

RED LIGHT THERAPY: **REAL MEDICINE, MODERN HYPE—OR BOTH?**

Your Weekly Newsletter

by Dr. Nick Sieveking

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For thousands of years, light has been recognized as a source of healing. Long before modern medicine, people observed that time spent in the sun seemed to improve physical health, elevate mood, and restore energy. Whether treating illness, lifting the spirits, or simply promoting a sense of well-being, sunlight has always been viewed as one of nature's most powerful medicines.

Only recently has science begun to explain why.

One of the best-studied examples is **Seasonal Affective Disorder (SAD)**, a form of depression that predictably occurs during the darker months of the year. In the northern United States and Canada, up to 5% of adults meet the diagnostic criteria for winter-pattern SAD.

The science supporting light therapy for SAD is remarkably strong. Hundreds of clinical trials have evaluated bright-light therapy, and multiple meta-analyses have demonstrated that exposure to a 10,000-lux light source for approximately 20–30 minutes each morning significantly improves symptoms in many patients.

Researchers now understand that sunlight influences several biological systems involved in mood regulation:

- **Serotonin:** Morning light increases serotonin activity, promoting improved mood and emotional well-being.
- **Melatonin:** Sunlight suppresses melatonin during the day, increasing alertness, while darkness allows melatonin to rise at night and support healthy sleep.
- **Circadian rhythm:** Morning light synchronizes the body's internal clock. Disruption of this rhythm has been linked to depression and other mood disorders.
- **Vitamin D:** Sunlight stimulates vitamin D production in the skin. Although low vitamin D levels are associated with depression in some studies,

supplementation appears to improve mood primarily in people who are truly deficient.

If simply exposing the eyes to bright light can alter brain chemistry and improve depression, an intriguing question naturally follows:

Could specific wavelengths of light produce therapeutic effects elsewhere in the body?

That question has fueled an explosion of interest in photobiomodulation, also known by several names:

- Red light therapy
- Near-infrared (NIR) light therapy
- Low-level light therapy (LLLT)
- Low-level laser therapy
- LED light therapy



Today, claims surrounding red and near-infrared light therapy extend far beyond improving mood. Depending on whom you ask, these devices can supposedly heal wounds, reverse aging, improve athletic performance, restore vision, enhance brain function, relieve chronic pain, increase testosterone, promote longevity, and even cure serious diseases.

Some of these claims are supported by high-quality scientific evidence....many are not!

WHERE DOES THE EVIDENCE STAND?

Separating Science from Speculation in Red & Near-Infrared Light Therapy

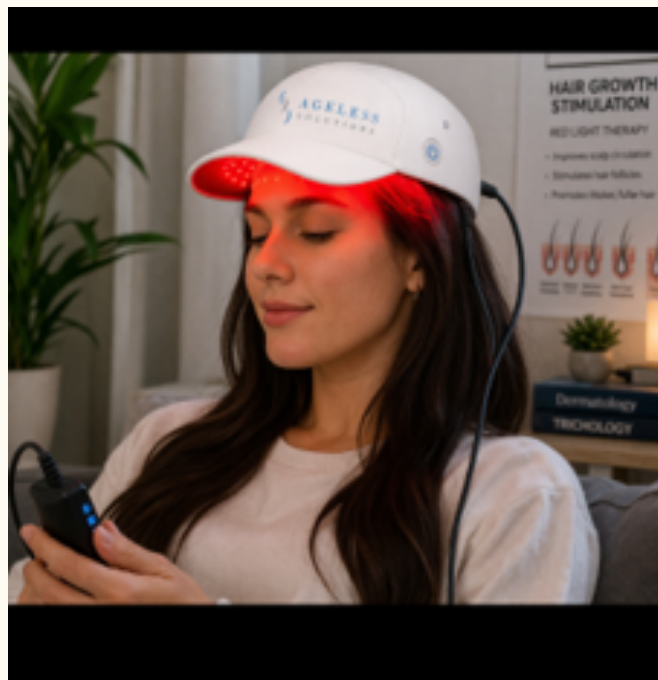
Not all claims surrounding photobiomodulation are supported equally.

After reviewing hundreds of clinical trials, systematic reviews, and meta-analyses, I have grouped the current evidence into four categories.

WELL-SUPPORTED

Strong clinical evidence

- ✓ Acne treatment
- ✓ Male & female pattern hair loss
- ✓ Reduction of fine lines & wrinkles
- ✓ Improved skin texture & collagen production
- ✓ Faster wound & surgical incision healing
- ✓ Improved scar appearance
- ✓ Oral mucositis during cancer treatment
- ✓ Temporary relief of knee osteoarthritis pain
- ✓ Reduced exercise-induced muscle soreness
- ✓ Some chronic neck & musculoskeletal pain conditions



PROMISING

Encouraging research, but additional studies are needed

- Fibromyalgia
- Diabetic foot ulcers
- Peripheral neuropathy
- Tendinopathies
- TMJ disorders
- Burning mouth syndrome
- Mild cognitive impairment
- Depression (transcranial PBM)
- Dry eye disease
- Age-related macular degeneration
- Sleep quality

- Inflammation

LIMITED EVIDENCE

Early research or inconsistent clinical results

- Parkinson's disease
- Alzheimer's disease
- Multiple sclerosis
- Stroke recovery
- Traumatic brain injury
- Long COVID
- Migraine prevention
- Autoimmune diseases
- Cardiovascular health
- Insulin sensitivity
- Fracture healing
- Testosterone
- Fertility
- Immune enhancement
- Healthy aging & longevity

MARKETING HYPE

Claims not supported by credible scientific evidence

- ✗ "Cures cancer"
- ✗ Reverses aging
- ✗ Melts fat without diet or exercise
- ✗ Detoxifies the body
- ✗ Repairs DNA
- ✗ Regrows organs
- ✗ Permanently cures arthritis
- ✗ Treats every mental illness
- ✗ Raises IQ
- ✗ Restores perfect vision
- ✗ Eliminates the need for medications
- ✗ Replaces hormone therapy
- ✗ Heals every organ simultaneously
- ✗ Adds decades to lifespan

The goal of this newsletter is not to sell red light therapy—or dismiss it.

It is to determine where the evidence is strong, where it is promising, where it is weak, and where marketing has outrun science.

Even on a cloudy day, nearly the entire solar spectrum still reaches the Earth's surface.



THE SUN'S LIGHT SPECTRUM

WAVELENGTHS, SAFETY & EFFECTS

Different wavelengths of sunlight have different potentially positive stimulation
– and different effects on the human body.

WAVELENGTH (nm)	BAND	SAFETY	NATURAL BIOLOGICAL EFFECTS	POTENTIAL THERAPEUTIC EFFECTS
100 200	UVC 100–280 nm (Ultraviolet-C)	NOT SAFE Should be kept from human exposure	• Germicidal – destroys bacteria and viruses	• Causes severe sunburn • Skin cancer • Eye damage • Suppresses immune system
280 315 380	UVB 280–315 nm (Ultraviolet-B)	USE CAUTION Brief exposure amounts recommended for vitamin D	• Vitamin D synthesis • Moderates immune function • Treats some skin conditions (psoriasis, eczema, vitiligo)	• Sunburn • Skin aging • Eye damage • Skin cancer (external)
450	UVA 315–380 nm (Ultraviolet-A)	USE CAUTION Moderate and safe daytime exposure amounts	• May enzymes, mood • Modulates immune system and reduces overall toxicity	• Skin aging (wrinkles) • DNA damage • Eye damage risk • Eye damage
495 570	VISIBLE LIGHT Violet – Blue 380–495 nm	SAFE	• Regulates circadian rhythm • Elevates mood • Supports alertness • Aids light responses in eye (pupil regulation)	• Excessive blue light at night may disrupt sleep • Bright light exposure improves mood
590	Green – Yellow 495–570 nm	SAFE	• Supports visual acuity • Enhances contrast sensitivity	• No known significant harm from normal exposure
620 750	Orange – Red 570–750 nm	SAFE	• Supports recovery and tissue repair • Aids light in plant biological function • Stimulates mitochondria	• No known significant harm from normal exposure
1,000+	NEAR-INFRARED 750 nm – 1 mm+ (Infrared)	SAFE	• Penetrates deep into skin & tissues • Increases healing • Reduces inflammation • Aids muscle • Used in red & near infrared light therapy	• Excessive heat exposure may cause tissue damage or burns (from high intensity sources) • Normal therapeutic levels are non-harmful



KEY TAKEAWAY

UVC is dangerous. Use UVB and UVA responsibly.
Visible and near-infrared (red/NIR) are powerful and mostly safe.



DAILY SUN EXPOSURE

Morning sunlight (10–30 min) supports rhythm
Midday exposure needs caution to avoid burn
Balance is the key: Get enough, but not too much

This chart is for informational purposes only. It is not a substitute
for advice by healthcare professionals and is not a substitute for medical advice.

What is Photobiomodulation (PBM)?

Photobiomodulation (PBM) is the therapeutic use of specific wavelengths of **non-ionizing red and near-infrared light** to stimulate beneficial biological responses within cells.

Unlike ultraviolet (UV) radiation, which can damage DNA, the wavelengths used in PBM are selected because they can influence cellular function without causing ionizing damage. Rather than heating or destroying tissue, PBM works by delivering carefully controlled doses of light energy that alter cellular activity in ways that may promote healing, reduce inflammation, and improve tissue function.

In simple terms, **PBM harnesses selected therapeutic wavelengths that naturally exist within sunlight while excluding the harmful ultraviolet portion of the spectrum.**

How is PBM Delivered?

Photobiomodulation can be administered using a variety of medical and consumer devices, including:

- LED light panels
- Low-level laser devices
- Facial masks
- Handheld treatment devices
- Hair growth caps and helmets
- Localized treatment panels
- Full-body light panels or beds

PBM primarily utilizes the visible red and near-infrared (NIR) portions of the electromagnetic spectrum.

Visible Red Light

The most commonly studied therapeutic red wavelengths include:

- 630 nm
- 660 nm
- 670 nm

Because visible red light penetrates only a few millimeters into tissue, it is primarily used for more superficial structures, including:

- Epidermis
- Dermis
- Fibroblasts
- Superficial wounds
- Hair follicles
- Skin inflammation
- Collagen remodeling



Near-Infrared Light

Frequently studied near-infrared wavelengths include:

- 810 nm
- 830 nm
- 850 nm

Near-infrared light penetrates more deeply into tissue than visible red light and is therefore being investigated for conditions involving:

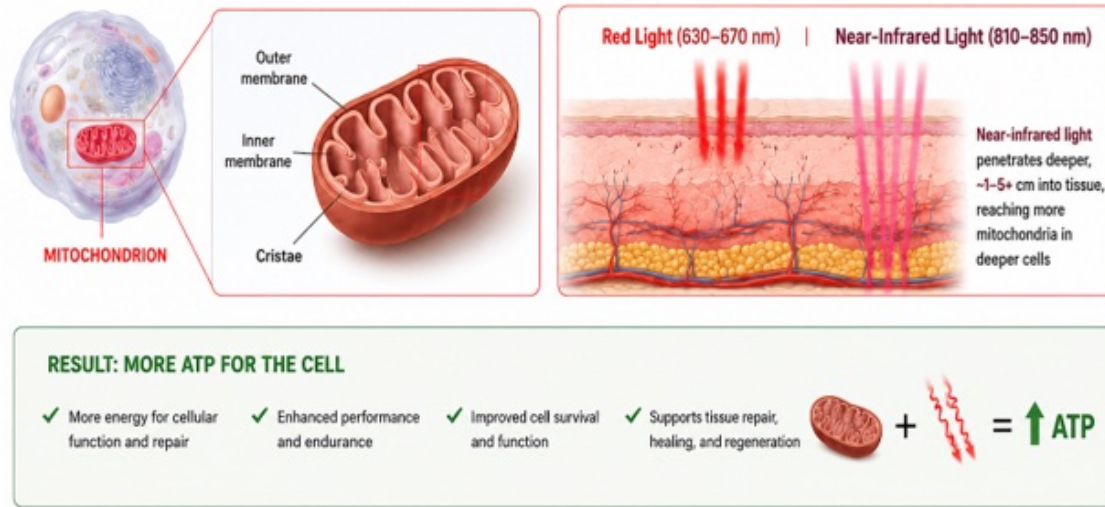
- Deeper wounds
- Skeletal muscle recovery
- Tendons and ligaments
- Joints
- Peripheral nerves
- Experimental transcranial (brain) photobiomodulation

How PBM Works on a Cellular Level

1. More ATP production through Mitochondrial Stimulation

How Red and Near-Infrared Light Increase ATP Production

Mitochondrial Stimulation of the Electron Transport Chain



Photobiomodulation with red and near-infrared light enhances mitochondrial function at the source of cellular energy.

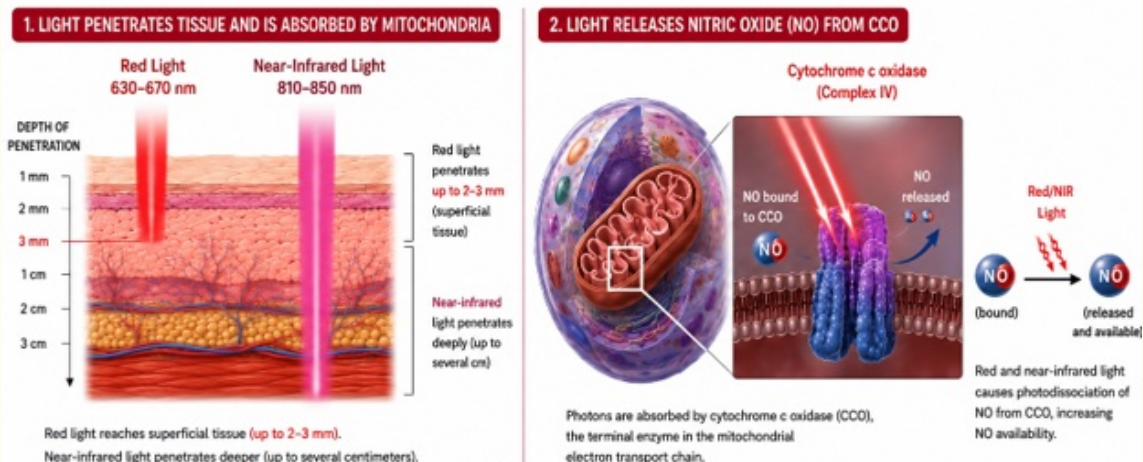
Effects

- ↑ Cellular Energy
- ↑ Tissue Repair
- ↑ Collagen Production
- ↑ Blood Flow
- ↑ Muscle Recovery
- ↑ Nerve Function
- ↓ Inflammation
- ↓ Oxidative Stress
- ↑ Cell Survival
- ↑ Skin Health

2. More Nitric Oxide Production and Availability.

HOW RED AND NEAR-INFRARED LIGHT INCREASE NITRIC OXIDE (NO) PRODUCTION AND AVAILABILITY

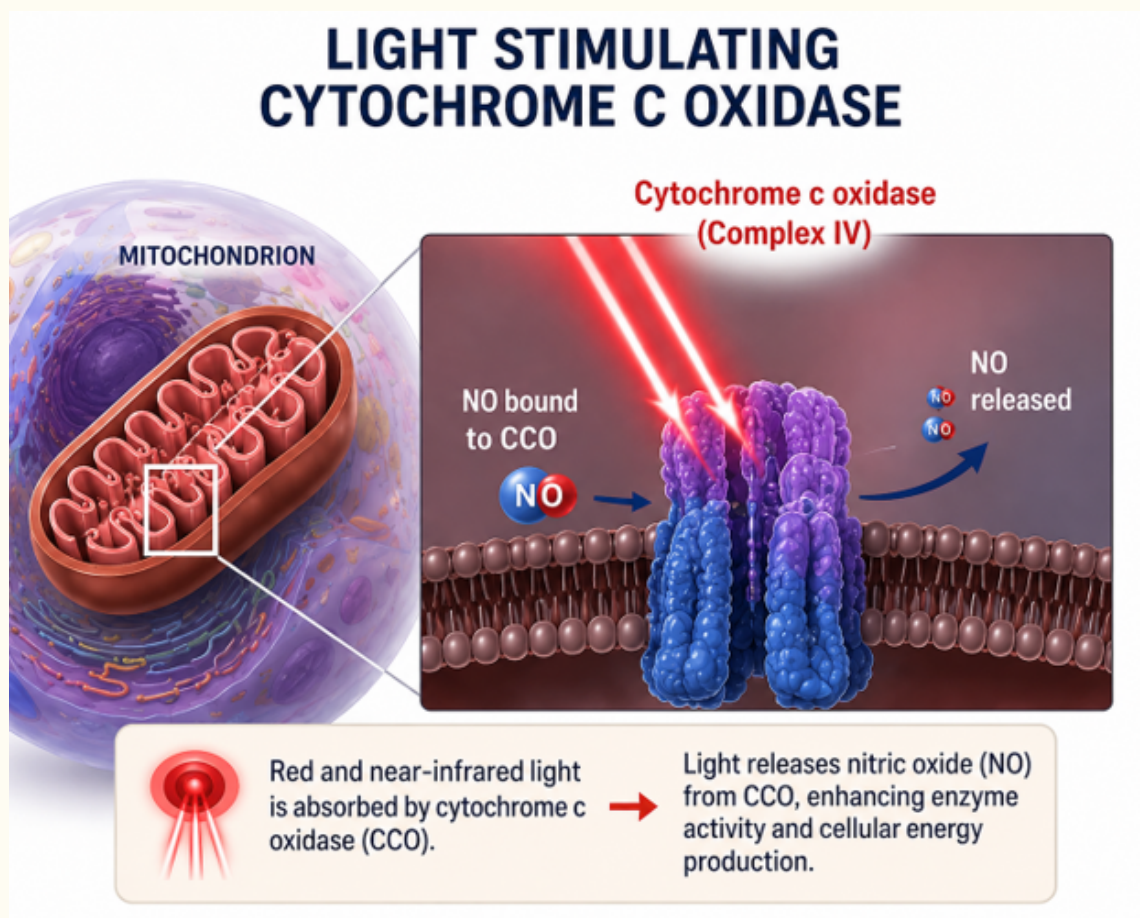
Photobiomodulation (PBM) stimulates light-sensitive proteins in cells to release more nitric oxide, improving blood flow, oxygenation, and cellular function throughout the body.



Benefits of Increased Nitric Oxide (NO) Availability

- ✓ Improves blood flow and circulation
- ✓ Enhances oxygen delivery to tissues
- ✓ Increases nutrient delivery to cells
- ✓ Supports healthy blood pressure and cardiovascular function
- ✓ Boosts cellular energy (ATP production)
- ✓ Reduces inflammation
- ✓ Promotes tissue repair and wound healing
- ✓ Improves exercise performance and recovery
- ✓ Supports cognitive function and brain health
- ✓ Enhances erectile function

3. Cytochrome C Oxidase



How Red and Near-Infrared Light Improve Cellular Energy

- Inside every cell are tiny “power plants” called mitochondria.
- Within each mitochondrion is an important enzyme called cytochrome c oxidase.
- Cytochrome c oxidase helps convert oxygen and nutrients into ATP—the energy that powers every cell in your body.
- Without this enzyme, cells cannot efficiently produce the energy needed for normal function, repair, and healing.
- Red and near-infrared light are absorbed by cytochrome c oxidase.
- This light energy releases nitric oxide (NO) that is temporarily attached to the enzyme.

- Once nitric oxide is released, cytochrome c oxidase works more efficiently, allowing mitochondria to produce more ATP (cellular energy).
- The released nitric oxide also helps relax blood vessels, increasing blood flow and improving oxygen and nutrient delivery to tissues.

The Result

- ✓ Increased cellular energy (ATP)
- ✓ Improved blood flow and circulation
- ✓ Better oxygen and nutrient delivery
- ✓ Enhanced tissue repair and healing

4. Reactive Oxygen Species (ROS)

Reactive oxygen species (ROS) are highly reactive oxygen-containing molecules that are naturally produced by your cells as a byproduct of normal metabolism, particularly during ATP (energy) production inside the mitochondria.

Common Reactive Oxygen Species

- **Superoxide ($O_2^{\bullet-}$)** – The primary ROS produced by mitochondria.
- **Hydrogen peroxide (H_2O_2)** – Not a free radical, but an important signaling molecule that can be converted into more reactive species.
- **Hydroxyl radical ($\bullet OH$)** – The most reactive and potentially damaging ROS.
- **Singlet oxygen (1O_2)** – An energized form of oxygen capable of damaging cellular structures.

ROS: Friend or Foe?

ROS often have a bad reputation because they are associated with oxidative damage. However, **ROS are not inherently harmful—in fact, they are essential for life**. Like many biological processes, the key is maintaining the right balance.

At Normal Levels, ROS:

- Regulate cellular signaling
- Stimulate the formation of new mitochondria (mitochondrial biogenesis)
- Promote tissue repair and wound healing
- Activate the body's natural antioxidant defenses
- Help immune cells destroy bacteria, viruses, and fungi
- Trigger beneficial adaptations to exercise and other healthy stressors

When ROS Become Harmful: Oxidative Stress

When ROS production exceeds the body's ability to neutralize them with antioxidants, **oxidative stress** occurs. Excessive ROS can damage virtually every part of the cell, including:

- DNA → mutations and accelerated aging
- Proteins → loss of enzyme function
- Cell membranes → lipid peroxidation and cell injury

- Mitochondria → impaired ATP production and even greater ROS generation

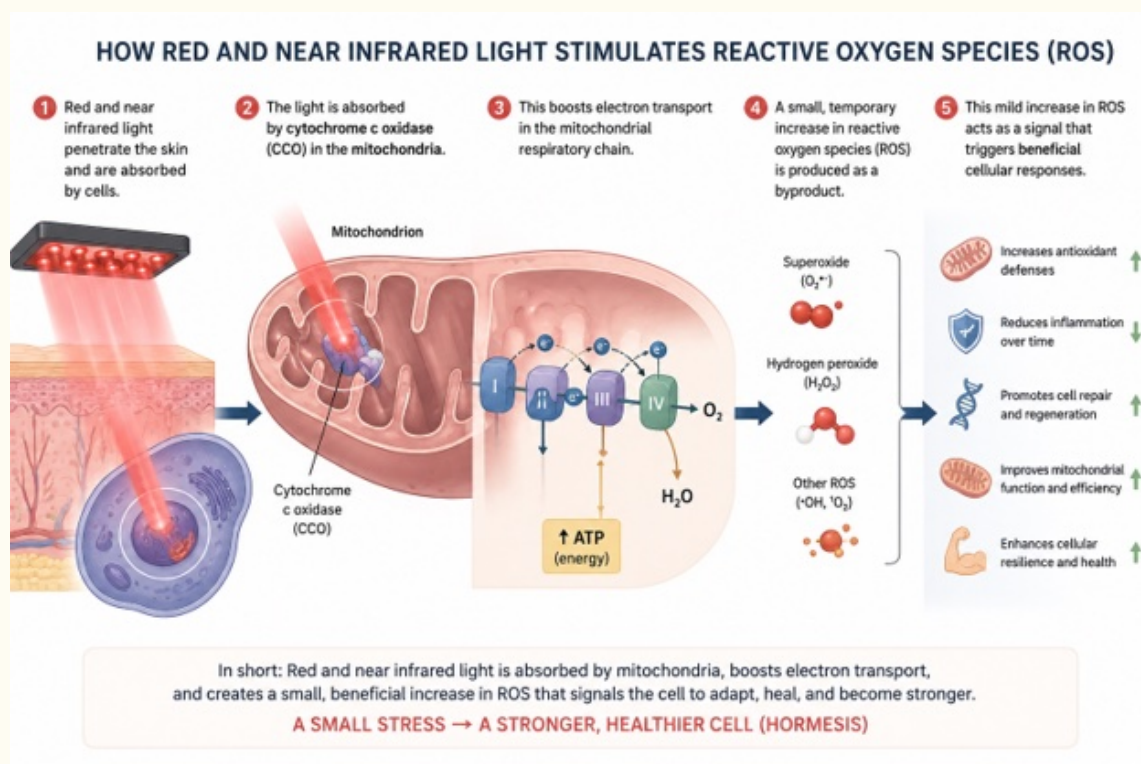
Chronic oxidative stress has been associated with numerous diseases, including:

- Cardiovascular disease
- Type 2 diabetes
- Neurodegenerative disorders (Alzheimer's and Parkinson's disease)
- Chronic inflammation
- Skin aging
- Cancer
- Autoimmune diseases

ROS and Red Light Therapy

One of the most fascinating aspects of photobiomodulation is its effect on ROS.

When red and near-infrared light are absorbed by **cytochrome c oxidase**, a key enzyme within the mitochondria, electron transport becomes more efficient, leading to increased ATP production. During this process, cells generate a **small, temporary increase in ROS**.



Unlike the excessive ROS seen during oxidative stress, this brief increase serves as an important **cellular signaling mechanism**, triggering beneficial adaptations that include:

- Increased production of antioxidant enzymes
- Reduced inflammation over time
- Enhanced tissue repair and healing
- Improved mitochondrial function
- Greater cellular resilience and stress resistance

Hormesis: A Little Stress Makes Cells Stronger

This temporary increase in ROS is an example of hormesis—a biological phenomenon in which a small, controlled stress stimulates the body to adapt and become stronger.

Exercise provides a familiar example. During a workout, muscles produce more ROS, yet this mild oxidative stress signals the body to build stronger muscles, produce more mitochondria, and increase antioxidant defenses.

Photobiomodulation appears to work in a similar way, using a brief rise in ROS as a signal that promotes healing, repair, and improved cellular function rather than damage.



When should you consider red light therapy and near infrared light therapy?

Condition	Level of Clinical Evidence
✓ Acne treatment	Strong ★★★★★☆
✓ Male & female pattern hair loss	Strong ★★★★★★
✓ Reduction of fine lines & wrinkles	Strong ★★★★★☆
✓ Improved skin texture & collagen production	Strong ★★★★★☆
✓ Faster wound & surgical incision healing	Strong ★★★★★☆
✓ Improved scar appearance	Moderate to Strong ★★★★★☆
✓ Oral mucositis during cancer treatment	Very Strong ★★★★★★
✓ Temporary relief of knee osteoarthritis pain	Strong ★★★★★☆
✓ Reduced exercise-induced muscle soreness	Moderate to Strong ★★★★★☆
✓ Chronic neck & musculoskeletal pain	Strong ★★★★★☆

This concludes Part 1 of our two-part series on red and near-infrared light therapy.

In Part 2, we'll take a closer look at **what the clinical research actually shows**. We'll review the strongest randomized controlled trials, discuss which conditions have the best scientific evidence, and explain how to separate marketing claims from proven medical benefits.

We'll also help you navigate the rapidly growing marketplace by discussing **which red and near-infrared light devices are worth considering**—and what features to look for before making a purchase.

The next newsletter will be published in two weeks following Dr. Sieveking's family vacation where he will be seeking some much needed light therapy of his own! Stay tuned!





STAY TUNED!

Be on the lookout for next week's newsletter, *"Red Light Therapy: Real Medicine, Modern Hype - Or Both? Part 2."*

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Sieveking Plastic Surgery

1200 Old Hillsboro Rd., B2,
Franklin, TN 37069
info@sievekingplasticsurgery.com
615-321-1010

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615-678-7784