

## RESEARCH ARTICLE

# Definitions and criteria for diabetes-related foot disease (IWGDF 2023 update)

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## Abstract

Multiple disciplines are involved in the management of diabetes-related foot disease and a common vocabulary is essential for clear communication. Based on the systematic reviews of the literature that form the basis of the International Working Group on the Diabetic Foot (IWGDF) Guidelines, the IWGDF has developed a set of

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definitions and criteria for diabetes-related foot disease. This document describes the 2023 update of these definitions and criteria. We suggest these definitions be used consistently in both clinical practice and research, to facilitate clear communication with people with diabetes-related foot disease and between professionals around the world.

**KEYWORDS**

definition, diabetes, foot disease

## 1 | INTRODUCTION

Multiple disciplines are involved in the management of diabetes-related foot disease, and interdisciplinary treatment is the cornerstone of its management and prevention. With all these disciplines involved, a common vocabulary is essential for clear clinical communication purposes. For research purposes, clear and unequivocal definitions are imperative for study methodology to be comparable between studies.

Since its inception in 1999, the International Working Group on the Diabetic Foot (IWGDF) has created a set of core definitions for diabetes-related foot disease, its diagnoses and interventions. These definitions were published online or as an addendum to successive systematic reviews and were published as separate peer-reviewed manuscript for the first time in 2019.<sup>1</sup> Further, the "Reporting standards of studies and papers on the prevention and management of foot ulcers in diabetes"<sup>2</sup> also recommended that these definitions should be used, to facilitate uniform reporting.

In this paper, we provide an update of all definitions and criteria for diabetes-related foot disease based on the systematic reviews of the literature that form the basis of the 2023 IWGDF Guidelines.<sup>3-13</sup> We have retained the definitions from previous versions,<sup>1</sup> to facilitate consistent comparison with older studies, but have made changes when the evidence necessitated updates or following evidence-based feedback from experts.<sup>14,15</sup> When no previous definition was available, we developed a consensus definition based on the literature findings. To indicate the changes in this list of definitions and criteria, we have denoted new definitions with an asterisk (\*) and updated definitions with an obelisk (†).

This paper is limited to general definitions and criteria for diabetes-related foot disease. Further specific definitions can also be found in the glossary of various IWGDF guidelines, such as in the prevention and offloading guidelines.<sup>16,17</sup> We do not provide definitions on diabetes or on other (chronic) diseases unless it is specifically relevant to the topic. Finally, it should be noted that no formal methodology has been used in the definition development of these definitions.

We suggest the definitions in this paper be used consistently in both clinical practice and research, to facilitate clear communication with people with diabetes-related foot disease and between professionals around the world.

## 2 | FOOT DISEASE RELATED DEFINITIONS

**Diabetes-related foot disease<sup>†</sup>:** Disease of the foot of a person with current or previously diagnosed diabetes mellitus that includes one or more of the following: peripheral neuropathy, peripheral artery disease, infection, ulcer(s), neuro-osteoarthropathy, gangrene, or amputation.

**Diabetes-related foot syndrome\*:** We suggest not using the term "diabetes-related foot syndrome", as the collective definition aligns with a disease, not a syndrome.

**Peripheral neuropathy:** The presence of symptoms or signs of peripheral nerve dysfunction.

**Loss of protective sensation:** A sign of peripheral neuropathy, characterised by an inability to sense light pressure, for example, as applied with a 10 g Semmes-Weinstein monofilament.

**Peripheral artery disease:** Obstructive atherosclerotic disease of the arteries from the distal aorta to the foot, with clinical symptoms, signs or abnormalities on non-invasive or invasive vascular testing or medical imaging, resulting in disturbed or impaired circulation in one or both of the lower extremities.

**Foot infection:** A pathological state of the foot, caused by invasion and multiplication of microorganisms in host tissues accompanied by tissue destruction and/or a host inflammatory response.

**Foot ulcer:** A break of the skin of the foot that involves as a minimum of the epidermis and part of the dermis.

**Diabetes-related foot ulcer:** A foot ulcer in a person with current or previously diagnosed diabetes mellitus, and usually accompanied by peripheral neuropathy and/or peripheral artery disease in the lower extremity.

**First-ever foot ulcer:** A foot ulcer occurring in a person who has never before had a foot ulcer.

**Recurrent foot ulcer:** A new foot ulcer in a person who has a history of foot ulceration, irrespective of the location and time since the previous foot ulcer.

**Superficial foot ulcer:** A foot ulcer not penetrating any structure deeper than the dermis.

**Deep foot ulcer:** A foot ulcer penetrating below the dermis into subcutaneous structures, such as the fascia, muscle, tendon or bone.

**Neuropathic foot ulcer\*:** A foot ulcer in the presence of peripheral neuropathy but not peripheral artery disease.

**Ischaemic foot ulcer\*:** A foot ulcer in the presence of peripheral artery disease and ischaemia but not peripheral neuropathy.

**Neuro-*ischaemic* foot ulcer:** A foot ulcer in the presence of both peripheral neuropathy and peripheral artery disease and ischaemia.

**Healed foot ulcer:** The intact skin at a previous foot ulcer site, meaning complete epithelialisation without any drainage.

**Foot in remission:** Intact skin, and absence of infection, of the complete foot after healing of any foot ulcer(s).

**Neuro-osteopathy (Charcot-foot)<sup>†</sup>:** An inflammatory process in persons with diabetes mellitus and neuropathy which results in injury to bones, joints, and soft tissues.<sup>18</sup>

**Active Charcot neuro-osteopathy\*:** The presence of a red, warm, swollen foot with osseous abnormalities on imaging in a person with diabetes mellitus and neuropathy. During the course of the disease, as long as there are signs of inflammation in the affected foot, the Charcot neuro-osteopathy is presumed to be “active”.<sup>18</sup>

**Gangrene:** A condition that occurs when the body tissue dies because of insufficient blood supply, infection or injury. Without infection this generally results in dry and black tissue, frequently called dry gangrene; when the tissue is infected, with accompanying putrefaction and surrounding cellulitis, it is often called wet gangrene.

**Foot lesion<sup>†</sup>:** Any abnormality associated with damage to the skin, nails or deep tissues of the foot. Includes both foot ulcer(s) and pre-ulcerative lesion(s).

**Pre-ulcerative lesion:** Foot lesion that has a high risk of developing into a foot ulcer, such as intra- or subcutaneous haemorrhage, blister, or skin fissure not penetrating into the dermis, in a person at risk.

**Ulcer-free survival days:** Days that a person is alive and without a foot ulcer. Please note that a person with a healed amputation wound (see definition below) and no further foot ulcer(s) can be considered as having ulcer-free survival days from that moment onwards but is never amputation-free.

### 3 | FOOT-RELATED DEFINITIONS

**Forefoot:** The anterior (distal) part of the foot, that is composed of the metatarsal bones, the phalanges and associated soft tissue structures.

**Midfoot:** The part of the foot that is composed of the cuboid, navicular, and cuneiform bones, and associated soft tissue structures.

**Rearfoot or hindfoot:** The posterior (proximal) part of the foot that comprises the talus and calcaneus, and associated soft tissue structures.

**Plantar foot surface:** The underside or weight-bearing surface of the foot.

**Non-plantar foot surface:** All other surfaces of the foot that are not defined as a plantar foot surface.

**Dorsal foot surface:** The upper side of the foot, opposite to the plantar foot surface.

**Foot deformity:** Alterations or deviations from the normal shape or size of the foot, such as hammer toes, mallet toes, claw toes, hallux valgus, prominent metatarsal heads, pes cavus, pes planus, pes

equinus, or results of Charcot neuro-osteopathy, trauma, amputations, other foot surgery or other causes.

**Limited joint mobility:** Reduced mobility of the joints of the foot, including the ankle, caused by changes in joints and associated soft tissues.

**Callus<sup>†</sup>:** Increased thickness of the outer layer of the skin caused by excessive mechanical loading.

**Plantar pressure:** The distribution of forces over a given plantar foot surface, mathematically defined as ‘force divided by the contact area’. Often expressed as peak pressure or pressure-time integral.

### 4 | PERIPHERAL ARTERY DISEASE RELATED DEFINITIONS

**Ischaemia\*:** Blood supply to the foot or part of the foot that is insufficient to meet the metabolic demands of tissue, associated with signs or symptoms of reduced perfusion.

**Claudication<sup>†</sup>:** Pain in the lower limb that occurs during walking and is relieved by rest, and is caused by peripheral artery disease.

For further definitions on peripheral artery disease, we refer to the Global Vascular Guidelines on the management of chronic limb-threatening ischemia.<sup>19</sup>

### 5 | INFECTION RELATED DEFINITIONS

**Superficial infection:** An infection of the skin not extending to any structure deeper than the dermis.

**Deep infection:** An infection that extends deeper than the dermis, that may include abscess, septic arthritis, osteomyelitis, septic tenosynovitis or necrotizing soft tissue infection.

**Erysipelas:** An infection of the upper part of the skin (epidermis and dermis, not hypodermis) manifested by one or more of the following: induration, erythema, warmth, pain or tenderness.

**Cellulitis:** An infection of the skin (epidermis and dermis and hypodermis [subcutaneous fat and connective tissue]) manifested by one or more of the following: induration, erythema, warmth, pain or tenderness.

**Septic arthritis:** An infection of the joint and joint capsule.

**Osteomyelitis:** An infection of the bone, with involvement of the bone marrow.

**Pathogen:** A microorganism that is considered to be causing an infection, as opposed to colonizing or contaminating tissue.

**Clinical resolution of infection\*:** The resolution of all acute signs and symptoms related to the infection, or improvement such that antimicrobial therapy of any kind is not required anymore.<sup>20</sup>

### 6 | AMPUTATION RELATED DEFINITIONS<sup>21</sup>

**Amputation:** Resection of a segment of a limb through a bone or through a joint.

**Major amputation:** Any resection proximal to the ankle.

**Major amputation levels:**

- Transtibial amputation: amputation through the tibia and fibula (frequently referred to as 'below knee amputation')
- Knee disarticulation: amputation of the lower limb at the knee joint (frequently referred to as 'through knee amputation')
- Transfemoral amputation: amputation through the femur (frequently referred to as 'above knee amputation')
- Hip disarticulation\*: amputation of the lower limb at the hip joint
- Transpelvic amputation\*: amputation of the lower limb together with all or part of the pelvis

**Minor amputation:** Any resection through or distal to the ankle.

**Minor amputation levels†:**

- Toe amputation: amputation of part of one or more toes
- Metatarsal-phalangeal disarticulation: amputation of one or more entire toes at one or more of the metatarsal-phalangeal joint
- Transmetatarsal amputation: amputation of a part of the foot through one or more of the metatarsals
- Tarso-metatarsal disarticulation: amputation of a part of the foot at one or more of the tarso-metatarsal joints
- Midtarsal disarticulation: amputation of a part of the foot through any of the tarsal bones and/or joints
- Ankle disarticulation: amputation of the lower limb at the ankle joint

**Healed amputation wound\*:** The intact skin at the amputation site, meaning complete epithelialization without any drainage. Please note that a person with a healed amputation wound (and no further foot ulcers) can be considered as having ulcer-free survival days from that moment onwards (see definition of ulcer-free survival days above). However, this person can never be considered to be amputation-free anymore.

**Amputation-free survival days\*:** Days that a person is alive without amputation.

## 7 | MISCELLANEOUS DEFINITIONS

**Interdisciplinary (or multidisciplinary) clinical team:** A grouping of professionals from relevant clinical disciplines, whose interactions are guided by specific team functions and processes to achieve team- and person-defined favourable outcomes (based on:<sup>22</sup>).

**Necrotic tissue:** Devitalised (dead) tissue.

**Limb oedema:** Swelling of the leg or foot caused by increased interstitial fluid.

**Erythema:** A pink or red discolouration that blanches to some degree on compression, caused by increased blood flow to the involved tissue.

**Debridement†:** The removal of callus or dead and devitalised tissue (necrosis and slough).

**Wound debridement\*:** Debridement from a wound in order to create a clean wound bed. There are several different types of

debridement including physical (e.g. surgical, sharp, hydro or gaseous), biological (larvae), autolytic (hydrogels) or biochemical (enzymes).

**Offloading:** The relief of mechanical stress (pressure) from a specific region of the foot.

**Offloading intervention:** Any intervention undertaken with the intention of relieving mechanical stress (pressure) from a specific region of the foot (includes surgical offloading techniques, offloading devices, footwear, and other offloading techniques).

**Diabetes-related foot disease hospitalisation\*:** Admission of a person into a hospital with a principal (primary reason for the admission) or additional (secondary reason for the admission) diagnosis of diabetes-related foot disease.<sup>23</sup>

**Foot screening:** To test for the presence or absence of diabetes-related foot disease.<sup>15</sup> For details on the contents of foot screening in people with diabetes, see the IWGDF prevention guideline.<sup>16</sup>

**Foot examination:** Detailed inspection of the foot in a person considered having diabetes-related foot disease.<sup>15</sup> For details on the contents of foot examination in people with diabetes, see the IWGDF prevention guideline.<sup>16</sup>

## 8 | CRITERIA FOR DIABETES-RELATED FOOT DISEASE

**Diabetes-related foot ulcer risk:** Criteria for foot ulcer risk in persons with current or previously diagnosed diabetes are defined in the IWGDF risk stratification system; please see the IWGDF prevention guideline for these criteria and their details.<sup>16</sup>

**Peripheral artery disease:** Criteria for diagnosing peripheral artery disease in people with diabetes and a foot ulcer are defined in the peripheral artery guideline; please see the IWGDF peripheral artery guideline for these criteria and their details.<sup>24</sup>

**Foot infection:** Criteria for diagnosing foot infection in people with diabetes are defined in the IWGDF/IDSA foot infection classification system; please see the IWGDF infection guideline for these criteria and their details.<sup>25</sup>

## 9 | CONSIDERATIONS

This document describes the most up to date international definitions and criteria for diabetes-related foot disease. Compared to the 2019 update,<sup>1</sup> the majority of definitions are unchanged or have had relatively minor changes, and if so, predominantly as the result of discussions within the IWGDF working groups or textual improvements for clarity.

The most major definitional change though concerns the definition of diabetes-related foot disease itself. In 2019, this was defined as "Infection, ulceration or destruction of tissues of the foot of a person with currently or previously diagnosed diabetes mellitus, usually accompanied by neuropathy and/or peripheral artery disease in the lower extremity". However, we noted that the second part of

this definition (“usually accompanied by...”) could lead to confusion or misinterpretation. From one perspective, people with either peripheral neuropathy or peripheral artery disease could be seen as not specifically having foot disease, while from another perspective their condition could be seen as already having impact on the foot. Following discussion and reflection, we have clarified and expanded the definition. The updated 2023 definition now clearly states that people with diabetes and peripheral neuropathy or peripheral artery disease, when present in the lower limb, are also included within the definition of diabetes-related foot disease.

The primary reason for this change to the definition of diabetes-related foot disease is to improve the communication with, and understanding of, people with the disease, their caregivers, and healthcare professionals about diabetes-related foot disease. If a person has either peripheral neuropathy or peripheral artery disease in their lower limb, we think it should be communicated that they have an ongoing disease that requires action to prevent their disease from becoming worse or more severe, such as developing a foot ulcer or infection. Such actions are, for example, described in the IWGDF prevention guideline.<sup>16</sup> The second reason for this change is to better reflect the actual numbers of people affected, and the disease burden caused, by foot pathologies related to diabetes mellitus.

We acknowledge that this change in definition suddenly enlarges the number of people affected by diabetes-related foot disease globally, potentially by a factor of seven.<sup>26</sup> This should not be seen as an artificial enlargement of a disease, but instead as a much more accurate estimation of the global numbers and global burden of disease caused by diabetes-related foot disease. With the collective pathologies that make up diabetes-related foot disease already frequently investigated together in epidemiological studies (e.g.,<sup>23,26</sup>), we suggest that this new definition should not pose major challenges for past or current research, as long as the various diabetes-related foot disease pathologies are also separately reported in studies.

The other major definitional changes mostly concern the definition of (active) neuro-osteoarthropathy. This definition was formulated by the inaugural Charcot working group, who wrote IWGDF guidelines on this specific topic.<sup>18</sup> Further discussions and clarifications concerning these definitions can be found in the Charcot guidelines.<sup>18</sup> Otherwise, a definition of ischaemia was added thanks to the intersocietal working group on peripheral artery disease, who realised that this term was frequently used, but often ill-defined.<sup>24</sup> Similarly, the infection working group added a definition on resolution of infection,<sup>25</sup> while the wound healing working group added a definition on wound debridement.<sup>27</sup>

Clear definitions and criteria continue to be vital for communication about a disease, whether that be communication with an individual patient sitting in front of you, with healthcare professionals managing the patient and their disease, or with global colleagues collectively researching the disease. This is especially the case in diabetes-related foot disease, where multiple disciplines are involved in clinical management and research. Since we published the first peer-reviewed set of definitions and criteria in 2019, we

have seen great uptake of these definitions in clinical practice research, with numerous publications using and citing these definitions as their basis. We hope this 2023 update of diabetes-related foot disease definitions and criteria will continue to be widely used.

#### AUTHOR CONTRIBUTIONS

Jaap J. van Netten wrote the first draft of this manuscript. All authors provided critical feedback and the first and subsequent drafts. All authors agree with the final manuscript.

#### ACKNOWLEDGEMENTS

We would like to thank William Jeffcoate (independent external expert) for his peer review of the manuscript.

#### CONFLICT OF INTEREST STATEMENT

Production of the 2023 IWGDF Guidelines was supported by unrestricted grants from Advanced Oxygen Therapy Inc., Essity, Mölnlycke, Reaplix, and Urgo Medical. These sponsors did not have any communication related to the systematic reviews of the literature or related to the guidelines with working group members during the writing of the guidelines and have not seen any guideline or guideline-related document before publication. All individual conflict of interest statement of authors of this guideline can be found at <https://iwgdfguidelines.org/about-iwgdf-guidelines/biographies/>.

#### DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

#### ETHICS STATEMENT

Not Applicable.

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**How to cite this article:** van Netten JJ, Bus SA, Apelqvist J, et al. Definitions and criteria for diabetes-related foot disease (IWGDF 2023 update). *Diabetes Metab Res Rev.* 2023;e3654. <https://doi.org/10.1002/dmrr.3654>