

A Review of the Literature

Red Yellow Black (RYB) Breakdown (prominent in nursing literature)

For this classification I didn't manage to find further information (yet)

- R: red wounds that exhibit pale pink to beefy red granulation tissue. Deemed to be inflammatory
 - Y: yellow wounds marked by pale ivory, yellowish green or brown color, slough of necrotic but moist tissue, wound exudates
 - B: black wounds marked by black or deep brown color, desiccated eschar
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Enna et al (1976) ⁽²⁾

Enna et al described four categories of non-ulcerated insensitive feet.

- Category 1: includes subjects lacking only sensation on the plantar aspect
- Category 2: includes those suffering from a loss of sensation and "deficiency of the subcutaneous soft tissue"
- Category 3: is defined as loss of plantar protective threshold, deficiency of plantar soft tissue, and gross deformity
- Category 4: includes the deformed, rigid, short foot secondary to distal osseous disintegration or ablative surgery

"...Based on these categories, recommendations were made as to appropriate shoe accommodation..." ⁽²⁾

Meggitt-Wagner or just Wagner^{(19) (22)} – Meggitt (1975)/Wagner (1981)

- Grade 0: No open lesion but may have deformity or callus
- Grade 1: Superficial ulcer, partial or full-thickness

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- Grade 2: Ulcer extends to ligament, tendon, joint capsule or deep fascia without abscess or osteomyelitis
- Grade 3: Deep ulcer with abscess, osteomyelitis or joint sepsis
- Grade 4: Gangrene localized to forefoot or heel
- Grade 5: Extensive Gangrene

While the Wagner classification is a simple, easy to remember system, based upon the location and depth of ulcerations, one should be aware of the system's limitations. The Wagner classification does not take the presence of neuropathy or the size of the lesion into account. ⁽⁹⁾

A validation of Wagner in relation to science, clinometric, readability, accuracy, reliability and validity has been published in 2008⁽¹⁴⁾

Stess and Hetherington (1989) ⁽²⁾

This system divides patients into three categories

- Category 1: includes the patient with lack of protective threshold, but with no ulcer and no active bony destruction
- Category 2: includes patients in whom "active bone destruction" is occurring
- Category 3: comprises ulcerated patients with or without bony deformity

"...Ulcers in this system are subdivided as fundamental or complicated. This classification system does not address vascular insufficiency, nor does it take into account presence or absence of infection..." ⁽²⁾

Ulbrecht et al (1993) ⁽²⁾

This risk assessment system, designed to assist in predicting probability of plantar pedal ulceration in the neuropathic patient, is unique in its schematic structure. It incorporates four variables:

- Variable 1: foot deformity
- Variable 2: step loading time

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- Variable 3: footwear cushioning
- Variable 4: activity level

"...By plotting the various factors on a graph, an assessment is made as to the potential foot-risk level. This innovative format provides an excellent framework for forming a logical, organized, treatment-oriented thought process. However, the format used in this system is too subjective to be reproducible on a wide level. Additionally, the present scheme does not include vascular status or infection in its assessment..." (2)

Depth-Ischemia Classification of Diabetic Foot Lesions⁽¹⁰⁾ **- Brodsky (1993)**

The depth-ischemia classification is a modification of the Meggitt-Wagner to make it more rational and easier to use.

Depth Classification

- Grade 0: At risk foot, previous ulcer or neuropathy with deformity that may cause new ulceration
- Grade 1: Superficial ulceration, not infected
- Grade 2: Deep ulceration exposing a tendon or joint (with or without superficial infection)
- Grade 3: Extensive ulceration with exposed bone and/or deep infection (i.e. osteomyelitis or abscess)

Ischemia Classification

- Grade A: Not ischemic
 - Grade B: Ischemic without gangrene
 - Grade C: Partial (forefoot or heel gangrene of the foot)
 - Grade D: Complete foot gangrene
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Birke and Sims (1995) ⁽²⁾

Divided into four categories:

- Category 0: Protective sensation intact

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- Category 1: loss of protective sensation
- Category 2: loss of protective sensation with high pressure on the plantar aspect or poor vascularity
- Category 3: including those with a history of ulcer or neuropathic fracture with major deformity

"...This system is easy to use. The authors also make logical shoe recommendations based on foot risk. This classification system does not, however, include infection. In addition, it does not allow for vascular insufficiency to coexist with a previous history of ulceration. As was the intention of the authors, this index is an excellent tool for screening, but may not be as valuable for active or acute conditions, such as open ulceration or acute neuropathic Osteoarthropathy..." ⁽²⁾

Treatment-based Diabetic Foot Index – Armstrong (1996) ⁽²⁾

More details on each category can be found in tables of the original article ⁽²⁾

- Category 0: Minimal Pathology
- Category 1: Insensate Foot
- Category 2: Insensate Foot with Deformity
- Category 3: Demonstrated Pathology
- Category 4: Insensate Injury
- Category 4 A: Neuropathic Ulceration
- Category 4 B: Acute Charcot's Arthropathy
- Category 5: Infected Diabetic Foot
- Category 6: Dysvascular Foot

"...Ideally, such a system would be used by all participants in the limb-salvage team. Clearly, the classification system reviewed calls for further validation through clinical investigation..." ⁽²⁾

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University of Texas Wound Classification System (UT) ⁽²⁰⁾ (1996)

While the Wagner classification shows 6 grades (0-5), the TU makes do with four grades (0-3) but has also four stages with each grade. So it ends up with 16 different categories.

- Stage A: No infection or ischemia
- Stage B: Infection present
- Stage C: Ischemia present
- Stage D: Infection and Ischemia present
- Grade 0: Epithelialized wound
- Grade 1: Superficial wound
- Grade 2: Wound penetrates to tendon or capsule
- Grade 3: Wound penetrates to bone or joint

Armstrong tried to prove in a study⁽³⁾ that outcomes deteriorated with increasing grade and stage of wounds when measured using the TU.

"...Most classification systems previously reported in the medical literature have primarily focused on the depth of the ulceration and have neglected or inconsistently included infection and peripheral arterial occlusive disease..."⁽³⁾

Oyibo et al ⁽⁴⁾ compared the Wagner and the TU in 2001. They stated that both systems are easy to use among health care providers, and both can provide a guide to planning treatment strategies. The conclusion of their study stated that the UT system's inclusion of stage makes it a better predictor of outcome.

In Brazil a group of physicians compared the Wagner, the UT and the S(AD)SAD classification⁽¹⁷⁾

IWGDF Risk Classification⁽¹⁴⁾ (2001)

This is a modified version of the Texas Foot Risk Classification:

- Group 0: No PN, no PAOD
- Group 1: PN , no PAOD, no deformity
- Group 2A: PN and deformity, no PAOD

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- Group 2B: POAD
 - Group 3A: Ulcer history
 - Group 3B: Amputation history
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Scottish Care Information – Diabetes Collaboration (SCI-DC) ⁽¹³⁾ ulcer risk score (2001)

Based on assess foot pulse, monofilament sensation, history of foot ulcer, presence of foot deformity and inability to self care, the SCI-DC categorizes:

- Low Risk:
 - Able to detect at least one pulse per foot AND
 - Able to feel 10g monofilament AND
 - No foot deformity, physical or visual impairment
No previous ulcer
 - Moderate Risk:
 - Unable to detect both pulse in a foot OR
 - Unable to feel 10g monofilament OR
 - Foot deformity OR
 - Unable to see or reach foot
No history of previous ulcer
 - High Risk:
 - Previous ulceration or amputation OR
 - Absent pulse AND unable to feel 10g monofilament OR
 - One of above with callus or deformity
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PEDIS ⁽²³⁾ (2003)

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Data extracted from the 2011 Interactive DVD International Consensus on the Diabetic Foot & Practical and Specific Guidelines on the Management and Prevention of the Diabetic Foot by the IWGDF 2011. See reference⁽²³⁾ for further details

- *P (perfusion)*
 - Grade 1: No symptoms or signs of PAD in the affected foot
 - Grade 2: Symptoms or signs of PAD, but not of critical limb ischemia
 - Grade 3: Critical limb ischemia

- *E (extent/size)*
D (depth of tissue loss)
 - Grade 1: Superficial full thickness ulcer, not penetrating any structure deeper than the dermis
 - Grade 2: Deep ulcer, penetrating below the dermis to subcutaneous structures, involving fascia, muscle, or tendon
 - Grade 3: All subsequent layers of the foot involved, including bone and/or joint

- *I (infection)*
 - Grade 1: No symptoms or signs of infection
 - Grade 2: Infection involving the skin and the subcutaneous tissue only
 - Grade 3: Erythema >2cm or infection involving structures deeper than the skin and subcutaneous tissues
 - Grade 4: any foot infection with signs of systemic inflammatory response syndrome (SIRS)

- *S (sensation)*
 - Grade 1: No loss of sensation
 - Grade 2: Loss of sensation

DEPA Score (2004)⁽⁹⁾

"...Although the DEPA Scoring System is a validated system, it involved a small number of patients and a relatively short follow-up period..."

- D: depth of the ulcer
- E: extent of bacterial colonization
- P: phase of ulcer
- A: associated etiology

If you check the reference in detail it seems to be too complicated to me.

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Diabetic Foot Infection Guidelines (DFIG) ⁽¹¹⁾ **– Infectious Disease Society of America (IDSA) (2004)**

- Category 1, Uninfected: wound without purulence or any manifestation of inflammation
- Category 2, Mild: Manifestation of inflammation
- Category 3, Moderate: Infection in a patient who is systemically well and metabolically stable
- Category 4, Severe: Infection in a patient with systemic toxicity or metabolic instability

S(AD)SAD^{(9) (12) (17)} (2004)

Developed by an English group. Each category does have three grades

- S(AD): Size (area, depth)
 - Area: 0=Skin intact
1=Lesion < 1cm²
2=Lesion from 1 to 3cm²
3=Lesion > 3cm²
 - Deep: 0=Skin intact
1=Superficial
2=Lesion penetration to tendon, periosteum, capsule
3=Lesion in bone or joint space
- S: Sepsis
 - 0= ./.
 - 1=No infected lesions
 - 2=Cellulitis-associated lesions
 - 3=Lesions with osteomyelitis
- A: Arteriopathy
 - 0=Pedal pulses present
 - 1=Pedal pulses reduced or one missing
 - 2=Absence of both pedal pulses
 - 3=Gangrene
- D: Denervation
 - 0=Intact
 - 1=Reduced
 - 2=Absent
 - 3=Charcot joint

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Diabetic Ulcer Severity Score (DUSS)⁽⁷⁾– Becket (2006)

Becket et al categorized diabetic foot ulcer according to a severity score ranging from 0-4 using wound-based parameters

- Palpable Pedal Pulse Score: present = 0 / absent = 1
- Probing to Bone Score: probing no = 0 / probing yes = 1
- Ulcer Location (Toe or Foot) Score: toe = 0 / foot = 1
- Presence of Multiple Ulcers Score: single = 0 / multiple = 1

Diabetic Ulcer Severity Score (DUSS) was calculated by adding these separate grading to a theoretical maximum of 4. ⁽⁷⁾

SINBAD – Ince (2008) ⁽¹⁸⁾

- Site 0=Forefoot
 1=Midfoot and Hind Foot
- Ischemia 0=Pedal blood flow intact
 1=Reduced pedal blood flow
- Neuropathy 0=Sensation intact
 1=Sensation lost
- Infection 0=None
 (bacterial) 1=Present
- Area 0=Ulcer < 1cm²
 1=Ulcer ≥ 1cm²
- Depth 0=Ulcer confined to skin and subcutaneous tissue
 1=Ulcer reaching muscle, tendon or deeper

Risk Classification of the Foot Care Interest Group of ADA ^{(19) (20)} (2008)

- Risk Category 0: No LOPS, no PAD, no deformity
- Risk Category 1: LOPS +/- deformity
- Risk Category 2: PAD +/- LOPS
- Risk Category 3: History of ulcer or amputation

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KOBE Classification⁽²¹⁾ (2010)

- Type I: Mainly PN
- Type II: Mainly PAD
- Type III: Mainly Infection
- Type IV: PN & PAD & infection

In the cited article there are also treatment recommendations to each type.

Simplistic Classification by Frykberg (2011) ⁽¹⁾

- Neuropathic
 - Ischemic
 - Neuroischemic
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Jain Teaching Tool (2012)

Please see reference ⁽²⁴⁾ This article is interesting as it was published in 2012(!) by an Indian surgeon from Bangalore (!)

Van Acker/Peter Classification (VA/P) ⁽¹⁶⁾

This system is based on Wagner and UT (plus some other) and divides into 25(!) different classes on a two-dimensional axis. Unfortunately I couldn't find any further information, not even the year of first publication than the cited source⁽¹⁶⁾

Comment:

The summary is based on the articles I reviewed in a chronological order. Depending on the publication date, the information might be timely overlapping. I tried to assort the results based on the publication dates...

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Having reviewed the literature, you will notice that “older” articles mostly refer to Wagner and TU, several articles offer comparison studies about the outcome related to the classification. I think we should **not** only concentrate on Wagner and TU. Although some classification systems are too simple and some are simply widely unknown in the physicians’ community, we must consider having a look at the upcoming, **new classification systems**, too. Especially the **S(AD)SAD⁽¹⁷⁾** seems to be interesting as it takes the dimension of the wound under consideration. These newer classification systems anyway still need to establish themselves in the physicians world.

Further Reading for Understanding the Diabetic Foot:

Beside several available books on Diabetic Foot (see attached list) and the very end of this summary, there are two further recommendations of mine to read:

- **The Standard of Care for Evaluation and Treatment of Diabetic Foot Ulcers**

by: University of Michigan
2010, 26 pages, incl. an self-assessment examination

This was a self-study brochure, certified to get CME points. Unfortunately expiration date was January 30th, 2012

- **Diabetic Foot Disorders**

A clinical practice guideline
by: Frykberg, R. / Zgonis, Th. / Armstrong, D. et al
2006 (revision)

This was a supplement to The Journal of Foot & Ankle Surgery. The first edition published in 2000

Acronyms:

CFU	Chronic Foot Ulcer
DFU	Diabetic Foot Ulcer
LOPS	Loss of Protective Sensation
PAD	Peripheral Arterial Disease
PAOD	Peripheral Arterial Occlusive Disease

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PN Peripheral Neuropathy

References

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