Abstract

Hard-to-heal wounds constitute a significant clinical and organisational problem for modern healthcare systems. Prolonged treatment time, frequent complications, and the need for long-term patient care place a considerable burden both on healthcare systems as well as on patients and their families. Proper assessment of wound aetiology, comprehensive therapeutic management, and systematic monitoring of healing dynamics are of particular importance in the treatment of chronic wounds. In recent years, increasing attention has been paid to the need for structured management strategies that enable the organisation of the treatment process and support clinical decision-making. One such approach is the TIMERS strategy, recommended in the literature as a comprehensive model for the management of hard-to-heal wounds. This model includes the assessment of tissues in the wound bed, control of infection and inflammation, maintenance of an appropriate moisture balance, stimulation of tissue regeneration, evaluation of wound edges, and consideration of systemic factors influencing the healing process.

The aim of this study was to evaluate the effectiveness of comprehensive therapeutic management of hard-to-heal wounds provided by a nurse in a home care setting based on the TIMERS strategy, with particular emphasis on wound healing dynamics and factors influencing the healing process. The study also analysed the relationships between wound healing rate and wound aetiology, applied therapeutic methods, and selected clinical factors related to the patient's general condition.

The study included data on 39 hard-to-heal wounds in 25 patients receiving specialised nursing care in a home care setting. The study had a retrospective and observational design. Medical documentation regarding the course of treatment, wound healing dynamics, and applied therapeutic methods was analysed. Among other parameters, the time required to achieve successive stages of reduction in wound surface area was assessed, including reductions of 50%, 80%, and complete wound healing. The analysis also included wound aetiology, selected local treatment methods, including negative pressure wound therapy and platelet-rich fibrin preparations, and clinical factors related to the patient's condition, such as age, nutritional status, risk of pressure ulcer development assessed using the Waterlow scale, and the time between wound onset and initiation of treatment.

Non-parametric statistical tests appropriate for the analysed variables were applied. The Kruskal–Wallis test and the Mann–Whitney U test were used to assess differences between groups. Relationships between selected variables were evaluated using Spearman's rank

correlation coefficient. The statistical analyses allowed the assessment of relationships between clinical factors, applied treatment methods, and the dynamics of wound healing.

The obtained results indicate that the use of comprehensive therapeutic management based on the TIMERS strategy in a home care setting enables effective treatment of hard-to-heal wounds and leads to a significant reduction in wound surface area. In the analysed group, the median reduction in wound surface area after four weeks of treatment was 48.9%, indicating a favourable healing trajectory. The median time to achieve a 50% reduction in wound surface area was 4.5 weeks, an 80% reduction was achieved after 7 weeks, and complete wound healing occurred after a median of 10.5 weeks.

The analysis of healing dynamics according to on wound aetiology revealed significant differences between the groups. The slowest healing rate was observed in vascular wounds, in which the median time to achieve a 50% reduction in wound surface area was 9 weeks, an 80% reduction was achieved after 21 weeks, and complete healing occurred after approximately 40.5 weeks. In the case of pressure ulcers, a 50% reduction in wound surface area was achieved after a median of 4 weeks, an 80% reduction after 10 weeks, and complete healing occurred after approximately 11 weeks. The fastest healing dynamics were observed in inflammatory wounds and complicated postoperative wounds, where a 50% reduction in wound surface area was achieved after approximately 3 and 3.75 weeks, respectively, while complete healing occurred after approximately 6 weeks.

The statistical analysis demonstrated a significant relationship between wound aetiology and the time required for complete healing. A significant positive correlation was also found between the time from wound onset to the initiation of treatment and the duration of wound healing, indicating that delays in implementing appropriate therapeutic management may prolong the treatment process. Additionally, a positive correlation was observed between the Waterlow scale score and wound healing time, suggesting the importance of systemic factors in the course of tissue regeneration.

The effectiveness of selected therapeutic methods used in the treatment of hard-to-heal wounds was also assessed. In the case of negative pressure wound therapy (NPWT), an average reduction in wound surface area of 61.6% was achieved over six weeks of treatment, corresponding to an average daily reduction of approximately 1.47%. A statistically significant difference in wound healing time was observed between the groups according to the use of silver-containing hydrofiber dressings. A longer healing time was observed in wounds treated with silver-containing hydrofiber dressings, which most likely reflects their more frequent use in infected, complicated, or more advanced wounds.

In the analysed group of patients, autologous regenerative methods were also applied, including platelet-rich fibrin preparations. In patients treated with PRF preparations, the median treatment time was 8 weeks, while the median percentage of wound healing reached 100%. These results indicate that the use of blood-derived preparations may represent a valuable complement to comprehensive treatment of chronic wounds, particularly when combined with appropriate wound bed preparation and other therapeutic methods.

The obtained results indicate that the TIMERS strategy may constitute a practical and effective tool supporting the management of hard-to-heal wounds in home care settings. A structured approach to wound assessment and therapeutic planning enables systematic monitoring of treatment progress and early identification of factors delaying wound healing. The implementation of this strategy also promotes rational selection of therapeutic methods and improves the quality of patient care.

Based on the conducted analyses, it can be concluded that comprehensive therapeutic management based on the TIMERS strategy enables effective treatment of hard-to-heal wounds in home care settings. The rate of wound healing varies significantly depending on wound aetiology, and the use of advanced methods such as negative pressure wound therapy and platelet-rich fibrin preparations may accelerate tissue regeneration. Systemic factors related to the patient's general condition, as well as the time between wound occurrence and the initiation of appropriate treatment, also play an important role in healing dynamics. Therefore, the TIMERS strategy may represent a valuable tool supporting nurses' autonomy in the comprehensive management of chronic wounds in a home care setting and may contribute to improving treatment effectiveness and the quality of patient care.

Keywords: hard-to-heal wounds, chronic wound, wound healing, TIMERS strategy, negative pressure wound therapy (NPWT), platelet-rich fibrin (PRF), home care, nursing care