PERI EDU

PERI-IMPLANTITIS BEYOND BIOFILM

Inflammatory response, systemic disease, and new directions in risk assessment.

EDUCATIONAL MATERIAL FOR DENTAL PROFESSIONALS

PERI-EDU – Integrating peri-implantitis research into higher education curriculum

Co-funded by the European Union

WWW.PERI-EDU.UMW.EDU.PL

INTRODUCTION

Peri-implantitis remains one of the most challenging complications in contemporary implant dentistry. For many years, the disease has been described mainly as a consequence of bacterial biofilm and the local inflammatory response around an implant. This model is still fundamental to diagnosis and prevention, but it is becoming increasingly clear that it does not explain the full clinical variability of the disease.

In some patients, inflammation around an implant develops slowly and responds well to treatment. In others, it progresses more rapidly, leading to bone loss, recurrence, and difficult therapeutic decisions. Similar oral hygiene, a similar local clinical picture, or a similar prosthetic restoration does not always mean a similar prognosis.

This e-book presents peri-implantitis as a multifactorial disease developing at the intersection of biofilm, host immune response, systemic diseases, metabolism, local peri-implant conditions, and potential inflammatory markers. It is not a treatment manual, but a concise guide to the logic of the PERI-EDU project: from the classical biofilm model to a more integrated understanding of the implant patient.

PERI EDU

CHAPTER 1

PERI-IMPLANTITIS DOES NOT END WITH BIOFILM

WWW.PERI-EDU.UMW.EDU.PL

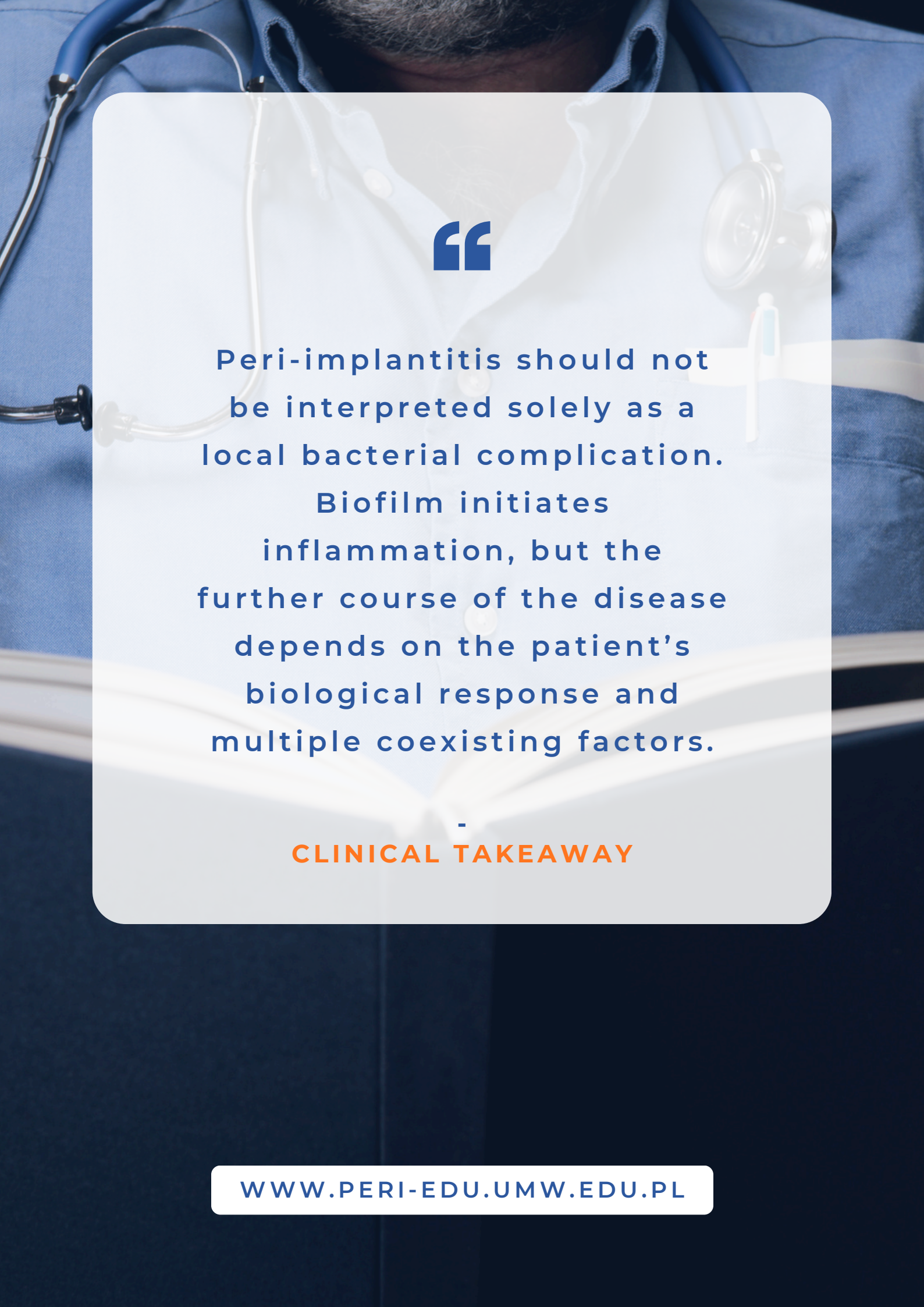
PERI-IMPLANTITIS DOES NOT END WITH BIOFILM

Bacterial biofilm remains the main factor initiating inflammation of peri-implant tissues. It triggers a local immune response that, under unfavorable conditions, may progress from peri-implant mucositis to peri-implantitis with bone loss.

However, biofilm alone does not explain the full course of the disease. In clinical practice, patients with similar local conditions may show very different rates of progression. This is why increasing attention is being paid not only to the presence of bacteria, but also to how the patient's organism responds to this challenge.

The host response is central. Pro-inflammatory cytokines such as IL-1β, IL-6, and TNF-α may enhance osteoclast activity and promote bone resorption. If the inflammatory reaction is excessive, chronic, or insufficiently resolved, a local stimulus may lead to disproportionate tissue destruction.

This is why peri-implantitis should be viewed as a disease at the intersection of microbiology, immunology, biomechanics, material science, and general medicine. This approach does not deny the importance of biofilm, but shows that biofilm is the beginning of the process, not its only explanation.



Peri-implantitis should not be interpreted solely as a local bacterial complication. Biofilm initiates inflammation, but the further course of the disease depends on the patient's biological response and multiple coexisting factors.

-

CLINICAL TAKEAWAY

WWW.PERI-EDU.UMW.EDU.PL

PERI EDU

CHAPTER 2

WHY CAN PERI-IMPLANTITIS PROGRESS FASTER THAN PERIODONTITIS?

WWW.PERI-EDU.UMW.EDU.PL

WHY CAN PERI-IMPLANTITIS PROGRESS FASTER THAN PERIODONTITIS?

Peri-implantitis is often compared to periodontitis developing around an implant. This comparison is understandable, but incomplete. Both diseases involve biofilm and a chronic inflammatory response, but tissues around an implant differ from tissues around a natural tooth.

An implant has no periodontal ligament. Its connection with bone is based on osseointegration, and the organization of soft tissues around the implant is different. In practice, this may mean a weaker barrier against chronic inflammatory infiltration and easier spread of the process toward the bone.

Peri-implantitis may involve a more extensive inflammatory infiltrate, faster bone loss, and a more limited regenerative capacity of tissues. Therefore, even minor signs of inflammation around an implant should not be underestimated. The disease may remain relatively silent for a long time while still leading to significant loss of bone support.

Local factors are also important: implant surface characteristics, difficulty of decontamination, cement remnants, overload, prosthetic misfit, and limited access for hygiene. In implant dentistry, the environment around the implant is largely shaped by surgical and prosthetic decisions.

“

An implant is not biologically the same as a tooth. Peri-implantitis may progress faster and less predictably than periodontitis, which is why regular monitoring and early response to the first signs of inflammation are essential.

-

CLINICAL TAKEAWAY

WWW.PERI-EDU.UMW.EDU.PL

PERI EDU

CHAPTER 3

THE IMPLANT PATIENT AS A SYSTEMIC PATIENT

WWW.PERI-EDU.UMW.EDU.PL

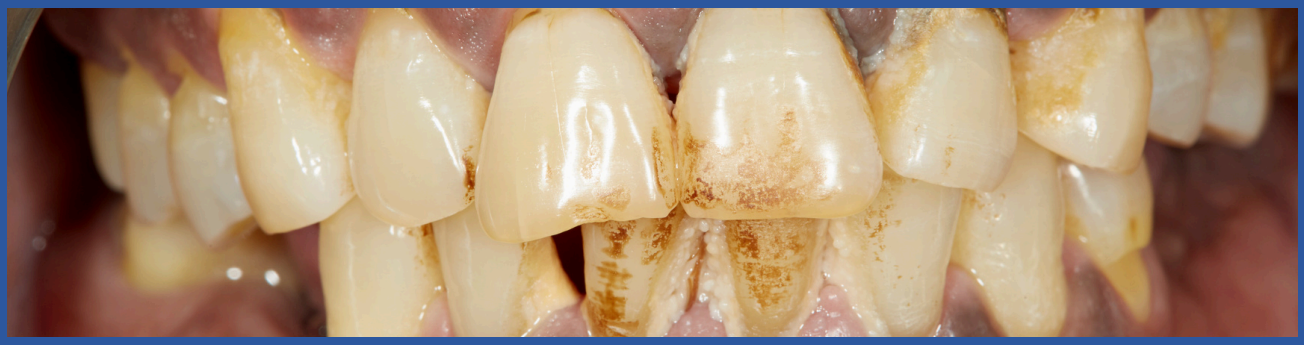
THE IMPLANT PATIENT AS A SYSTEMIC PATIENT

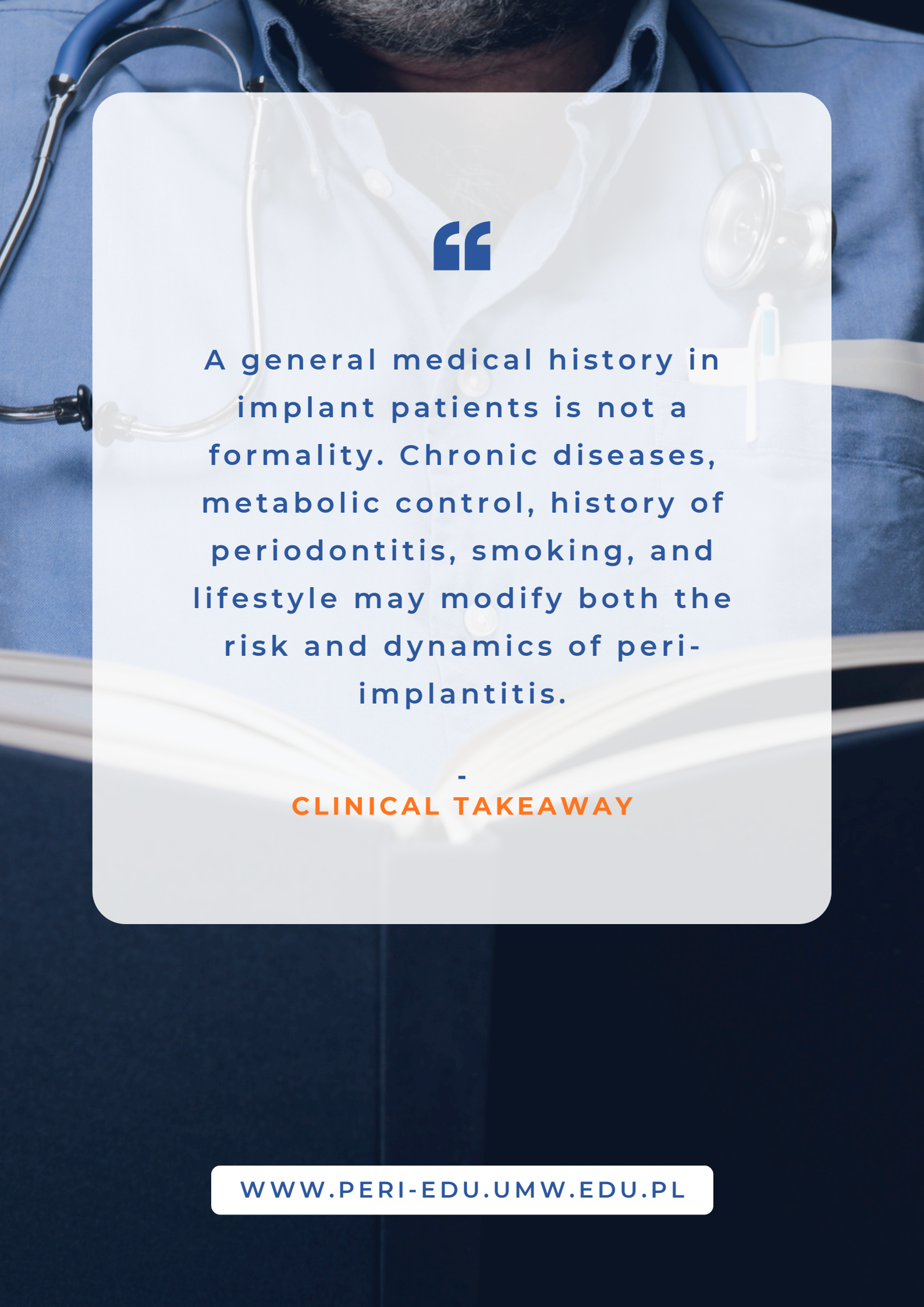
The long-term success of implant treatment depends not only on implant position, bone quality, prosthetic design, and oral hygiene. It also depends on the organism in which the implant will function over the following years.

A patient with an implant has a specific medical history, metabolism, immune profile, lifestyle, and potential inflammatory burden. Diabetes, obesity, metabolic syndrome, cardiovascular disease, osteoporosis, and autoimmune disorders are not always direct causes of peri-implantitis. However, they may create an environment in which inflammation develops more easily, healing is less effective, and bone metabolism is less favorable.

Poorly controlled type 2 diabetes is particularly relevant. Hyperglycemia may promote oxidative stress, impaired collagen turnover, delayed wound healing, and an intensified inflammatory response. Obesity and metabolic syndrome, in turn, are associated with chronic low-grade inflammation, which may affect peri-implant tissues.

A history of periodontitis is also highly important. A patient who has lost teeth due to periodontal disease does not become biologically “new” after implant placement. They may still be susceptible to dysbiosis, excessive inflammatory response, and the need for consistent supportive care.





A general medical history in implant patients is not a formality. Chronic diseases, metabolic control, history of periodontitis, smoking, and lifestyle may modify both the risk and dynamics of peri-implantitis.

-

CLINICAL TAKEAWAY

WWW.PERI-EDU.UMW.EDU.PL

PERI EDU

CHAPTER 4

CAN BLOOD TESTING COMPLEMENT PATIENT ASSESSMENT?

WWW.PERI-EDU.UMW.EDU.PL

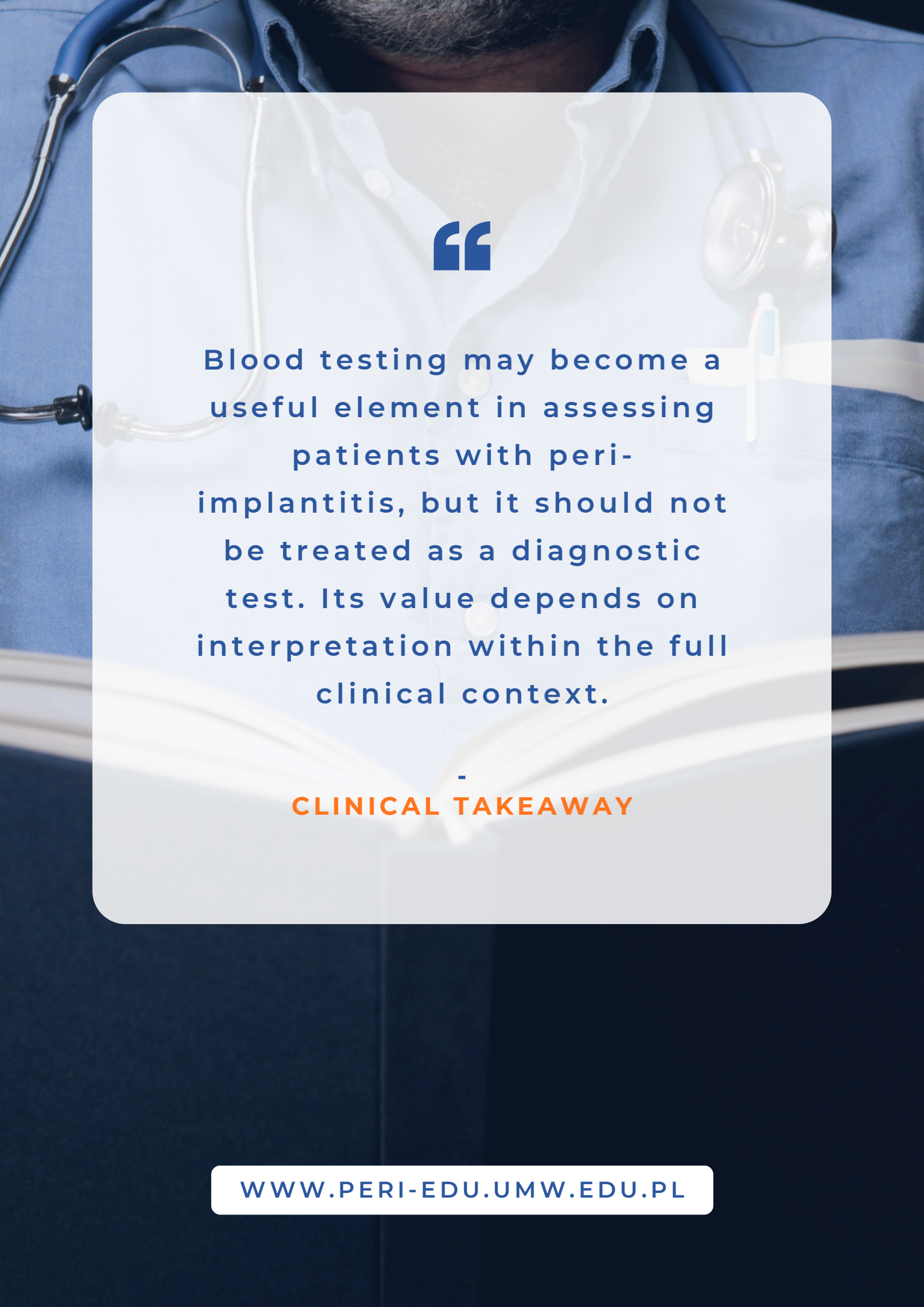
CAN BLOOD TESTING COMPLEMENT PATIENT ASSESSMENT?

Peri-implantitis is diagnosed primarily through clinical and radiological assessment. The foundation remains probing, bleeding on probing, pocket depth, suppuration, soft tissue condition, evaluation of bone loss, and analysis of prosthetic factors. Blood tests do not replace this diagnostic process.

However, they may in the future become a useful complement. If peri-implantitis also has a systemic dimension, it is reasonable to ask whether blood parameters can help describe the patient's inflammatory background. The aim is not to diagnose the disease based on CRP or blood count, but to better understand whether the patient's organism shows signs of increased immune-inflammatory activation.

Classical markers such as CRP, WBC, IL-6, TNF-α, and IL-1β are well known and relatively easy to measure. Their limitation is nonspecificity. They may change in infections, chronic diseases, trauma, inflammatory stress, pharmacotherapy, or metabolic disorders.

Therefore, their value does not lie in independently diagnosing peri-implantitis, but in complementing the broader patient picture. A laboratory result becomes meaningful only when interpreted together with clinical examination, radiology, history of periodontitis, systemic diseases, medications, and risk factors.



Blood testing may become a useful element in assessing patients with peri-implantitis, but it should not be treated as a diagnostic test. Its value depends on interpretation within the full clinical context.

-

CLINICAL TAKEAWAY

PERI EDU

CHAPTER 5

FROM SINGLE MARKERS TO COMPOSITE INDICES

WWW.PERI-EDU.UMW.EDU.PL

FROM SINGLE MARKERS TO COMPOSITE INDICES

Single inflammatory markers show only one fragment of the biological response. CRP signals inflammatory activity, leukocytes reflect basic immune response, and pro-inflammatory cytokines participate in mechanisms of tissue destruction and bone resorption. These are important data, but they do not describe the full immune balance.

This is why aggregated indices, most often based on routine blood count parameters, are attracting growing interest. NLR, PLR, MLR, SII, SIRI, and AISI/PIV attempt to capture relationships between different cell populations: neutrophils, lymphocytes, monocytes, and platelets.

Their advantage is that they do not rely on a single signal. They try to synthetically describe the balance between pro-inflammatory, effector, vascular, and regulatory components of the immune response. In a disease as complex as peri-implantitis, this may be more useful than interpreting one isolated parameter

This does not mean that composite indices are ready-made clinical tools. In peri-implantitis, they remain an area requiring further research. They may be particularly interesting in the assessment of patients with chronic diseases, a history of periodontitis, metabolic disorders, or rapid disease progression not fully explained by the local clinical picture.

“

The transition from CRP to SII represents a shift in thinking: from a single inflammatory signal to an attempt to assess the patient’s overall immune-inflammatory balance.

-

CLINICAL TAKEAWAY

PERI EDU

CHAPTER 6

POTENTIAL AND LIMITATIONS OF INFLAMMATORY INDICES

WWW.PERI-EDU.UMW.EDU.PL

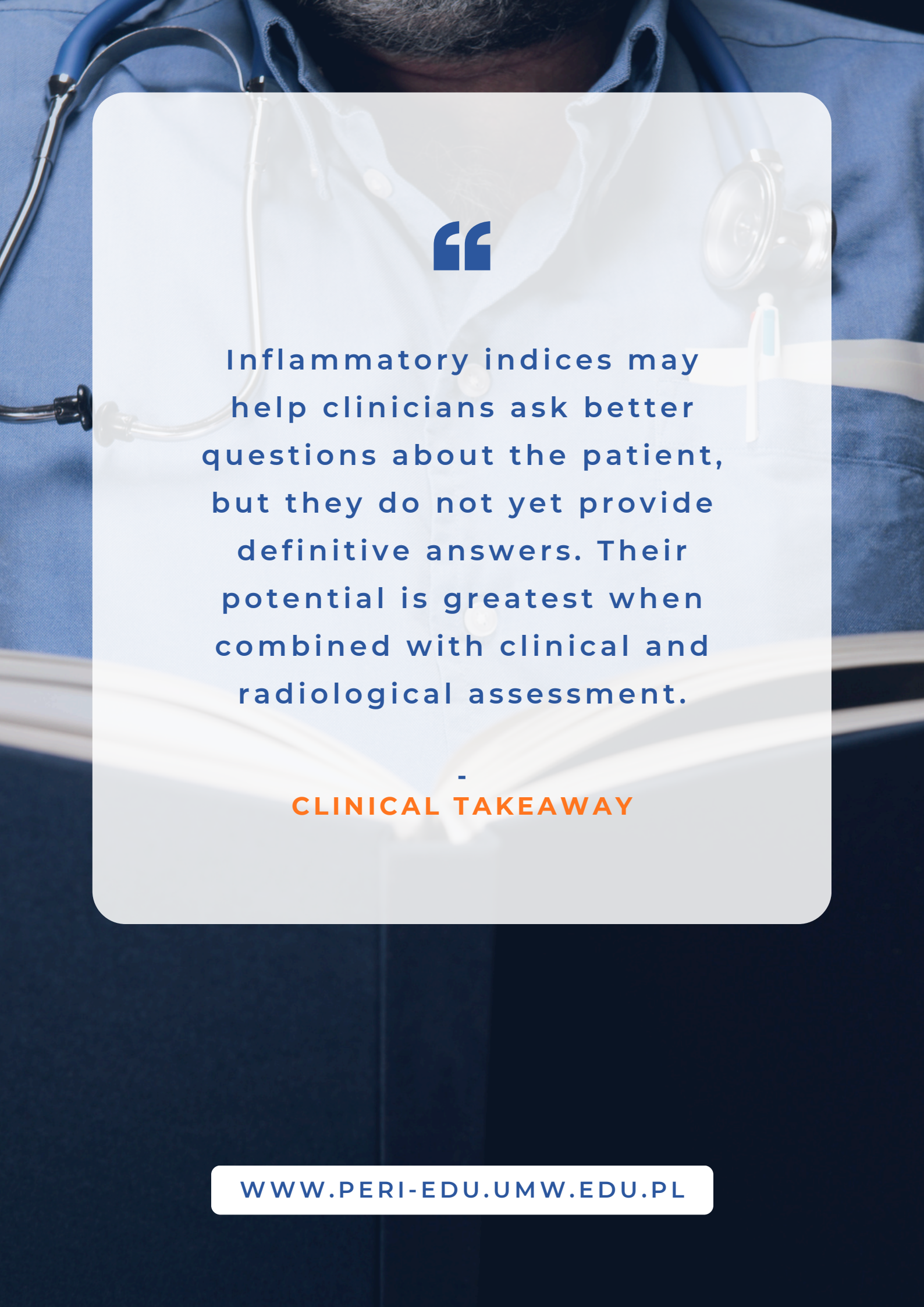
POTENTIAL AND LIMITATIONS OF INFLAMMATORY INDICES

Aggregated inflammatory indices are attractive because they are inexpensive, accessible, reproducible, and based on routine blood tests. They may potentially support patient monitoring, trend assessment, and risk stratification, especially in individuals with systemic diseases.

Their greatest limitation is nonspecificity. An elevated index does not automatically mean that peri-implantitis is the cause. Values may change due to infections, autoimmune diseases, cancer, medication, stress, metabolic disorders, age, or general health status.

Another problem is the lack of standardized diagnostic cut-off values specific to peri-implantitis. It is not yet clear which values should raise concern, whether the same cut-offs can be used in healthy patients and in patients with chronic diseases, or how changes in indices over time should be interpreted.

Therefore, inflammatory indices should be treated as one element of a larger puzzle. They may support clinical reasoning, but they cannot replace it. Their future value depends on prospective studies, validation, standardization, and responsible interpretation in the context of the whole patient.



Inflammatory indices may help clinicians ask better questions about the patient, but they do not yet provide definitive answers. Their potential is greatest when combined with clinical and radiological assessment.

-

CLINICAL TAKEAWAY

PERI EDU

CHAPTER 7

SIMREX AS A PERI-EDU RESEARCH DIRECTION

WWW.PERI-EDU.UMW.EDU.PL

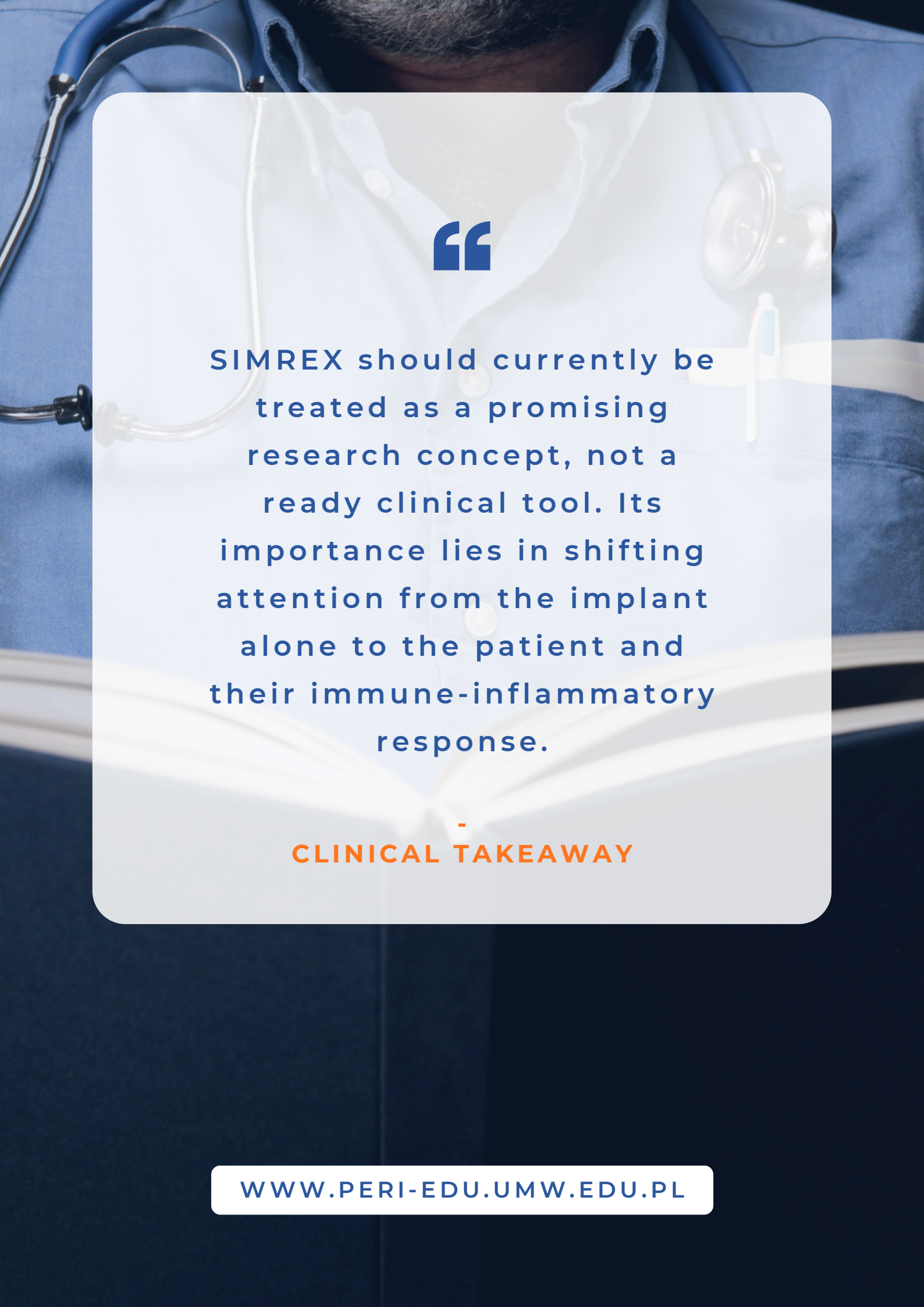
SIMREX AS A PERI-EDU RESEARCH DIRECTION

The PERI-EDU project introduces the concept of SIMREX — the Systemic Implant Immune Response Index. It is a project-based immune-inflammatory response index intended to be specific to peri-implant tissue inflammation and based on the integration of selected blood count parameters such as NEU, MON, PLT, WBC, and RBC.

SIMREX is interesting because most known inflammatory indices were not developed with implant dentistry in mind. NLR, PLR, SII, and SIRI have been studied in many inflammatory, metabolic, cardiovascular, and oncological diseases. They may be useful, but they do not directly address the specificity of peri-implant tissues, implant surfaces, osseointegration, and bone loss around implants.

At this stage, SIMREX is not a ready diagnostic test or screening tool. It should not be presented as an index that independently diagnoses peri-implantitis. Its current value lies mainly in organizing an important research question: do we need a more peri-implantitis-specific immune-inflammatory index than general indices used in other areas of medicine?

In this sense, SIMREX is an example of science in progress. It shows how the **PERI-EDU** project connects clinical observation, research questions, laboratory data, and education. Its future depends on validation, standardization, and assessment of usefulness in real clinical practice.



SIMREX should currently be treated as a promising research concept, not a ready clinical tool. Its importance lies in shifting attention from the implant alone to the patient and their immune-inflammatory response.

-

CLINICAL TAKEAWAY

WHAT DOES THIS MEAN FOR CLINICAL PRACTICE?

The most important conclusion is simple: peri-implantitis should not be analyzed only as a local problem around an implant. Biofilm remains the starting point, but the further course of the disease depends on many more variables.

For clinicians, this means the need for a broader view of the patient. Assessment of hygiene, BoP, PD, bone loss, and prosthetic factors remains fundamental. However, the patient's systemic health, history of periodontitis, control of chronic diseases, metabolism, smoking, healing potential, and systemic inflammatory response may also become increasingly important.

Modern implant dentistry is therefore not only about correct implant placement and prosthetic restoration. It is also about maintaining long-term biological stability. This cannot be assessed without understanding the patient as a whole.

PERI-EDU develops precisely this perspective: from local diagnostics to integrated thinking about disease, from single markers to a broader assessment of immune-inflammatory response, and from the implant procedure to the biology of the patient.

SUMMARY

Peri-implantitis is a multifactorial disease. Biofilm initiates the inflammatory process, but its course depends on the host response, systemic diseases, metabolism, local conditions, prosthetic factors, and potentially measurable indicators of systemic inflammatory response.

Single inflammatory markers may provide valuable information, but they have limited specificity. Aggregated indices offer a broader perspective, but require further research and validation. SIMREX, as a project-based concept, shows the direction in which **PERI-EDU** is moving: toward a more integrated, biological, and educationally useful assessment of peri-implantitis.
The aim is not to replace classical diagnostics with a new index. The aim is to better understand the patient in whom disease around an implant develops within a specific immunological and systemic context.
This shift in perspective may become one of the most important elements of modern implant education and clinical practice.

EDUCATIONAL NOTE

This material is educational in nature and does not replace individual diagnostics, therapeutic decision-making, or current clinical guidelines. Inflammatory indices and the **SIMREX** concept should be interpreted as elements of research and education developed within the **PERI-EDU** project, not as standalone diagnostic tools ready for routine clinical use.

PERI
EDU

FROM RESEARCH TO EDUCATION

A broader understanding of peri-implantitis

PERI-EDU connects current research on peri-implantitis with higher education and clinical awareness. The project explores how biofilm, host immune response, systemic inflammation, chronic diseases and implant-related factors may influence disease development and progression.

The goal is not to replace clinical judgement with a single marker or index, but to support a more integrated way of thinking about the implant patient.

Peri-implantitis is complex.
Education should reflect that complexity.

Funded by the European Union. Views and opinions expressed are, however, those of the author or authors only and do not necessarily reflect those of the European Union or the National Agency for the Erasmus+ Programme. Neither the European Union nor the National Agency can be held responsible for them.

Co-funded by
the European Union

WWW.PERI-EDU.UMW.EDU.PL