

## Low-Level Light/Laser Therapy Versus Photobiomodulation Therapy

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**A**S JULIET STATES: “WHAT’S IN A NAME? That which we call a rose by any other name would smell as sweet.”<sup>1</sup> However, a name, if ill-conceived and lacking a clear definition, can have profound effects on the image and acceptance of a therapy by mainstream medicine.

Sunlight has much anecdotal use in ancient scriptures. In the late eighteenth century, Niels Ryberg Finsen pioneered the use of red and blue light to treat various human ailments, especially *Lupus vulgaris*. He was awarded the Nobel Prize in medicine and physiology in 1903 for his pioneering demonstration that concentrated chemical rays from sunlight could be bactericidal as well as stimulating surrounding tissue.<sup>2</sup> Although this seminal work received much attention from physicians and scientists, the lack of mechanistic explanation relegated it non-mainstream medicine. The second major milestone in therapeutic use of light began with the invention of laser technology in the early 1960s.<sup>3</sup> Given its electromagnetic nature and significant destructive power, there were immediate concerns about its biological safety. Among the earliest studies to assess effects of lasers on biological tissues were the standard dose escalation studies that many laboratories immediately began to perform. Mester et al. noted that laser light at low doses demonstrated increased hair growth at an accelerated rate, and promoted excisional wound healing. This observation was termed “laser biostimulation.”<sup>4</sup> Thus, the specialized field of phototherapy that utilizes low-dose light for clinical therapy was reborn. Since then, the field has matured, and much has been learned about the mechanistic basis of this therapy, including a key fact that this application of light to tissues and organisms can elicit both stimulatory and inhibitory responses, depending upon the light parameters used.

In addition to biostimulation, a few of the other names previously used for this therapy have included low-level laser (or light) therapy (LLLT), low-intensity laser therapy, low-power laser therapy, cold laser, soft laser, photobiostimulation, and photobiomodulation. There is clearly a dismal lack of consistency and consensus on terminology. The most frequently used term is low-level laser therapy (LLLT). LLLT is the often-cited Medical Subject Headings (MeSH)

term contained in the National Library of Medicine’s controlled vocabulary thesaurus.<sup>5</sup> This term is ambiguous, as the words “low” and “level” are vague and not accurately definable, whereas the word “laser” is no longer appropriate, as other types of light devices such as LEDs and broadband light sources are currently used for this application.<sup>6</sup>

A nomenclature consensus meeting was organized under the auspices of the joint conference of the North American Association for Light Therapy and the World Association for Laser Therapy in September, 2014. It was attended by 15 international participants and co-chaired by Drs. Jan Bjordal and Juanita Anders (see Acknowledgments). Several key points were discussed in this meeting. The two major highlights are summarized here.

1. Low level light therapy (LLLT) is a well-established, searchable MeSH term, and both clinicians and researchers use it extensively. Moreover, many patients are familiar with this term. However, this term is not optimal for many reasons, as has been discussed. It is a very broad term that could include photodynamic therapy (PDT) and optogenetics. Both of these popular techniques use low-dose light typically administered using laser or LED illumination. Both of these require exogenous chromophores and/or the use of engineered light-activated chemical switches. LLLT, on the other hand, utilizes endogenous chromophores with low-dose illumination delivered at the target site.
2. The ideal term and its definition should be specific for this application of light and be accurate, and it should emphasize its scientific basis. Photobiomodulation was considered by many participants to be the term of choice to describe this use. However, a major limitation was that the term, “photobiomodulation therapy” is not a MeSH term of the National Library of Medicine’s controlled vocabulary thesaurus.

A request was submitted to the MeSH Section at the National Library of Medicine, based on this concerted effort. There was a clear acknowledgement that this term has been used; the first formal reported use in the PubMed

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literature dates back to 1997, although it had apparently been used colloquially for several preceding years.<sup>7</sup>

We were delighted to be informed recently that the term photobiomodulation therapy will be added to the MeSH database for its 2016 version as an entry term to the existing record of laser therapy, low-level. It will be indexed with terms on this record, starting in November 2015. The addition of photobiomodulation therapy to the MeSH vocabulary is an important step in defining what this therapy precisely represents. The use of this term is key, as it distinguishes photobiomodulation therapy, which is nonthermal, from the popular use of light-based devices for simple heating of tissues as can be accomplished using near-infrared (NIR) lamps, or other applications of light energy that rely on thermal effects for all or part of their mechanism of action. This fact will likely also have significant impact on safety and regulation of commercial products specifically marketed for this use.

Universal acceptance and use of this new terminology will not only distinguish this application's uniqueness among the other forms of phototherapy, but will also promote better organization of the literature and future studies aimed specifically at this therapy. We suggest a more comprehensive definition for the term photobiomodulation therapy as "A form of light therapy that utilizes non-ionizing forms of light sources, including lasers, LEDs, and broadband light, in the visible and infrared spectrum. It is a nonthermal process involving endogenous chromophores eliciting photophysical (i.e., linear and nonlinear) and photochemical events at various biological scales. This process results in beneficial therapeutic outcomes including but not limited to the alleviation of pain or inflammation, immunomodulation, and promotion of wound healing and tissue regeneration."

The scientific jargon nature of this new terminology is a major concern raised in various forums. Although we are in agreement that a change in commonly utilized and arguably "accepted" terminology is cumbersome, we strongly believe that the accuracy and distinction afforded by this new terminology change supersedes the misinformation and confusion pervasive in the field. It is expected that familiarity and continued use of this more precise terminology will aid in its widespread acceptance, as has been the case for complicated laser terminology such as "laser *in situ* keratomileusis" or LASIK.

In summary, photobiomodulation therapy is an accurate and specific term for this effective and important application of light. Universal use of this term would reduce, and potentially eliminate, confusion in the field and in both the scientific and lay literature. This would engender a unified, positive image to showcase the exciting clinical applications photobiomodulation therapy can offer for various medical applications.

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#### Author Disclosure Statement

The opinions and assertions contained herein are solely of the authors themselves and are not to be construed as official or reflecting the views of the Department of Defense, Uniformed Services University of the Health Sciences, Health and Human Services or the National Institutes of Health.

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