and there were no signs of infection. The patient had no wound pain and was able to do light physical tasks at work during healing. The national lockdowns due to the COVID-19 pandemic enabled the patient to rest at home and offload the wound. The ongoing management plan included referral for a total contact cast, follow-up at the health clinic and dietician's clinic, weekly infrared light therapy for pain relief were part of the management plan, and support to conduct home self-monitoring of blood glucose and daily foot inspection.

Discussion

In this case series, the DFU T.I.M.E. CDST helped to guide a comprehensive MDT approach for DFU management. The non-specialist felt the tool supported their decision making, enhanced their confidence as a non-specialist to make decisions and enabled them to make more consistent use of the dressings and products available to them.

For any strategy to be effectively implemented, education and training needs to be in place to support uptake by all healthcare professionals and support staff. In the case of the T.I.M.E. CDST, all should be familiar with the relevance of the ABCD and E approach, each element of wound bed preparation (i.e. T, I, M, and E) and their local protocols and products that are on their formularies.

Conclusion

The DFU T.I.M.E. CDST eased decision-making and guidance on appropriate treatment, allowed a systematic approach and aided communication between clinicians. For the non-specialist who used the DFU T.I.M.E. CDST in this case series, it provided consistent guidance on appropriate treatment and was particularly valuable in aiding communication between the non-specialist and members of the MDT. Tools, such as the T.I.M.E. CDST, can be used as part of a systematic and structured approach to wound management to promote consistent holistic wound management and eliminate variation in practice. WINT

Declaration

This case series has been supported by Smith & Nephew.

References

Blackburn J, Ousey K, Stephenson J (2019) Using the new T.I.M.E. Clinical Decision Support Tool to promote consistent holistic wound management and eliminate variation in practice: Part 5, survey feedback from non-specialists. *Wounds International* 10(4): 40–9

Dowsett C, Hall Y (2019) T.I.M.E to improve patient outcomes: optimising wound care through a clinical decision support tool. *Br J Community Nurs* 28(6): Tissue Viability suppl S17–21

Carville K, Snowball G, Westmorland L et al (2019) Using the new T.I.M.E. Clinical Decision Support Tool to promote consistent holistic wound management and eliminate variation in practice: Part 4 at the Silver Chain, Perth, Australia. *Wounds International* 10(4): 32–9

Guest JF, Ayoub N, McIlwraith T et al (2015) Health economic burden that wounds impose on the National Health Service in the UK. *BMJ Open* 5(12): e009283

Hussein Z, Taher SW, Gilcharan Singh HR et al (2015) Diabetes Care in Malaysia: Problems, New Models, and Solutions. *Annals of Global Health* 81(6): 851-62

International Working Group on Diabetic Foot (2019) *IWGDF Guidelines on the Prevention and Management of Diabetic Foot Disease.* Available at: https://bit.ly/38eFnIG (accessed 10.10.2019)

International Wound Infection Institute (IWII) (2016) *Wound infection in clinical practice*. Wounds International, London.

Jelnes R, Halim AA, Mujakovic A et al (2019) Using the new T.I.M.E. Clinical Decision Support Tool to promote consistent holistic wound management and eliminate variation in practice: Part 2 at Sjukhus Sønderjylland Hospital, Denmark. *Wounds International* 10(3): 40–7

Lavery LA, Armstrong DG, Harkless LB (1996) Classification of diabetic foot wounds. *J Foot Ankle Surg* 35(6): 528-31

Moore Z, Dowsett C, Smith G et al (2019) TIME CDST: an updated tool to address the current challenges in wound care. *J Wound Care* 28(3): 154-61

Ousey K, Gilchrist B, James H (2018) Understanding clinical practice challenges: a survey performed with wound care clinicians to explore wound assessment frameworks. *Wounds International* 9(4): 58–62

Schultz GS, Sibbald RG, Falanga V et al (2003) Wound bed preparation: a systematic approach to wound management. *Wound Rep Regen* 11(2): S1–28

Swanson T, Duynhoven K, Johnstone D (2019) Using the new T.I.M.E. Clinical Decision Support Tool to promote consistent holistic wound management and eliminate variation in practice at the Cambourne Medical Clinic, Australia: Part 1. *Wounds International* 10(2): 28–39

Woo KY (2019) Using the new T.I.M.E. Clinical Decision Support Tool to promote consistent holistic wound management and eliminate variation in practice at the West Park Healthcare Centre, Chronic Care and Rehabilitation Hospital, Canada: Part 3. *Wounds International* 10(3): 48–55

World Union of Wound Healing Societies (2020) *Strategies to reduce practice variation in wound assessment and management: The T.I.M.E. Clinical Decision Support Tool.* London: Wounds International. Available at: www.woundsinternational.com