TIME CDST: an updated tool to address the current challenges in wound care

Abstract: Despite the understanding that wounds are a common problem affecting the individual, the health service and society as a whole, there continues to be a lack of a systematic, structured, evidence-based approach to wound management. The TIME principle was first published in 2003,¹ and has since been integrated by many into clinical practice and research. However, this tool has been criticised for its tendency to focus mainly on the wound rather than on the wider issues that the patient is presenting with. At an expert meeting held in London in 2018, this conundrum was addressed and the TIME clinical decision support tool (CDST) was elaborated upon. This article introduces the TIME CDST, explains why it is required and describes how its use is likely to benefit patients, clinicians and health-service organisations. It also explores the framework in detail, and shows why this simple and accessible framework is robust enough to facilitate consistency in the delivery of wound care and better patient outcomes. Finally, it outlines the next steps for the rollout, use and evaluation of the impact of the TIME CDST.

Declaration of interest: This article is based on an expert group discussion held in October 2018. Smith & Nephew (S&N) provided MA Healthcare financial support to facilitate the group discussion. The authors were paid honoraria for their time in panel engagement. TS is an advisor for S&N. DW is a speaker for S&N. HJ is currently an employee of S&N.

clinical decision tool • hard-to-heal wound • chronic wound • TIME • wound healing

ounds and their associated problems pose an important healthcare challenge, with estimates suggesting a point prevalence range of 2-3.55 per 1000 population.² Annually, health-care budgets deliver a substantial financial investment in the management of wounds, for example, £5.3 billion in the UK alone.³ However, the work of Guest and colleagues explored the current provision of wound care within the UK and found that many individuals lack an accurate diagnosis and are often managed using an inappropriate treatment plan.³ This is of particular concern, given the morbidity and often mortality associated with hard-toheal wounds.⁴ Further, inappropriate management compounds the problem of wounds, with the mean patient care cost of an unhealed wound estimated at 135% more than that of a healed wound.⁵

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 Professor and Head, School of Nursing and Midwifery. Director, Skin Wounds and Trauma Research Centre, Royal College of Surgeons in Ireland, Dublin, Ireland. 2 East London NHS Foundation Trust, London, UK. 3 St Helens Medical Centre, Isle of Wight, UK. 4 Mid Yorkshire NHS Trust/University of Huddersfield, UK. 5 Hoag Hospital, Newport Beach, California, US. 6 Deputy Director, Geriatrics Research Group, Charité University Berlin, Germany. 7 Professor of Obstetrics and Gynecology, University of Florida, Gainesville, Florida, US. 8 Warrnambool, Victoria, Australia. 9 Bradford Teaching Hospitals NHS Foundation Trust, UK. 10 Catholic Health Advanced Wound Healing Centres, Buffalo, New York, US. 11 Associate Professor, University of Chicago, Illinois, US. 12 Global Medical Director Wounds, Smith & Nephew, London, UK. many in practice.^{6–8} However, the current gaps in practice⁵ indicate that there is a need for expansion to a simple framework for the assessment and management of chronic wounds, which incorporates the TIME paradigm. This will serve to help standardise wound care, both regionally and internationally, and thus improve outcomes, while also saving costs.⁹

The TIME principle¹ has been widely adopted by

The origins of TIME

At an expert meeting, the concept of 'TIME' was born in an endeavour to enhance the assessment and management of wounds using agreed criteria.¹ Research evidence at the time, synthesised by the expert group, highlighted the key differences between healing and hard-to-heal wounds, with particular emphasis placed on understanding the biological imbalances present in wounds that are hard-to-heal.¹ For example, fluid from hard-to-heal wounds was found to differ substantially from that of healing wounds, displaying an imbalance between the production of proteases and their inhibitors.¹⁰ This imbalance causes an excess production of proteases, such as matrix metalloproteinases (MMPs) and serine proteases, which impact negatively on the functionality of growth factors and extracellular matrix (ECM) proteins. As a result, there is inhibition in the proliferation of the essential cells required for wound healing.¹⁰ Given the distinct difference between healing and hard-to-heal wounds, from a cellular perspective, the requirement for a focused approach to correction of the imbalance within hard-to-heal wounds was seen as being of distinct importance.

The concept of TIME, which is familiar to most health professionals, incorporates: Tissue; Infection/

inflammation; Moisture; and Epidermis. It was set out to provide a framework by which clinicians could address the challenges within hard-to-heal wounds in a systematic way. In 2005, the 'E' character of the TIME paradigm was changed from 'epidermis' to 'edge of wound' (Table 1). The rationale for this change was to ensure that the focus was not just on a failure of the epidermis, but also on the potential for problems within the ECM, or with the cells at the wound edge itself.¹¹

Since its inception, the TIME principle has been widely adopted by many into practice and research.^{7,8,13-18} Indeed, a recent survey identified that TIME is the most commonly used wound assessment tool in Europe.¹⁹ Probably one of the key reasons why TIME proved to be a popular and enduring paradigm was that it guided health professionals towards the key elements to address in those with hard-to-heal wounds. Effective preparation of the wound bed was seen as central to successful wound healing, and a large evidence base has grown to support this premise.^{1,15,17,20–35} TIME has continued to be relevant as it is responsive to the developments in wound care, such as greater use of repetitive/ maintenance debridement,^{36,37} acceptance of the infection continuum and the concept of wound biofilms,38 and the development of advanced dressings/therapeutics such as negative pressure wound therapy (NPWT),³⁹ which were often designed specifically to address the 'M' and 'E' components of the paradigm. As such, the developments in wound management have helped reinforce the need for, and clinical relevance of, the paradigm.

Time to re-evaluate TIME

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Dowsett and Newton⁶ have always argued that the concepts of wound bed preparation (WBP) and TIME should only be considered in the context of whole patient assessment, accurate diagnosis, and ongoing evaluation of the outcomes of treatment interventions. For this reason, Dowsett and Newton⁶ advocated the use of what they termed a WBP care cycle. The cycle begins with the patient and addresses the achievement of an accurate diagnosis before planning the appropriate treatment, which is followed by a prevention pathway⁶ (Fig 1). This issue has also been addressed by others where limitations in the original TIME model were addressed to include both the local conditions of the wound and the general condition of the patient.¹⁷ The model is now known as the Modified TIME-H⁴⁰ and its clinical use has been established among 46 participants with wounds.⁴¹ Results of the evaluation showed the model to be a useful tool for assessment, patient-centred management and establishment of the prognosis for individuals with non-healing wounds.⁴¹

The importance of assessment and diagnosis is not novel, though research suggests that currently many patients lack an accurate diagnosis, and that social and patient-related factors are poorly addressed. As a result, patients are subject to protracted treatment regimens

Table 1. The TIME principles

1	Г	Tissue:	non-viable or	deficient
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- I Infection/inflammation
- M Moisture imbalance
- E Edge, which is not advancing or undermining
- (Dowsett and Ayello, 2004)12

which significantly adds to the burden of wounds. For example, Guest and colleagues⁵ identified that 30% of all wounds being managed within the NHS lacked a differential diagnosis. Furthermore, just 16% of patients with a lower leg ulcer, or diabetic foot ulceration. underwent a vascular assessment with Doppler ABPI. Other noted concerns were dressing and bandage types that were continually switched at successive wound dressing changes, indicating confusion and conflict within the treatment plan. These findings are not unique to the NHS. Work by Skerritt and Moore⁴² in Ireland identified a similar trend. The majority of wounds in their study (79%; n=148) were found not to have a problem with exudate. However, of these lowexuding wounds, 31% (n=46) were dressed with an absorptive dressing. In addition, in 76% (n=144) of patients no infection was suspected in their wounds. Of these non-infected wounds, an antimicrobial dressing was used as the primary wound dressing in 42% (n=61) of cases.⁴² From a surgical site infection perspective, further work from the UK and the Netherlands indicated a lack of a standardised approach to wound management.^{43,44} In the study by McCaughan et al.,⁴³ wound-associated factors were found to have a profoundly negative impact on daily life, physical and psychosocial functioning, and wellbeing. Furthermore, participants expressed dissatisfaction with a perceived lack of continuity and consistency of care in relation to wound management.

The implications of poor management of wounds are far-reaching and involve both the individual patient and the health system as a whole. The work of Guest



Fig 1. The wound bed preparation care cycle from Dowsett and Newton⁶

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and colleagues⁵ estimated that resources consumed in managing unhealed wounds are significantly greater than those in managing healed wounds. The authors highlighted that hard-to-heal wounds required an extra 20% more practice nurse visits and 104% more community nurse visits.⁵ As a result, the economic estimates suggested the annual cost of managing wounds that healed was £2.1 billion, compared with £3.2 billion for the 39% of wounds that did not heal within the study year. Thus, non-healed wounds consumed a mean 135% more patient care costs compared with those of healed wounds.⁵ Given these resource implications, it is imperative that a more focused approach to wound management is adopted, particularly as these resources are set to increase exponentially, in line with the increasing age of the population and the association between ageing and the development of multisystem comorbidities.45

For these reasons, it has recently been debated as to whether the TIME paradigm should be revised further to address current challenges in wound care, with a key consideration being the variations and lack of standardisation in the delivery of wound care. Further, it was felt that a simple, clinically-led, internationally accepted, one-page tool could help address this theory/ practice gap.

Expansion of TIME

A criticism of the TIME paradigm was that it was too wound focused and not patient-centred enough.⁶ Therefore a priority was to ensure that the revised TIME framework would address this issue. It was subsequently decided to develop the TIME paradigm into a more process-led framework covering all aspects of assessment and management within the wound trajectory.

As a first step, a survey was undertaken by attendees of the European Wound Management Association (EWMA) 2018 conference in Krakow, Poland.¹⁹ Following an iterative review of the literature, a survey instrument was developed to explore current practice on standard wound care and the use of woundassessment frameworks to identify ways for improvement in wound care diagnosis, management and healing outcomes. It included 20 questions, including a screening section of four questions and the questionnaire itself (16 questions) exploring attitudes and clinical practice in chronic wound care. The survey was presented in an electronic form (tablet) and took, on average, seven minutes to complete.¹⁹ The aim of the survey was to establish areas for improvement in wound care diagnosis, management and healing outcomes and to use this information as a basis for further development of TIME. A total of 300 participants were invited to complete the survey and a response rate of 83% (n=250) was realised. Although TIME was the most commonly used assessment tool (51%; n=128), 40% (n=100) of participants reported that they did not use a formal wound assessment tool. Further, among those who reported using a tool, the application of the tool was often inconsistent and erratic. Interestingly, despite the growing evidence base regarding the impact of biofilms on wound healing,⁴⁶ 40% (n=100) of respondents underestimated the amount of chronic wounds containing biofilm.¹⁹ The role of wound debridement in the management of hard-to-heal wounds has evolved significantly over the past number of years.³⁷ However, among the respondents there seemed to be a lack of integration of this knowledge into practice. This was evidenced by the fact that most reported primarily using autolytic debridement techniques.¹⁹ Regarding the ideal assessment framework, there was congruence among the respondents that this should be easy to use, accurate and practical for use among diverse health professionals. Furthermore, the framework should guide the assessor consistently through the assessment and reassessment processes, so that the most appropriate therapeutic intervention can be selected.19

Results from the survey informed the development of the first draft of the TIME clinical decision support tool (CDST). This draft was then assessed and fine-tuned by an international group of expert clinicians at a consensus meeting, in London, in October 2018. The meeting was supported by Smith & Nephew and the *Journal of Wound Care*.

Given their importance, performing a holistic patient assessment and involving a multidisciplinary team (MDT) as appropriate were the initial starting elements, followed by wound assessment and treating the elements of TIME that are impeding wound healing.¹⁸ The final element was the evaluation of the wound management. Therefore, the TIME CDST offers an A, B, C, D and E approach as follows:

- Assess: accurate assessment, measurement and diagnosis of the patient and their wound
- Bring: bring in the MDT to promote holistic care
- Control: control and treat systemic causes
- Decide: decide appropriate treatment
- Evaluate: evaluate treatment and wound management goals (Fig 2).

Evidence base for the CDST elements

Each of the CDST elements (A, B, C, D and E) has a solid evidence base to support their inclusion in the TIME CDST. For example, in terms of 'A', accurate and ongoing patient and wound assessment are the foundation for the development of an effective wound management strategy.47 However, in the study by Guest et al.,⁵ less than 50% of wounds healed, with lack of a diagnosis being an important contributing factor, and this was compounded by the failure to undertake a holistic patient and wound assessment. Given the importance of this issue, and to address the challenges in achieving consistent assessment for individuals with wounds, the Commissioning for Quality and Innovation (CQUIN) framework, introduced by the Department of Health and Social Care, specified 'Improving the assessment of wounds' as a key goal of the CQUIN



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scheme for 2017–2019.⁴⁸ Fundamentally, the aim of this goal is to improve patient and wound outcomes and, in doing so, to reduce unnecessary health-care expenditure.⁴⁸ A key element to achieving this goal is to ensure that consideration is also given to understanding the patient's perspective pertaining to their wound and the impact that this has on their life. In placing attention on understanding what the patient wants/is willing to do regarding their treatment plan, the patient will have access to the right services and the right information, which will give them the knowledge and confidence to make informed decisions about their own care.⁴⁹

Patient safety is at the centre of all health-care interventions, meaning that healthcare providers have to demonstrate an evidence-based, cost-effective and efficient rationale for the choice of specific care pathways for individual patient groups.⁵⁰ The World Health Organization (WHO) argues that professionals who actively bring the skills of different individuals together, with the aim of clearly addressing the healthcare needs of patients and the community, will strengthen the health system and lead to enhanced clinical and health-related outcomes.51 Indeed, a number of systematic reviews and individual clinical studies have noted a positive impact in the use of MDTs for a variety of clinical conditions, including wounds of varying aetiologies. As such, the B within the TIME CDST is based upon this evidence base.

It is well known within both clinical practice and research that to appropriately manage individuals with wounds the next step following assessment and diagnosis is to address and modify the underlying causative factors and comorbidities, where possible.53 For example, offloading is a key treatment strategy for the management of diabetic foot ulceration.54 A systematic review summarised the evidence for offloading and identified that healing rates, healing times and reduction in ulcer size were improved with the use of total contact casting (TCC).⁵⁴ Further, in the management of individuals with venous leg ulcers (VLU), compression therapy is a fundamental intervention to address the underlying venous disease.55 Similarly, a systematic review concluded that healing outcomes (including time to healing) were better when patients received compression compared with no compression.55 Evidence within these systematic reviews reiterates the importance of addressing contributory factors. These could include risk factors and underlying comorbidities such as a review of glycaemic control in the holistic management of individuals with wounds. The C within the TIME CDST draws attention to this element of patient management, ensuring that the practitioner focuses on this aspect of the patient profile.

The work by Guest et al.,⁵ Skerritt and Moore⁴² and McCaughan et al.⁴³ have illuminated the lack of congruence in the use of topical treatments for wounds, in addition to highlighting the frustration that this

causes to individual patients. The D within the TIME CDST focuses on deciding on the most appropriate treatment modality. Here, there is a clear link between TIME and treatment options, ensuring the WBP is appropriately addressed. For example, bioburden is a significant barrier to healing for all chronic wounds.⁵⁶ Thus, researchers argue that if appropriate attention were given to managing bioburden, then it would be possible to promote the return of normal tissue physiology and function.⁵⁶ This is of fundamental importance, given the positive impact of WBP on clinical outcomes.⁵⁷

Because wound management often involves repeating the cycles of assessment and evaluation, the E within the TIME CDST completes the first cycle in the wound assessment and management trajectory, focusing the attention on the role of evaluation in assessing goal attainment.⁴⁹ Here, attention is placed on determining whether there is progression in terms of wound healing or in terms of other goals of care, for example, reduction in exudate and inflammation/ infection. It is also of importance to ensure that the goals of care have been those which are in congruence with the patients' goals, as far as possible. The rights of patients to have a central part in the health-care process is an important aspect of health-care provision.58 The benefits include enhanced motivation and knowledge about health and illness, resulting in patients having increased capacity to monitor and look after themselves.⁵⁹ Living with a wound can lead to loss of independence or control. As such, all individuals should have the chance to understand their condition, be involved in decisions about treatment and take responsibility for managing their wound where they are able to do so.49 Fundamentally, the aim is to maximise patients' health and wellness, and to ensure greater satisfaction with care.⁴⁹

Future-proofing the TIME CDST

Wound management is an ever-evolving speciality.⁸ As such, assessment and management algorithms developed today need to ensure that they are futureproof, so that they can readily respond to emerging technologies and interventions as relevant.⁶⁰ In order to ensure future-proofing of the TIME CDST, consideration was given to a number of key elements:

- Awareness: are people familiar with the tool and do they know how best to use it in practice?
- Use: how do people use the tool in practice? How does use transfer across different clinical care settings and across different healthcare practitioners?
- Impact: what is the impact of use of the tool on the different stakeholders, patients, health-care delivery, clinical outcomes and health economics?

Work by Dowsett⁶¹ examined the impact of delivering an educational programme using the concept of WBP and the associated TIME framework on community nurses' wound care knowledge and practice. A pre-post design was employed among a

sample of 47 community nurses from one primary care trust. Results showed that statistically significant improvements were achieved in community nurses' wound care knowledge p<0.001 and practice p<0.001 when the TIME framework was incorporated into an educational programme. While acknowledging the importance of education for practice, work by Smith et al.⁶² explored the impact of a bespoke education programme on nurses' dressing selection. Outcomes demonstrated an improved wound management practice which results in a reduction in the costs of wound care. However, the authors⁶² reflected that the focus was almost exclusively on the structure of the educational tool, and not its functionality. This issue has been borne in mind in relation to the development of the TIME CDST. The CDST fits TIME into a structure that nurses and other professionals can follow. Further, it has the potential to work within the parameters of existing procedural guidelines. Thus, in this way, the functionality of the TIME CDST has also been emphasised as of key importance.

A number of clinical developments and technologies that the expert panel felt would most likely affect WBP in the future include techniques to localise biofilms and confirm debridement on wound beds, and rapid visual detection of planktonic bacteria. In the field of diabetic foot ulcers (DFU), point-of-care biomarkers that predict healing or hard-to-heal wounds were increasingly more important. In response to the management of biofilms, NPWT with instillation was already making an impact in addition to enhancing the healing of chronic wounds, and also orthopaedic infected wounds with osteomyelitis.63 From a management perspective, autologous platelet extract/PDGF (advanced treatment based on growth factors combined with bioengineered matrix), advanced tissue products, such as amnion/ chorion, as well as any other tissue basement membrane dressings and stem cell therapies, autologous or allogeneic cells, were all considered of interest in the healing of chronic wounds. In addition to these future developments, the panel discussed four principles of biofilm-based wound care and how these are incorporated into WBP:

- Perform frequent, sharp/mechanical debridement: this is critical to physically remove biofilm communities. However, physically debriding biofilm alone is not sufficient because, within 3 days, bacteria can reform tolerant biofilms
- Use an effective, fast-acting microbicidal dressing after debridement: a microbicidal dressing should be used after debridement to manage residual biofilm bacteria and to prevent reformation of biofilms
- Alter topical and systemic antimicrobial treatments: after 5–7 days, the DNA pattern of the bacteria in the wound changes
- Consider a 'step-down, step-up' treatment to rapidly decrease biofilms and proteases that impair healing: 'step-down' would consist of using the most effective treatment first to control the barriers and the elements

that are preventing healing, including biofilms. Once that is under control, the wound bed is ready, if needed, to 'step-up,' which involves the use of advanced wound products.⁶⁴

The next steps

The cornerstone of evidence-based practice (EBP) is the integration of high-quality research evidence into clinical-decision making. This evidence is used in combination with clinical judgement and experience to plan the most appropriate patient treatment.⁶⁵ There are many influencing factors that have contributed to the rise in EBP, probably none more so than the increasing economic constraints imparted on healthservice delivery.⁶⁰ With limitations in resources and an increasing demand on service delivery, the choice of the most appropriate, effective treatments are paramount to the success of the health service.⁶⁰ Those wishing to justify continued investment in current practice, or conversely, development of new innovative methods of care delivery, are expected to be explicit in their requests.⁶⁶ This explicitness has to include evidencebased material to support arguments appropriately.⁶⁷

To evaluate the TIME CDST, the next steps will involve four essential elements:

- Raising knowledge and awareness: an educational package will be developed to address the tenets of the TIME CDST
- Measurable endpoints: elements of the TIME CDST to be measured will be agreed with specific reference to ensuring that the impact before and after TIME CDST is captured
- Cost: local stories will be captured from practicing clinicians using TIME CDST to develop an understanding of how cost-savings were achieved.

Conclusion

Wounds and their associated complications are a significant issue for individuals, the health service and society as a whole. Despite the longevity of involvement in wound management, research shows that patients are often poorly assessed, impacting negatively on the ability to establish a clear diagnosis and resulting in the absence of appropriate treatment plans and outcomes. This creates unnecessary expenditures, compounding the challenges in achieving costeffective, efficient delivery of wound management services.

The TIME principle was a first step in addressing the failure to adopt a systematic approach to wound management, and since its inception, TIME has been widely integrated into research and practice. A limitation of TIME, however, was that it focused primarily on the wound, and although acting as a guide for WBP, a more holistic framework was needed. In answering this need, the group of experts gathered in London developed the TIME CDST. This model, consisting of A, B, C, D and E, takes health professionals though assessment, use of an MDT and control of

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Reflective questions

- How would you apply the newly developed TIME clinical decision support tool (CDST) in your practice?
- What are the main challenges in implementing TIME CDST in your clinical setting, and how would you tackle these?
- Do you currently use a clinical decision support tool, and how is it different from the TIME CDST?

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The next step in the journey from TIME to TIME CDST is the evaluation of the model, education of healthcare professionals about the TIME CDST, and implementation and evaluation of outcomes achieved from its use. It is evident that exciting times lie ahead. JWC

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