# PROPOSAL FOR A NEW PRESSURE ULCER (PRESSURE INJURY) CLASSIFICATION BASED ON DEPTH, INFECTION, AND PERFUSION


## Abstract

Pressure ulcers (PU) represent a major cause of morbidity and reduced quality of life for patients in long-term care facilities and hospitals and come at high costs to individuals and health care systems across the globe. A comprehensive evaluation of PU facilitates therapeutic decisions and effective management, which in turn can reduce complications, costs, and healing times. However, most classification systems for PU focus mainly on wound depth and do not consider other factors that impact management and prognosis, while others have proven to be too cumbersome for everyday clinical use. A proposal for a simple, comprehensive PU classification system based on the University of Texas Diabetic Foot Classification contemplating wound depth, infection status and vascular supply is hereby presented.


**Key words:** Pressure ulcer ■ pressure-related injury ■ decubitus ulcer ■ classification ■ staging

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Pressure ulcers (PU), also known as pressure injuries, are caused by sustained pressure to an area of skin, usually over a bony prominence, causing occlusion of blood vessels and ischemia-induced tissue damage as well as cellular deformation-induced tissue damage to the skin and underlying tissues.[1–4]

PU represent a significant cause of morbidity for patients in long-term care facilities and hospitals, particularly in intensive care units. Approximately one in every 10 patients admitted to an ICU will develop a pressure ulcer, with around 70% of them being more severe than stage 1.[5–7] Among patients in long-term care facilities, prevalence has been reported to be up to 23.9%.[8]

In Mexico, a study in three general hospitals in three different regions revealed a general prevalence of 17%; prevalence increases to 60.3% when only patients with moderate to severe risk in the Braden scale are included.[9]

PU management comes at high costs to individuals and health care systems. In the US, hospital-acquired pressure ulcers cost about $11 billion annually and the average cost of a hospital stay increases by $40,000 if the patient has a PU.[10] Estimating the cost of hospital acquired pressure injuries (HAPIs) to US hospitals using simulation methods, Padula and Delarmente (2019) reported the incremental costs to hospitals for the treatment of HAPIs as much higher, at $26.8 billion annually.[11]

## Pressure ulcer classifications

One of the first documented pressure ulcer classification systems was developed by Shea in 1975. 'Bedsores' were classified by the depth of soft tissue damage and exposure into grades I–V; an additional stage termed 'closed pressure sore' described subcutaneous necrosis without skin ulceration.[12]

In 1989, the National Pressure Ulcer Advisory Panel (NPUAP) developed a four stage classification system based on the Shea staging system, with stage I defined as 'non-blanchable erythema of intact skin' considered to be the heralding lesion of skin ulceration, and stage IV describing a full thickness wound with exposure of tendons or bones.[13] In 2016, categories were added to include deep tissue injury without skin ulceration and wounds that cannot be staged.[14]

The Stirling Pressure Ulcer Severity Scale was developed in 1994 in the UK by a multidisciplinary team who sought to create a comprehensive system

that included important factors, such as wound bed and infection status, along with wound depth. Stages 0–4 describe the depth of the ulcer, stage 0 being used to describe a pre- or post-ulcer stage, while a second digit is used to describe other wound findings, such as the presence of undermining and sinus tracts. A third and fourth digit can be added to describe the nature of the wound bed and infective complications, respectively.[15] While using this scale provides an accurate description of the ulcer, it proved to be too complex for everyday use and failed to gain popularity in clinical settings.

To date, the NPUAP Pressure Injury Staging System remains one of the most widely used classification systems in the world, both in clinical practice and for research purposes; in some countries, it also serves as the basis for reimbursement of medical expenses.[14] While it is updated regularly, as scientific evidence widens our knowledge and understanding of injury mechanisms, it has failed to include factors that are known to complicate the management of PUs, such as infection, ischaemia, or bone or joint involvement. Also, the NPUAP discourages reverse staging ulcers as they heal because it deems it 'anatomically incorrect' as a healing wound will never return to having normal skin anatomy. Clinicians are expected to describe the wound elsewhere on the patient´s clinical file to maintain its accuracy.[16] These revised definitions of the staging system have been criticized for 'not adding clarity, improving accuracy, nor correlating with patient outcomes', and being 'soft on scientific evidence and heavy on isolated personal experiences'.[17]

## Wound depth, infection and vascular supply as prognostic factors in pressure ulcers

Appropriate documentation and care of PU requires a clear, descriptive classification system that may be used to direct therapy and possibly indicate prognosis. Such classification would ideally be clinically relevant, easy to use, reproducible and effective to accurately describe the severity of the ulcer as well as associated factors that could worsen the prognosis or imply the need for a more complex treatment plan. Unfortunately, there are few studies evaluating the factors influencing healing and outcomes in PU.

Berlowitz et al. found that PUs with higher wound stages had a lower probability of healing in long-term care residents. At a six-month follow up, 72, 45.2 and 30.6% of patients with stage 2, 3 and 4 PUs, respectively, were found to be wound free. When compared with stage 4 ulcers, stage 2 and 3 ulcers had significantly higher odds of healing (odds ratio (OR) 5.2 and 1.5).[18]

In a study involving 140 patients with heel PUs, wound severity and the presence of peripheral artery disease (PAD), were identified as prognostic factors for healing. For this type of ulcer, having a deeper ulcer was associated with half the chance of the ulcer healing while the presence of PAD was associated with a slightly lower probability of healing during an 18-month follow-up.[19]

The most common complication identified in a review of the literature was bacterial infection which may in turn lead to bacteraemia and death. Unfortunately, several reviews attempting to provide evidence on the role of bacteria in PU prognosis have been unsuccessful due to great variability in sampling. The presence of deeper ulcers with large amounts of tissue necrosis and/or bone infection increased the probability of gram negative and anaerobic bacteria, that in turn increased the risk of necrotising infections. In individuals with spinal cord injury (SCI), grade III and IV PU, characterised by full-thickness tissue loss and the presence of necrosis, are at increased risk for these complications. In general, the effect of bacterial presence in PU and their role on healing have been poorly characterised.[20]

Most experts in the treatment of patients with PU agree that wounds with bone or joint involvement are much more difficult to heal. In a study evaluating the presence of osteomyelitis or pressure-induced bone injury, Sugarman et al. recommended evaluating for bone involvement as a cause for PUs not responding to treatment after pressure had been eliminated.[21]

Bone involvement has also been shown to complicate surgical closure procedures in grade IV pressure ulcers. Schryvers et al. found that out of 421 surgical procedures, 108 (26%) required bone removal. Of these patients, 49 (45%) developed wound dehiscence compared with only 81 (26%) patients with no bone removal during their procedure. Out of those 49 who developed wound dehiscence after bone resection, 20 (41%) required re-operation, while only 25 (31%) patients who had wound dehiscence with no bone removal had to be re-operated.[22]

The presence of osteomyelitis has also been shown to significantly increase the cost of treatment when compared with grade IV PUs with no complications. Bennet et al. calculated the average treatment cost per episode of a grade IV PU without and with osteomyelitis to be £7,750 and £24,214, respectively.

Even when compared with grade IV PUs with other complications such as cellulitis, treatment of ulcers with osteomyelitis more than doubled the average treatment cost per episode at £9,670 and £24,214, respectively.[23]

Unfortunately, studies comparing outcomes with and without bone involvement are scarce; one likely cause being that the present staging system considers all stage IV ulcers the same whether bone or joint are involved or not.

## Rationale for a PU classification based on the UT Diabetic Foot Classification

As mentioned before, it is important to identify and include factors other than wound depth in the classification of PU to aid in making therapeutic decisions and to establish prognosis for healing. Even though research is limited, there seems to be enough evidence supporting the idea that the presence of ischaemia and infection influence the therapeutic interventions warranted in PU and that they are usually related to prognosis. Such is also the case for diabetic foot wounds. While pressure and diabetic foot ulcers have little in common in terms of pathophysiology, predisposing conditions, patient-centered concerns, and other patient characteristics, they do share similarities in some of the above-mentioned factors, such as depth of tissue involvement, infection and perfusion being among the most studied markers of poor outcome.

In 1996, the University of Texas Diabetic Foot Classification (UTex), also known as the University of Texas San Antonio Diabetic Wound Classification, was published to provide clinicians with a practical and clinically relevant system that categorises the severity of ulcers to provide treatment strategies and predict outcomes in persons with diabetic foot ulcers. The authors observed that: '…poor outcomes are often associated with wounds of increasing depth, increasing severity of infection, and presence of peripheral vascular disease', and considered that those factors have been widely discussed in the foot care literature.[24] Additionally, the cumulative effect of such factors contributed to complications and poor outcomes. Ulcers with higher grades (deeper ulcers) underwent more amputations, and those with higher grades and higher stages were less likely to heal.[25] This classification system has proven to be a valuable tool in the management of patients with diabetic foot as it forces clinicians to evaluate important factors about the ulcer to initiate diagnostic and therapeutic interventions.

A proposal for a new PU classification based on the UTex is hereby presented, contemplating not only depth, but also wound perfusion and the presence of infection, aiding clinicians in planning treatment strategies, monitoring treatment effectiveness, predicting clinical outcomes, and improving research and communication among healthcare providers (Fig 1).

## Description of the pressure ulcer classification system based on depth, infection, and perfusion: the DIP classification

The DIP classification is based on grades and stages; grades describe wound depth while stages describe wound complications. Grade 0 represents a pre- or post-ulcerative lesion that includes healed ulcers, scars and non-blanchable erythema. While this grade does not describe a true ulcer, it helps identify sites at high risk of ulceration or re-ulceration. It also acknowledges the fact that closed wounds never fully return to their pre-wound state, allows an accurate description of the wound's status, and aids in proper follow-up.

Grade 1 ulcers describe skin damage without visible subcutaneous tissue (for example, blisters, abrasions, superficial ulcers). Grade 2 involves subcutaneous tissue and muscle without bone or joint exposure. Ulcers that involve bone, joint, or prosthetic or osteosynthesis material are described as grade 3. If wound depth cannot be assessed due to the presence of eschars or slough, or when deep tissue injury is suspected without a visible ulcer, the wound is classified as grade X.

Stages are used to describe associated infection or ischemia. Stage A describes a wound with no signs of either condition. Ulcers with suspected or confirmed infection are classified as stage B. PU located in extremities with signs of ischaemia or compromised perfusion (for example, no detectable pulse) are classified as stage C. Ulcers that have concomitant ischemia and infection are classified as stage D. As pre- and post-ulcerative lesions cannot be infected, grade 0 lesions cannot be staged as B or D.

## Downgrading and accuracy of medical files

As opposed to the NPUAP classification, where reverse staging is discouraged, clinicians are expected to restage ulcers as they improve or deteriorate when using the DIP classification, reflecting the dynamic nature of the wound healing process. Continuous restaging helps maintain medical files accuracy as wound stage will reflect wound characteristics at the time of

**Figure 1.** *Tension-extension profile of wrap system samples*

| | | Grade | | | | |
|---|---|---|---|---|---|---|
| | | X | 0 | 1 | 2 | 3 |
| Stage | A | Unknown. Wound depth cannot be assessed[1] | Pre- or post-ulcer, completely epithelialized[2] | Partial skin damage (subcutaneous tissue not visible) | Subcutaneous tissue and muscle involvement | Bone or joint involvement or exposed osteosynthesis or prosthetic material |
| | B | Infection | | Infection | Infection | Without osteomyelitis (OM-)[3] |
| | | | | | | With osteomyelitis (OM+)[3] |
| | C | Ischaemia | Ischaemia | Ischaemia | Ischaemia | Ischaemia |
| | D | Infection and ischaemia | | Infection and ischaemia | Infection and ischaemia | Infection and ischaemia |

each evaluation. This in turn allows clinicians to redirect diagnostic and therapeutic interventions suited to the current status of the wound. Finally, reverse staging reflects improvement or worsening of the ulcer, allowing for a more objective method to evaluate treatment effectiveness in clinical trials.

## Discussion and final comments

PU are a major public health issue due to their frequency and the cost they represent. The PU classification systems currently in use are based solely on the depth of the affected tissues. The classification system hereby presented is an improvement to previous classifications in two truly relevant ways. First, it considers the involvement of bone or joint as a different type of deep PU. PU with exposed bone or joints behave differently and therefore require different diagnostic and management strategies. Second, it considers two particularly important factors also affecting evaluation and treatment: the presence of infection and impaired circulation.

The DIP system will allow healthcare professionals develop stronger diagnostic protocols and treatment plans focusing on the complex nature of PU. ■

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