

GEORGIAN MEDICAL NEWS

ISSN 1512-0112

NO 9 (366) Сентябрь 2025

ТБИЛИСИ - NEW YORK



ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии
საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

Monthly Georgia-US joint scientific journal published both in electronic and paper formats of the Agency of Medical Information of the Georgian Association of Business Press.
Published since 1994. Distributed in NIS, EU and USA.

GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman (Кириллица)**, для текста на грузинском языке следует использовать **AcadNusx**. Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи.** Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - <http://www.spinesurgery.ru/files/publish.pdf> и http://www.nlm.nih.gov/bsd/uniform_requirements.html. В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректур авторам не высылаются, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or computer-printed on a single side of standard typing paper, with the left margin of 3 centimeters width, and 1.5 spacing between the lines, typeface - **Times New Roman (Cyrillic)**, print size - 12 (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf

In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned
Requirements are not Assigned to be Reviewed.**

ავტორთა საყურადღებო!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე, დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx**. შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემავსებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრაფიის ფოტოსურათები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შედეგების ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფხიხლებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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RECOMMENDATIONS FOR THE MANAGEMENT OF DIABETIC FOOT

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Abstract.

Diabetic foot disease remains a leading cause of non-traumatic lower-extremity amputations worldwide, contributing significantly to morbidity, mortality, and healthcare costs. This article synthesizes evidence-based recommendations from the International Working Group on the Diabetic Foot (IWGDF), International Diabetes Federation (IDF), and American Diabetes Association (ADA) to provide a comprehensive approach to prevention, classification, and management. Core principles include early identification of at-risk feet, patient education, biomechanical offloading, restoration of perfusion, infection control, and coordinated multidisciplinary care. Implementation of these strategies has been shown to reduce amputation rates and improve patient outcomes.

Key words. Diabetic foot, ulcer prevention, offloading, peripheral artery disease, infection management, multidisciplinary care.

Introduction.

The Escalating Challenge of the Diabetic Foot.

Diabetes-related foot disease represents one of the most serious and costly complications of diabetes mellitus, imposing a profound burden on individuals, healthcare systems, and societies worldwide. It is a complex clinical syndrome that culminates from a confluence of systemic pathologies, leading to a spectrum of foot-related problems including ulceration, infection, and tissue destruction, often resulting in lower-extremity amputation. The management of an active diabetic foot ulcer (DFU) is not merely a matter of local wound care; it is the management of a systemic disease manifesting in the lower limb. Consequently, an effective approach requires a comprehensive, evidence-based, and integrated strategy. The International Working Group on the Diabetic Foot (IWGDF) has been at the forefront of establishing such a strategy, producing and updating international consensus guidelines since 1999. The 2023 IWGDF Guidelines, developed in collaboration with other key societies such as the Infectious Diseases Society of America (IDSA), the European Society for Vascular Surgery (ESVS), and the Society for Vascular Surgery (SVS), represent the most current, rigorously evaluated global consensus on the prevention and management of diabetic foot disease. This review synthesizes these latest recommendations to provide a definitive overview of the evidence-based standards of care for clinicians and researchers [1,2].

The Global Burden: Epidemiology and Mortality:

The scale of the diabetic foot problem is inextricably linked to the global diabetes pandemic. With an estimated 537 million

people living with diabetes worldwide, the population at risk is immense and growing. The lifetime risk of a person with diabetes developing a foot ulcer is estimated to be between 19% and 34%, with a global prevalence of active DFUs among the diabetic population of approximately 6.3%. This prevalence varies significantly by region, with rates in North America (13.0%) being substantially higher than in Europe (5.1%) or Asia (5.5%).

These statistics position the DFU not as an acute, isolated event, but as a chronic disease state with a relapsing-remitting course. Recurrence rates are exceptionally high: approximately 40% of patients experience a recurrence within one year of healing, a figure that rises to 65% within five years. This pattern of relapse underscores the necessity of a paradigm shift in clinical management—from a focus on reactive treatment of an open wound to a proactive, lifelong strategy of surveillance and secondary prevention, analogous to the management of other chronic conditions like heart failure or cancer.

The consequences of DFU are severe. It is the leading precursor to non-traumatic lower-extremity amputations, preceding 80-85% of such procedures. It is estimated that a limb is lost to diabetes-related complications every 20 to 30 seconds worldwide. The mortality associated with DFU is alarmingly high, exceeding that of many common cancers. The five-year mortality rate for an individual with a DFU is approximately 30-40%. This figure escalates dramatically following an amputation, with a five-year mortality rate of 56.6% after a major amputation and exceeding 70% in some cohorts [3,4].

The Pathophysiological Triad: Neuropathy, Angiopathy, and Impaired Wound Healing.

The development and persistence of a DFU are driven by a complex interplay of underlying pathologies, often referred to as the pathophysiological triad: neuropathy, angiopathy (vascular disease), and a compromised immune response leading to impaired wound healing.

Diabetic Neuropathy is the primary initiating factor in the majority of DFUs. Chronic hyperglycemia induces metabolic derangements, such as the activation of the polyol pathway and the formation of advanced glycation end-products (AGEs), which are directly toxic to nerve cells. This damage manifests in three ways:

□ **Sensory Neuropathy:** Leads to the loss of protective sensation (LOPS), rendering the foot insensate to pain, pressure, and temperature. This allows repetitive microtrauma or acute injury to go unnoticed, leading to skin breakdown.

□ **Motor Neuropathy:** Causes atrophy of the small intrinsic muscles of the foot, leading to an imbalance between flexor and extensor muscle groups. This results in structural

foot deformities such as hammertoes, claw toes, and prominent metatarsal heads, which create areas of focal high plantar pressure during ambulation.

□ **Autonomic Neuropathy:** Disrupts the regulation of sweat and oil glands, leading to dry, inelastic skin that is prone to cracking and fissuring. It also contributes to arteriovenous shunting, which can paradoxically make an ischemic foot feel warm to the touch, masking underlying vascular compromise.

• **Angiopathy**, primarily in the form of peripheral artery disease (PAD), is a critical factor that impairs wound healing and dramatically increases amputation risk. PAD is present in up to 50% of patients with a DFU. In individuals with diabetes, PAD has a distinct pattern: it tends to affect younger individuals and is characterized by multi-segmental, calcified, and predominantly distal (below-the-knee) arterial occlusions. This pattern can make diagnosis and revascularization more challenging.

• **Impaired Wound Healing** is the third component, creating a biological environment that prevents the closure of ulcers initiated by neuropathy and perpetuated by ischemia. The diabetic wound is stalled in a chronic pro-inflammatory state. This is driven by multiple molecular dysfunctions, including dysregulated neutrophil activity (NETosis), hyperactivity of matrix metalloproteinases (MMPs) which degrade the extracellular matrix, reduced local concentrations of essential growth factors like vascular endothelial growth factor (VEGF), and dysfunction of endothelial progenitor cells (EPCs) crucial for angiogenesis. This complex pathophysiology creates a vicious cycle: neuropathy allows the ulcer to form from mechanical stress, while the systemic diabetic state and local ischemia create a non-permissive biological environment that prevents it from healing. This dual mechanism explains why management must address both the mechanical cause (e.g., offloading) and the underlying biological deficits [1,5-9].

The Imperative for Evidence-Based, Integrated Care:

Given the complexity of diabetic foot disease, effective management cannot be delivered by a single practitioner or with a single intervention. The IWGDF guidelines are built on the foundational principle that care must be evidence-based, systematic, and delivered by an integrated, multidisciplinary team. The evolution of the guidelines to the 2023 version reflects a commitment to increasing methodological rigor, notably through the adoption of the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework. This system ensures that recommendations are transparently linked to the quality of the underlying evidence and a careful weighing of benefits, harms, costs, and patient preferences. The consistent finding that implementation of these principles within a multidisciplinary framework is associated with a significant decrease in amputation rates provides a clear mandate for their universal adoption [1].

Foundational Strategies: Prevention of the First and Recurrent Ulcer.

Prevention is the most effective and cost-effective strategy for reducing the global burden of diabetic foot disease. The 2023 IWGDF Prevention Guideline provides a clear, evidence-based framework for proactive care, centered on the early

identification of the "at-risk" foot and the implementation of five key preventative pillars.

Systematic Screening and Risk Stratification:

The cornerstone of any prevention program is the systematic identification of individuals at risk of ulceration. This requires a structured screening process for all individuals with diabetes, followed by risk stratification to tailor the intensity and frequency of subsequent care. The IWGDF recommends an annual foot screening for all individuals with diabetes who are currently at very low risk (IWGDF Risk 0). This initial screen is designed to detect the two most critical risk factors: loss of protective sensation (LOPS) and peripheral artery disease (PAD). LOPS can be reliably assessed at the bedside using simple tools like the 10-g Semmes-Weinstein monofilament or a 128 Hz tuning fork. The initial assessment for PAD involves taking a relevant history and palpating for pedal pulses. Once an individual is identified as having LOPS or PAD, they are classified as "at-risk" (IWGDF Risk 1 or higher), and the frequency and comprehensiveness of screening must increase. Further assessments should then include screening for a history of prior ulcer or amputation, the presence of end-stage renal disease, foot deformities, limited joint mobility, and any pre-ulcerative signs such as excessive callus or subcutaneous hemorrhage. The 2023 IWGDF Risk Stratification System provides a clear framework for this process, as detailed in Table 1 [1,10-16].

The Five Pillars of Prevention: An Integrated Approach:

For all individuals identified as being at risk (IWGDF Risk 1-3), a multi-faceted preventative strategy should be implemented, encompassing five key pillars.

Structured Patient Education and Self-Management:

Providing structured, organized, and repeated education is a strong recommendation, aimed at improving a patient's self-care knowledge, enhancing self-protective behaviors, and motivating adherence. Key educational messages that must be conveyed and reinforced include:

- **Daily Foot Inspection:** Patients must be taught to inspect the entire surface of both feet daily, including between the toes, using a mirror if necessary, and to report any abnormality (e.g., blister, cut, redness, swelling) to a healthcare professional immediately.

- **Foot Hygiene:** Daily washing with lukewarm water (below 37°C) and careful drying, especially between the toes, is essential. Emollients should be used to lubricate dry skin, but not applied between the toes.

- **Appropriate Nail Care:** Toenails should be cut straight across to avoid ingrown nails.

- **Avoiding Trauma:** Patients must be strongly advised against walking barefoot, in socks without shoes, or in thin-soled slippers, both indoors and outdoors. They should also avoid using chemical agents or plasters to remove corns and calluses. A significant evolution in the 2023 guidelines is the move towards technology-assisted self-management. This represents a paradigm shift from passive patient education ("look at your feet") to active, data-driven patient engagement ("measure and act on this data"). The guidelines now include a conditional recommendation to consider coaching moderate-to-high risk patients in the daily self-monitoring of foot skin temperatures

Table 1. The 2023 IWGDF Risk Stratification System and Recommended Screening Frequencies.

IWGDF Risk Category	Characteristics	Recommended Screening Frequency
0 (Very Low Risk)	No Loss of Protective Sensation (LOPS) and No Peripheral Artery Disease (PAD)	Once a year
1 (Low Risk)	LOPS or PAD present	Once every 6-12 months
2 (Moderate Risk)	LOPS + PAD, or LOPS + Foot Deformity, or PAD + Foot Deformity	Once every 3-6 months
3 (High Risk)	LOPS or PAD, and one or more of the following: history of foot ulcer, lower-extremity amputation, or end-stage renal disease	Once every 1-3 months

Table 2. Recommended Classification Systems (SINBAD, Wifl, IWGDF/IDSA) and Their Clinical Applications.

Classification System	Key Components	Primary Purpose	IWGDF Recommendation (2023)
SINBAD	Site, Ischaemia, Neuropathy, Bacterial Infection, Area, Depth	Communication among health professionals; Audit of outcomes in populations	Strong
IWGDF/IDSA	Clinical signs of inflammation (local and systemic)	Classifying the presence and severity of infection	Strong
Wifl	Wound, Ischaemia, foot Infection	Assessing perfusion, stratifying amputation risk, and predicting the benefit of revascularization	Conditional

Table 3. Summary of Key Recommendations for Offloading Plantar Neuropathic Ulcers.

Treatment Choice	Recommended Intervention(s)	Strength of Recommendation (2023)
First-Choice	Non-removable knee-high device (Total Contact Cast or irremovable walker)	Strong
Second-Choice	Removable knee-high or ankle-high offloading device (adherence must be encouraged)	Conditional
Third-Choice	Felted foam in combination with appropriately fitting footwear (if devices are unavailable)	Conditional
Surgical (for non-healing ulcers)	Achilles tendon lengthening, metatarsal head resection, or joint arthroplasty	Conditional
Surgical (first-line for specific ulcers)	Digital flexor tenotomy for ulcers on the apex of flexible hammertoes	Strong

Table 4. The IWGDF/IDSA Classification of Diabetic Foot Infection Severity.

Clinical Classification	IWGDF/IDSA Grade	Defining Clinical Signs and Symptoms
Uninfected	1	No signs or symptoms of infection.
Mild Infection	2	Presence of ≥ 2 inflammatory signs; cellulitis/erythema extends ≤ 2 cm from wound margin; infection limited to skin and subcutaneous tissue.
Moderate Infection	3	As above, but with cellulitis/erythema extending > 2 cm, or infection involving structures deeper than skin (e.g., abscess, osteomyelitis, septic arthritis), and no systemic inflammatory response signs.
Severe Infection	4	Any foot infection with the signs of the Systemic Inflammatory Response Syndrome (SIRS).

Table 5. Based on current evidence, the authors advocate the following integrated clinical protocol.

Parameter	Recommendation
Target Population	All patients with a diabetic foot ulcer, with particular emphasis on those with confirmed vitamin D deficiency.
Target 25(OH)D Level	≥ 30 ng/mL
Formulation	Cholecalciferol (Vitamin D3), oral administration.
Dosage Strategy	Loading Phase: 4,000–6,000 IU/day <i>or</i> 50,000–60,000 IU weekly for 8–12 weeks. Maintenance Phase: 1,000–2,000 IU/day <i>or</i> equivalent weekly/monthly regimen once target level is achieved.
Monitoring	Baseline and follow-up assessments of: - Serum 25(OH)D - HbA1c - Ulcer area and healing rate - Inflammatory markers (CRP, ESR)

using an infrared thermometer. An increase in temperature at a specific site on one foot compared to the corresponding site on the other foot of more than 2.2°C (4.0°F) for two consecutive days is indicative of sub-clinical inflammation. This finding should trigger a pre-agreed action plan, such as reducing ambulatory activity and contacting their foot care provider. This strategy empowers the patient to detect inflammation before a visible ulcer develops, enabling early and preventative intervention [1,13,14].

Evidence-Based Prescription of Therapeutic Footwear:

Inappropriate footwear is a leading cause of traumatic ulceration in the neuropathic foot. The 2023 guidelines provide more granular, evidence-based recommendations for footwear prescription, tailored to the patient's specific risk profile and foot structure:

- For individuals at risk but with no or limited foot deformity (IWGDF Risk 1-3), properly fitting, accommodative therapeutic footwear that provides adequate length (1-2 cm longer than the foot), width, and depth is sufficient.
- For individuals with significant foot deformity, pre-ulcerative signs, or a history of a non-plantar ulcer (IWGDF Risk 2 or 3), prescription of extra-depth shoes, custom-made footwear, or custom-made insoles should be considered to accommodate the deformity and reduce focal pressures.
- For individuals with a healed plantar foot ulcer (IWGDF Risk 3), the standard for secondary prevention is higher. Therapeutic footwear must have a demonstrated plantar pressure-relieving effect during walking. This can be verified with in-shoe pressure measurement systems, aiming for a peak pressure below 200 kPa or a reduction of at least 30% at high-risk sites. Patients must be encouraged to wear this footwear at all times, including indoors [1,16].

Treatment of Pre-Ulcerative Lesions and Risk Factors:

The prompt and effective treatment of any pre-ulcerative sign is a strong recommendation and a critical component of ulcer prevention. This includes professional debridement of abundant callus, protection and drainage of blisters, and treatment of ingrown nails or fungal infections. Furthermore, there is a growing confidence in the use of minimally invasive surgical procedures as a preventative measure for specific biomechanical problems. The 2023 guidelines include a conditional recommendation to consider a digital flexor tenotomy for individuals with a non-rigid hammertoe that is causing pre-ulcerative lesions (such as excessive callus or nail changes) on the apex of the toe. This marks a significant evolution from reserving surgery for active ulcers to employing it proactively to correct the underlying deformity and prevent the initial or recurrent ulceration. This shift suggests that for certain deformities, the risk of a simple prophylactic procedure is now considered potentially lower than the risk of developing a complex, hard-to-heal ulcer.

The Role of Integrated Foot Care Services:

The final pillar, which integrates all others, is the provision of care within a structured, integrated system. The 2023 guidelines strongly recommend that all individuals at moderate or high risk (IWGDF Risk 2 and 3) receive integrated foot care. This model ensures that the patient has regular access to professional foot care (e.g., for debridement of pre-ulcerative

lesions), is prescribed and fitted with appropriate footwear, and receives ongoing structured education. This integrated approach, delivered by a multidisciplinary team, is fundamental to preventing both first and recurrent ulcers [1,16,17].

Management of the Active Diabetic

Foot Ulcer: A Multimodal Approach.

The management of an established DFU requires a systematic, multimodal approach that simultaneously addresses the wound itself and the underlying pathologies driving its persistence. The 2023 IWGDF Guidelines provide a clear, evidence-based framework for this process, beginning with standardized assessment and proceeding through the core therapeutic interventions of offloading, perfusion restoration, and infection control [13].

Initial Assessment: Standardized Classification for Triage and Prognosis: A standardized initial assessment is critical to facilitate clear communication among healthcare professionals, guide initial treatment decisions, and allow for the auditing of clinical outcomes. The IWGDF recognizes that no single classification system can serve all purposes and therefore recommends the use of specific, validated systems for distinct clinical questions. A crucial evolution in the 2023 guidelines is the explicit decoupling of classification for population-level audit and communication from the prognosis of an individual patient. This reflects a critical understanding that while systems can predict outcomes across a large group, their accuracy is insufficient for reliable prediction in a single case.

The Cornerstone of Healing: Evidence-Based Offloading:

For neuropathic plantar ulcers, effective pressure redistribution, or offloading, is arguably the single most important intervention to facilitate healing. The IWGDF provides a clear, evidence-based hierarchy of offloading modalities [18-20].

The strong recommendation for a non-removable knee-high device as the first-line treatment is based on high-quality evidence demonstrating superior healing rates compared to removable devices, primarily because they enforce adherence. The 2023 update groups removable knee-high and ankle-high devices together as the second choice, reflecting new evidence and a person-centered approach that balances offloading capacity with likely patient adherence. For ulcers that fail to heal despite optimal non-surgical offloading, surgical intervention to correct underlying structural deformities should be considered. A significant update in the 2023 guidelines is the strong recommendation to use digital flexor tenotomy as a first-line treatment for neuropathic ulcers on the apex of flexible hammertoes [1,20].

Diagnosing and Managing Peripheral Artery Disease (PAD):

The presence of PAD dramatically worsens the prognosis of a DFU. The 2023 IWGDF guideline on PAD provides a comprehensive pathway.

- **Diagnostic Pathway:** Diagnosis begins at the bedside. Objective vascular testing is mandatory for every DFU, including assessment of pedal Doppler arterial waveforms, ankle-brachial index (ABI), and toe-brachial index (TBI). Medial arterial calcification can falsely elevate the ABI, making the TBI and waveform analysis particularly important.

- **Prognostication and the Wifl Classification:** The most useful bedside tests for predicting healing are toe pressure (TP) and transcutaneous oxygen pressure (TcPO₂). A TP of ≥ 30 mmHg or a TcPO₂ of ≥ 25 mmHg increases the probability of healing. The Wifl classification system is conditionally recommended to integrate these findings with wound severity and infection status for comprehensive risk stratification.

- **Revascularization:** Revascularization should be considered for any DFU that is not healing. The 2023 guidelines provide a pragmatic, time-bound framework: if a DFU fails to reduce in area by at least 50% within 4 weeks of optimal standard care, the patient's vascular status should be reassessed and a vascular specialist consulted. The goal is to restore direct, in-line pulsatile blood flow to at least one of the foot arteries, preferably the one supplying the anatomical region (angiosome) of the ulcer [1,21].

Diagnosis and Treatment of Diabetic Foot Infection:

Infection is a common and limb-threatening complication of DFU. The 2023 IWGDF/IDSA combined guideline provides a systematic approach to its diagnosis and management.

- **IWGDF/IDSA Classification and Biomarkers:** Infection is a clinical diagnosis, based on the presence of two or more classic signs of inflammation (redness, warmth, swelling, tenderness, or purulent discharge). The severity of infection is then graded using the IWGDF/IDSA classification system, which is essential for guiding therapeutic decisions, such as the need for hospitalization and the route of antibiotic administration (Table 4). In cases where the clinical diagnosis is equivocal, serum inflammatory biomarkers can serve as useful adjunctive tests. An elevated C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), or procalcitonin (PCT) can support the diagnosis of infection. An ESR greater than 70 mm/hr is particularly suggestive of underlying osteomyelitis [1,17].

- **Microbiological Assessment and Antimicrobial Stewardship:** To guide definitive antibiotic therapy, a specimen for culture should be obtained from nearly all clinically infected wounds after cleansing and debridement. The evidence strongly supports that a tissue specimen, obtained via biopsy or curettage, is superior to a superficial swab for identifying true pathogens and avoiding contaminants. A significant and new recommendation in the 2023 guidelines is the strong advice against the routine, first-line use of molecular microbiology techniques (e.g., PCR, sequencing) for diagnosis. While these methods identify a greater diversity of organisms, their clinical significance is often unclear, and they do not typically provide antibiotic susceptibility data, which is crucial for treatment.

- **Management of Soft Tissue Infection and Osteomyelitis: Medical and Surgical Approaches:** The choice of empiric antibiotic therapy depends on infection severity, recent antibiotic exposure, and local epidemiology. For mild infections in temperate climates in patients with no recent antibiotic use, targeting only aerobic Gram-positive cocci (e.g., *Staphylococcus aureus*, *Streptococci*) is often sufficient. For moderate-to-severe infections, or in tropical climates, broader-spectrum coverage for Gram-negative rods and sometimes anaerobes is necessary. The duration of therapy for

soft tissue infections is typically 1 to 2 weeks. For osteomyelitis, a longer course is required. If treated medically without bone resection, a course of up to 6 weeks is recommended. However, if all infected and necrotic bone is surgically removed, a short post-operative course of just a few days may be sufficient. Surgical intervention is a critical component of infection management. Urgent surgical consultation is mandatory for any severe infection, or for moderate infections complicated by deep abscess, extensive gangrene, or necrotizing fasciitis. For osteomyelitis, while surgical resection of infected bone has been the traditional standard, there is growing evidence that in selected cases (e.g., uncomplicated forefoot osteomyelitis with no other indication for surgery), a primary medical approach with antibiotics alone can be effective [1,15].

A Critical Review of Adjunctive Wound Healing Interventions:

While the core tenets of DFU management are offloading, perfusion, and infection control, a vast market of adjunctive therapies exists. The 2023 IWGDF Wound Healing Guideline, based exclusively on evidence from randomized controlled trials (RCTs), provides a sober assessment of these interventions. The overarching theme is a widespread lack of high-quality evidence, leading to a large number of "do not use" or conditional recommendations. This reflects a high bar for recommending therapies that add significant cost to the standard of care. This critical appraisal underscores a unified clinical pathway that is evident across all management domains: an initial, aggressive application of the standard of care (offloading, debridement, infection control, perfusion assessment), followed by a structured re-evaluation at a 2–4-week timepoint. This timepoint serves as a critical decision node. If the wound is not progressing satisfactorily, only then should the escalation to select, conditionally recommended, and often costly adjunctive therapies be considered [1].

Systemic and Local Therapeutic Horizons: A Modern Paradigm.

Building on the foundational principles of care, a modern paradigm integrates strategies that actively enhance the patient's intrinsic healing capacity and protect the compromised local tissue environment.

Systemic Optimization: The Pleiotropic Role of Vitamin D in Wound Healing.

While glycemic control is paramount, emerging evidence highlights the crucial role of other systemic factors in creating a biological environment conducive to healing. Vitamin D deficiency is highly prevalent in patients with type 2 diabetes and has been linked to impaired immune function, increased inflammation, and poor wound healing outcomes. A landmark 2024 meta-analysis provided compelling evidence for the benefits of Vitamin D supplementation in patients with DFUs. The study demonstrated that correcting Vitamin D deficiency significantly improves the overall probability of healing (**RR = 1.42, P = 0.03**), increases the percentage of ulcer area reduction (**MD = 13.11%, P < 0.01**), and decreases the absolute wound area (**MD = -3.29 cm², P < 0.01**). The benefits extend beyond the local wound, with notable improvements in metabolic and inflammatory parameters:

- **Glycemic Control:** A mean reduction in HbA1c of **-0.44%** ($P < 0.01$).

- **Inflammation and Oxidative Stress:** Significant reductions in hsCRP (**-0.83 mg/L**) and ESR (**-15.74 mm/hr**).

To effectively and rapidly correct deficiency and maximize patient adherence, high-dose weekly regimens are a practical and evidence-supported strategy. Oral cholecalciferol formulations that provide 50,000 IU weekly are designed to ensure a sustained release and stable elevation of serum 25(OH) D levels. This approach simplifies the treatment protocol for patients often managing polypharmacy, thereby optimizing the potential for systemic benefits [22-24].

Advanced Local Management: From Skin Barrier Protection to Wound Repair:

On the diabetic foot, there is no such thing as a "minor" wound. Proactive local care is therefore essential, not only to treat existing ulcers but to prevent them from developing. Advanced multi-action ointments are formulated to address the complex pathophysiology of the diabetic wound. Based on a synergistic combination of components, their mechanism of action is multifaceted:

- **Regenerative Action:** Biological peptides or other compounds stimulate keratinocyte proliferation and migration, enhance collagen synthesis, and promote angiogenesis—the foundational processes of tissue repair.

- **Anti-Inflammatory Effect:** phytosterols (such as β -sitosterol) actively reduce local inflammation and edema by suppressing pro-inflammatory cytokines, helping to break the cycle of a chronically inflamed wound.

- **Antibacterial Protection:** Certain natural or synthetic agents provide a broad antibacterial effect by damaging bacterial cell membranes and inhibiting protein synthesis, reducing the risk of secondary infection without contributing to systemic antibiotic resistance.

Unlike systemic vitamin D supplementation, where randomized controlled trials and meta-analyses provide a growing evidence base, the clinical efficacy of multifunctional topical ointments remains supported primarily by mechanistic studies, case series, or limited clinical trials. At present, no high-quality RCTs or systematic reviews robustly substantiate their routine use in DFU management. **This is therefore a domain where additional research is expected, and current recommendations should be interpreted with caution [24].**

An Integrated Clinical Protocol for Endocrinologists.

Based on current evidence, the authors advocate the following integrated clinical protocol. This is not a substitute for established guidelines (e.g., IWGDF), but a complementary framework designed to address systemic and local factors in diabetic foot ulcer management [1].

Protocol for Proactive Foot and Wound Care:

1. **Reinforce Patient Education at Every Visit:** Emphasize the critical importance of daily self-inspection and never walking barefoot.

2. **Aggressively Manage Pre-Ulcerative Lesions:** Ensure regular professional debridement of calluses, which can mask underlying tissue damage and dramatically increase plantar pressures.

3. **Prescribe Proactive Topical Care:** For patients with dry, cracking skin, fissures, or minor abrasions, recommend the application of a thin layer of a suitable multi-action regenerative ointment 1-2 times daily to cleansed skin. This helps restore the skin barrier, reduces inflammation, and prevents infection.

4. **Ensure Therapeutic Footwear:** Confirm that high-risk patients are consistently using appropriate, pressure-relieving footwear at all times.

The Organizational Mandate: The Multidisciplinary Foot Care Team.

The complexity of the evidence-based recommendations detailed in the 2023 IWGDF Guidelines makes it clear that optimal diabetic foot care cannot be delivered in silos. The sheer breadth of expertise required—spanning endocrinology, podiatry, vascular surgery, infectious diseases, orthopedics, and more—implicitly makes the multidisciplinary foot care team (MDFT) a non-negotiable standard of care rather than an optional best practice. A healthcare system that adopts the guidelines without providing the organizational structure of an MDFT is unlikely to achieve the desired outcomes.

Composition, Roles, and Responsibilities of the MDFT:

An effective MDFT is a coordinated group of specialists who collaborate to provide integrated care. While the exact composition may vary based on local resources, the IWGDF outlines an ideal structure:

- **Core Team:** This typically includes a diabetologist or endocrinologist to manage systemic disease, a specialist podiatrist to lead on preventative care and non-surgical wound management, and a vascular specialist (surgeon or interventionalist) for perfusion assessment and revascularization.

- **Extended Team:** Essential expertise is also provided by an orthopedic surgeon and/or plastic/reconstructive surgeon for complex wound closure and reconstructive procedures, an infectious diseases specialist for managing complex infections and antimicrobial stewardship, a clinical microbiologist, an orthotist for specialized footwear and bracing, and specialist nurses for wound care and patient education.

- **Primary Care and Community Services:** The primary care physician serves as a crucial gatekeeper for early risk identification and timely referral to the specialist team. Community podiatry and nursing services are vital for ongoing prevention and surveillance [25].

Implementing Integrated Care Pathways for Improved Outcomes:

The primary function of the MDFT is to implement a rapid and coordinated integrated care pathway. For patients with active foot disease, this means assessment by a member of the MDFT within 24 hours of presentation to establish a comprehensive management plan. This plan ensures that all critical aspects of care are addressed in parallel, not sequentially. For example, while a podiatrist initiates offloading and debridement, a vascular specialist can simultaneously assess for PAD, and an infectious diseases specialist can guide antibiotic therapy. This concurrent, collaborative approach is proven to reduce delays, improve decision-making, and ultimately lead to better outcomes, most notably a significant reduction in major amputation rates [1,26,27].

Conclusions and Future Directions.

Synthesizing the Key Recommendations for Clinical Practice:

The 2023 IWGDF Guidelines provide a comprehensive, evidence-based roadmap for reducing the devastating burden of DFD. The key clinical mandates are clear:

1. **Prioritize Prevention:** Implement systematic screening and risk stratification for all patients with diabetes, and deliver integrated preventative care—including education, footwear, and treatment of pre-ulcerative lesions—to all those identified as at-risk.

2. **Standardize Assessment:** Use validated classification systems (SINBAD, IWGDF/IDSA, WIfI) for their intended purposes of communication, infection grading, and perfusion assessment to guide initial management.

3. **Aggressively Implement Standard of Care:** For active plantar ulcers, the non-negotiable first-line treatments are effective offloading (preferably with a non-removable knee-high device), restoration of adequate perfusion, and control of infection.

4. **Adopt a Time-Bound Approach:** Re-evaluate all ulcers after 2-4 weeks of standard care. Lack of healing progression should trigger an escalation of therapy, including consideration of revascularization, surgical offloading, or select adjunctive wound healing interventions.

5. **Deliver Care via an MDFT:** The complexity of modern, evidence-based diabetic foot management necessitates a coordinated, multidisciplinary team approach to ensure all facets of the disease are addressed promptly and effectively.

Addressing the Gaps: A Global Research Agenda:

The 2023 guidelines also illuminate critical gaps in the current evidence base, setting a clear agenda for future research. The collective research priorities signal a maturation of the field, moving beyond basic efficacy questions to more sophisticated inquiries into personalization, value, and patient-centeredness. This is the new frontier for diabetic foot research. Key priorities include:

- **Improving Evidence Quality:** There is an overarching need for more high-quality RCTs across all domains, with rigorous methodology, adequate sample sizes, and adherence to established reporting standards.

- **Health Economics and Patient-Reported Outcomes:** Future trials must incorporate formal health economic analyses to determine the cost-effectiveness of interventions and include patient-reported outcomes, such as health-related quality of life, to ensure that treatments are not only clinically effective but also valuable from the patient's perspective.

- **Personalized Medicine:** Research is needed to better define which patient subgroups benefit most from specific interventions. This includes developing and validating prognostic tools for individual patients, potentially using machine learning, and identifying the optimal timing and combination of therapies.

- **Specific Clinical Questions:** Targeted research is required to determine optimal screening frequencies, the most effective educational and behavioral interventions to improve adherence, the role of novel revascularization and molecular

diagnostic technologies, and the true efficacy of the many adjunctive wound healing products on the market.

By embracing the current evidence-based recommendations and actively pursuing this research agenda, the global healthcare community can continue to improve outcomes for individuals with DFD, reducing the incidence of ulceration, amputation, and mortality.

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