

White Paper: Discovering New Potential for Long COVID Treatment with Neuro20 Whole-Body Electrical Stimulation (WBES)

This document was created after collecting anecdotal patient data over the past eight months on persons utilizing the Neuro20 PRO System. The science of electrical muscle stimulation (EMS), also known as Neuromuscular Electrical Stimulation (NMES), has been well documented for over fifty years, but the effects of whole-body electrical stimulation have not been examined as the technology previously did not exist and had not received FDA clearance for medical usage.

Since acquiring FDA clearance in February 2023 as a Class II Medical Device for **SIX INDICATIONS OF USE** common to the rehabilitation space, Neuro20 has been focusing on people with neurological and movement disorders. One of the most notable breakthroughs occurred on May 20, 2024, when a medical provider suffering from Long COVID for four years reported major health improvements after only four Neuro20 treatments, making the following statement:

"It feels like this device is tricking my brain into thinking I have exercised."

This document was created to aggregate the experiences and positive results seen using Neuro20 to create a working hypothesis for how the technology is impacting patients with Long COVID. We hope this information helps provide a working basis of knowledge that leads to increased research into the use of whole-body electrical stimulation (WBES) to help people suffering with Long COVID, as well as other neurological based movement disorders.

Words From the Author - Dr. Keith J. Cronin, DPT

"This technology was created by a Marine who wanted better for his life and to help those who served this country. In all my years of understanding how to improve the quality of life through movement, I have never seen anything like this, and to be candid, a medically trained person would never have created it. Years of EMS research has been drilled into my head, as well as millions of other providers, as to its capabilities and limits. Neuro20 was not built from scientific curiosity...it was built from the necessity of one individual to overcome the impossible and make a better life for himself...and to be a better man for his family.

I tried Neuro20 for the first time with extreme skepticism, knowing for more than a decade I had taught against using this type of technology because it did not create the change nor success I had been seeking. The science was not the issue; it was the technology to deliver the science in the right way that was missing. The writing of this paper has further challenged my own understanding and was created to bring awareness to other medical professionals that we have only scratched the surface on what EMS can do to help people.

I would like to thank the founders and team at Neuro20 Technologies for giving me the opportunity to gather this information. Furthermore, I offer special thanks to Dr. Brian Procter, MD and his team at The Well Integrative Medicine in McKinney, TX for taking the time, energy, and attention to provide video documentation of his patients to assist in putting a working theory together, as well as helping to edit this paper to make it presentable to the medical community.

This technology turned me, a rigid non-believer, into a staunch advocate. I hope this paper sheds light on what "can be", and that the necessary time, attention, and resources will be dedicated to research to help millions.

- Dr. Keith J. Cronin, DPT

Introduction

This document focuses on the use of the Neuro20 PRO System for Long COVID treatment. The results presented are profound, as there is no current standard of care to treat this complex, full body/head disorder. Since COVID emerged four years ago, science has barely begun to catch up with the symptoms and problems associated with the aftermath. Meanwhile, [24 million Americans](#)¹ are left hopeless and desperate.

Recent research has shed light on potential reasoning why Long COVID causes full-body and head issues, including but not limited to *fatigue, brain fog, chronic pain/inflammation, respiratory distress, dizziness, muscle soreness, and light-headedness*. For a more complete list, please visit this [CDC Site for Long COVID](#).²

Long COVID potentially affects both the brain and the body, resulting in a "push/pull" approach that leaves a patient constantly taking steps forward only to take the same number of steps, or more, backwards. Each patient has a different baseline or "basement" for their symptoms, preventing them from living the life they wish. Neuro20 may have "broken the dam" to allow recovery to occur by raising this "basement." Many of the symptoms associated with Long COVID are similar to conditions like Chronic Fatigue Syndrome, which have baffled health professionals for decades. -> [Link to More About CFS-like Conditions](#).³

Examining The Research

Recent findings have shown a connection between [Long COVID and dopaminergic neurons](#),⁴ causing a mix of "brain fog" and physical issues, sometimes referred to as "[body fog](#)".⁵ This makes exercise incredibly difficult. Previous research has shown that physical activity stimulates and regulates [appropriate levels of dopamine](#)⁶ thereby supporting motor function, memory, motivation, and more. Additionally, direct stimulation to the brain positively affects [the production of dopamine](#)⁷ and other mediators that impact structures like the hippocampus and other parts of the frontal lobe. Additional studies have [found decreases in another neurotransmitter, Serotonin](#)⁸, in Long COVID patients, which together would create a serious decrease in brain to body activity with decreased levels of these two critical mediators.

For years, conditions like [Chronic Fatigue Syndrome and Chronic Regional Pain Syndrome](#)⁹ have been understood as results of cascading events that leave people debilitated. However, with additional research specific to Long COVID [showing changes down to the mitochondrial](#)

[level](#)¹⁰, healthcare practitioners are left in a bit of a conundrum. Patients often show minimal to no change with things like muscle testing, nerve conduction tests, and other standard markers. Seeing changes at the [hormonal and immune level show promise](#)¹¹, but these are results of cascading events from multiple things happening in the body and head, so creating treatment solutions are difficult. This leads to questions such as:

"If this is a brain/neuron-based condition, should we focus on drug regimens to restore balance?"

"If this is a body/muscle issue, would physical therapy simply help patients push through the problems?"

"If this condition is affecting mental health, would not offering talk therapy help patients overcome challenges and make an impact?"

"If this condition is immune or mass inflammatory based, would not regimens of steroids work to address this?"

After four exhausting years, the medical community remains stumped by Long COVID, similar to how they have struggled with related conditions for decades. Yet with all the research and interventions, why have we not been able to solve this systemic problem affecting millions of people? At Neuro20, we believe the answer has always been there, but the technology to provide the correct adjunctive treatment did not exist.... until now.

Antidepressants, NSAIDs, Physical Therapy...What is the Answer?

Considering our overall understanding of the human body and the millions affected by Long COVID and other neurological conditions/chronic ailments, why have we not seen more measurable improvements?

Neuro20's working model focuses on several areas of both the brain **AND** the body. Research has shown that anti-depressants can positively affect the growth of new cells in the [hippocampus region](#)¹². Anti-inflammatories are known to cross the [blood-brain barrier](#)¹³, reducing the [central driven pain response](#)¹⁴. Decades of physical therapy research have demonstrated that exercise has both mental and physical effects, from reducing pain caused by immobility to the psychological benefits associated with the increased release of dopamine and serotonin. Breathing techniques, with the intent of stimulating the Vagus Nerve, also are encouraging to offer patients control over their dysfunctional nervous system. Pacing techniques are also regularly recommended, balancing activity and rest, with the

intent of slowly pushing recovery forward through managing the nervous system responses to maintain balance.

Question... Why do these three not work together to make massive change that is predictable and consistent? Why are there still 10.8 million Americans with Long COVID unable to work full-time, or out on disability?

We are still learning how COVID-19 affects the immune system, with some having barely any symptoms to others experiencing death rates far more significant than Influenza. Influenza, having been around for thousands of years, has allowed the human immune system to evolve to manage it. The explosion of Long COVID has revealed that we have seen this issue before. Recent studies have found that similar issues associated with [Long Flu](#)¹⁵ bear similarities to conditions like [Chronic Fatigue syndrome](#)¹⁶ (CFS) where [recovery rates are around 5%](#)¹⁷, indicating significant complexity.

Previously, only around 1% of the population was affected by these debilitating conditions. Now, with COVID, that number is 7 to 10 times greater. Techniques that were unsuccessful with CFS have similarly showed minimal long-term resolution of Long COVID symptoms. With [limited conclusively effective treatments](#)¹⁸ and low recovery rates for tens of millions of people, our country finds itself in moral and economic peril.

So, what is missing?

I believe Neuro20 has successfully bridged the gap to allow these other forms of treatment to be more effective, unlocking the full potential of someone suffering with this ailment to get past the "cycle" they find themselves stuck in.

Examining the Current Multi-Modal Approach to Long COVID Treatment

Please note, this white paper on Neuro20 is not to express that this technology is the "replacement" or "far superior treatment" for Long COVID. Far from it, in fact. The reality is that Long COVID is a *complex disease process*. As indicated above, common treatments including anti-depressants, NSAIDs, and physical therapy have been employed to facilitate change but, they have not been limited to just these interventions.

Pharmaceuticals - Incredible resources have been poured into examining the effects of different drugs on people affected with Long COVID. While there is not a single "magic bullet," here is a list from the [Mayo Clinic of commonly used drugs](#)¹⁹, as well as other ones

presented by medical professionals treating this disease:

- [Chromium](#)²⁰ - Used to treat immunological manifestations including MCAS (Mast Cell Activation Syndrome).
- [Colchicine](#)²¹ - Has been used to repair damaged cardiac myocytes in myocarditis and aids in treating chronic chest symptoms such as chest pain and dyspnea.
- [Hydroxychloroquine](#)²² - Has been used to treat rheumatological manifestations.
- [Ivermectin](#)²³ - Has been used to treat a multitude of Long COVID symptoms including dermatological conditions.
- [Montelukast](#)²⁴ - Mast cell stabilizer used to treat immunological manifestations including MCAS (Mast Cell Activation Syndrome).
- [Nadolo](#)²⁵ - A beta blocker used to treat symptoms resembling POTS (Postural Orthostatic Tachycardia Syndrome).
- [Nirmatrelvir-Ritonavir \(Paxlovid\)](#)²⁶ - Used for acute treatment of COVID but may have some use.

Nutraceuticals - Knowing there is an immune component to Long COVID, proper diet and [targeted nutritional interventions](#)²⁷ are used to "flush" the body of residual virus particles including spike protein and restore normal homeostasis. These interventions include but are not limited to:

- [Nattokinase](#)^{28,29,30} - A main component of Base Spike Detoxification Protocol, Nattokinase has proteolytic, thrombolytic, and anti-atherosclerotic properties to help combat spike protein systemically and within the central nervous system
- [Bromelain](#)^{28,29,30} - The second component of Base Spike Detoxification Protocol, Bromelain, has proteolytic, anti-coagulant, and anti-inflammatory properties to help combat spike protein directly.
- [Curcumin](#)^{28,29,30} - A third component of Base Spike Detoxification Protocol, Curcumin has antiviral, anti-inflammatory, and anti-fibrotic properties that enable it to combat inflammation in the process of Long COVID.
- [Alpha-lipoic Acid](#)³¹ – Used to treat systemic neuropathy and “brain fog” associated with long COVID.
- [Vitamin B12 \(Oral, intramuscular, or intravenous therapy\)](#)³² - Used to combat “brain fog” and “body fog” to improve cognition and energy.
- [Vitamin D3 \(Oral therapy\)](#)³³ - Used to combat “brain fog” to improve cognition and systemic inflammation.
- [Vitamin C \(High-dose intravenous therapy\)](#)³⁴ - Used as a potent anti-inflammatory and anti-viral agent to detoxify the body.

- [Glutathione - Oral and intravenous therapy](#)³⁵ - Used to detoxify the body and increase mitochondrial function to improve “brain fog” and “body fog.”
- [NAD - Oral and intravenous therapy](#)³⁶ - Used to detoxify the body and repair mitochondrial dysfunction to improve “brain fog” and “body fog.”

Other Treatments - There are many other treatments that have shown some positive results in Long COVID management (including functional and holistic regimens) including but not limited to:

- [Hyperbaric Oxygen Therapy](#)³⁷ (HBOT or HBOC) - Improve the lungs ability to take in and absorb more oxygen to restore pulmonary function
- [Ozone](#)³⁸ - Induce anti-viral support to the immune system to prevent virus replication
- [Vagus Nerve Stimulation](#)³⁹ - Inhibition of Cranial Nerve X results in dysfunctional parasympathetic activity throughout the body, which by doing direct stimulation, can potentially improve the body systemically
- [Steroids](#)⁴⁰ (Dexamethasone)- While effective in the short-term, the human body was not designed to be on these drugs for prolonged periods of time.
- [Stellate Ganglion Block](#)⁴¹ - Interventions to help the "memory of smell" can help patients restore normal olfactory (CN I) function to improve quality of life.
- [Cardiac / Pulmonary Rehabilitation](#)⁴² - If the lungs are affected to the point where perfusion of oxygen is limited at the source, addressing these two major organ groups is exceptionally important to establish a baseline to improve from
- [Counseling](#)⁴³ - The mental health effects of Long COVID are devastating, and being able to address the psychological components of the disease process is critical for long-term success

Example of Long Covid Multi-Therapy

Neuro20 is a physical modality that is showing promise to help patients with Long COVID improve their quality of life. It is important to note that due to the complexity of the condition, there are likely multiple treatments necessary to achieve positive outcomes. Brian Procter MD with The Well Integrative Medicine in McKinney, TX, supported writing this white paper and provided his treatment approach to helping Long COVID patients work through their symptoms to achieve a better quality of life. The following is what every patient coming into his office is prescribed, providing an example of this multi-treatment approach that has demonstrated positive effects with his patients:

- *"EVERYONE" goes on Base Spike Detox regimen for at least a year (most take 3 months*

to start feeling better), unless allergic to soy, nattokinase, bromelain, curcumin, or black pepper."

- "For skin involvement, we prescribe ivermectin (0.6mg/kg/day which is usually 24-48mg per day) for at least 3 mo. Most people tolerate Ivermectin fine without issue (even those that are highly allergic). Sometimes, we use Ivermectin for 3 months if Long-COVID."
- "For neurologic involvement (like neuropathy and/or brain fog), we add Alpha-lipoic acid 600mg twice daily, B100 Complex Capsule (1/day), and Vit D3 with K2 (10,000IU/day) for at least a year. Nicotine 7mg/day patch helps too."
- "For chest involvement (chest pain, painful breathing, shortness of breath), we prescribe colchicine 0.6mg (1-2 tabs per day depending on severity) for at least a year."
- "For POTS (autonomic dysregulation), we prescribe nadolol 20mg (0.5 tab to 1 tab twice daily) for at least a year. For MCAS, we prescribe Cromolyn 100-200mg twice daily and/or montelukast 10mg a day (Cromolyn works better) for at least a year."
- "For autoimmune issues (Rheumatoid Arthritis, Lupus with positive labs), we prescribe hydroxychloroquine 200mg bid for at least a year."

A panel of [Long COVID experts at Emory University](#)⁴⁴ gathered to discuss the future for people suffering with this disease, and while they could not come to a conclusion for the best strategy to apply, it was quoted, "With the right clinic and the right set of professionals trying different things, patients do get better. So don't lose hope."

Neuro20 is here with something *different* and hopes to complement all the arduous work of medical professionals worldwide.

Research Shedding Light on "EMS Benefits to Brain and Body"

The mechanisms for how Neuro20 technology works were a bit of a mystery for the past year, especially once it was cleared by the FDA for medical use. With whole-body wireless EMS never before cleared for medical patients in the US, the number of case studies to create a running hypothesis was limited. However, recent research in the past year has provided insights into why Neuro20 is showing effectiveness for Long COVID symptoms. Thousands of studies have been conducted on EMS, but three studies in particular have shown that we have only just begun to scratch the surface on what can be achieved with whole-body electrical stimulation.

Review of Recent Studies

1. [Cerebral Benefits Induced by Electrical Muscle Stimulation: Evidence from a Human and Rat Study](#) (France, January 2024)⁴⁵

Researchers examined how electrical stimulation in the quadriceps muscles can be used to create brain health benefits for people who have difficulty moving. Both rats and humans had bilateral quad muscle simulators used, with the rats undergoing dissections to determine hormonal changes and humans evaluated with cognitive tests. Key findings included:

- Improved executive function and reduced anxiety in humans.
- Increased Brain Derived Neuro-trophic Factor (BDNF) mRNA in the hippocampus in the rats
- Lactate is hypothesized to create "cross talk" between body and brain to promote the positive effects.

The combination of these effects shows that by only stimulating a small section of the body (quadriceps bilaterally) there is a systemic effect using electrical stimulation.

2. [Effect of Non-Invasive Spinal Cord Stimulation in Unmedicated Adults with Major Depressive Disorder: A Pilot Randomized Controlled Trial and Induced Current Flow Pattern](#) (December 2023)⁴⁶

This study showed applying an electrical stimulus directly to the spinal cord at rest without any exercise improved symptoms associated with depression. Decreases in both MADRS (reported sadness) and diastolic blood pressure were found within the study. Notably, this study showed positive brain and body changes without exercise, demonstrating the potential power of spinal gray matter stimulation.

3. [Effects of a full-body electro-stimulation garment application in a cohort of subjects with cerebral palsy, multiple sclerosis, and stroke on upper motor neuron syndrome symptoms](#). (February 2024)⁴⁷

This study showed using whole-body electrical stimulation had tremendous positive effects for patients with movement related challenges associated with Stroke, Cerebral Palsy, and Multiple Sclerosis. The researchers found improvements with static and dynamic balance, fall risk, mobility, upper extremity improvement, and an overall increase in health utility and a reduction in spasticity related pain. Most importantly, these positive effects were almost *immediate* and had a lasting carryover when not using the intervention. To date, this is the

most supportive evidence for being able to make lasting changes to people suffering upper motor neuron disorders with whole-body electrical stimulation.

Analysis of Research Studies

Examining these three articles is paramount to understanding how Neuro20 is potentially working to help Long COVID patients.

In the first study, they examined EMS over the quads but no other body parts. The Neuro20 whole-body EMS suit uses 20 large contoured electrodes to create a large sensorimotor effect and reduce skin irritation. Stimulating only one part of the body induced a 116% increase in Hippocampus BDNF (specific to mRNA). Combined with improvements in anxiety and executive functions, Neuro20's impact is promising considering that it can simultaneously stimulate 20 parts of the body and 44+ muscle groups.

The second study was able to replicate the effects of improved brain health with direct stimulation of the spinal cord. This reported "gray matter" stimulation with a metal interface was able to show improvements in mental health, showing that a bolus of electrical stimulation through the spine has a positive effect. Neuro20 covers the majority of peripheral nerves throughout the body, resulting in spinal cord excitement at various levels before going through the brainstem and spinothalamic tract to the sensorimotor parts of the brain.

Finally, the last study examined used technology that is similar to Neuro20's whole-body electrical stimulation (WBES). The objective physical improvements with upper motor neuron disorders were not only profound, but the effects were *immediate* (within ONE hour) and *lasting* (still having benefit ONE month later with regular use). As Long COVID presents with both **brain** and **body** symptoms, the functional capacities of Neuro20 fit with the needs of this challenging patient population.

So, if we layer these three studies together:

1. *WBES technology demonstrates the ability to make both immediate and lasting positive changes to the way someone moves with known motor neuronal diminished capacity.*
2. *The mental state of someone is improved with direct stimulation to the spine without exercise.*
3. *The cognitive state of a person is improved through bilateral quadriceps electrical stimulation (motor) and that same stimulation produced significant Hippocampus mRNA activation in rats.*

HYPOTHESIS BUILT FROM RESEARCH STUDIES

A



Quadriceps Stim / Seated

- Cognitive Improvement
- Significant Increase in Hippocampus Activity (rat dissection)

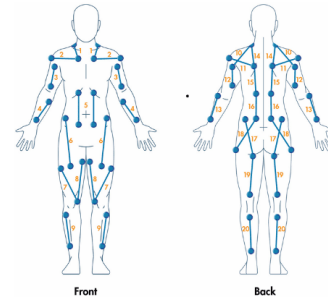


Applying one of the devices. (Cofleen Kelley/UC Marketing + Brand)

"Spinal cord stimulation is thought to help the brain modulate itself as it should by decreasing the noise or decreasing the hyperactive signaling that may be in place during a depressive syndrome," says neuroscientist Francisco Romo-Navia, from the University of Cincinnati College of Medicine.

Direct Stim to Spine / No movement

- Decrease in MADRS "reported sadness"
- Decrease in Diastolic BP



Whole Body Stimulation / Movement

- Static/Dynamic Balance, Fall Risk, and Mobility Improvements
- Cognitive not evaluated

Is this why we are seeing the positive effects of Neuro20 with patients working through Long COVID?

Therefore, it is hypothesized that Neuro20's positive effects on Long COVID are the result of an interaction at both the **brain** and **body**, resulting in a new potentially impactful physical modality treatment to support recovery of a complex condition.

Connecting Research to Results

Meet Ryan!

Ryan discovered Neuro20 after five and a half months of progressively debilitating Long COVID symptoms including severe bilateral lower extremity ataxia and paresis. Similar results have been found with other patients, but for this white paper, Ryan's story and progression will be used to illustrate these changes. How is the following video possible? (click on the link below and **WATCH THE VIDEO**)

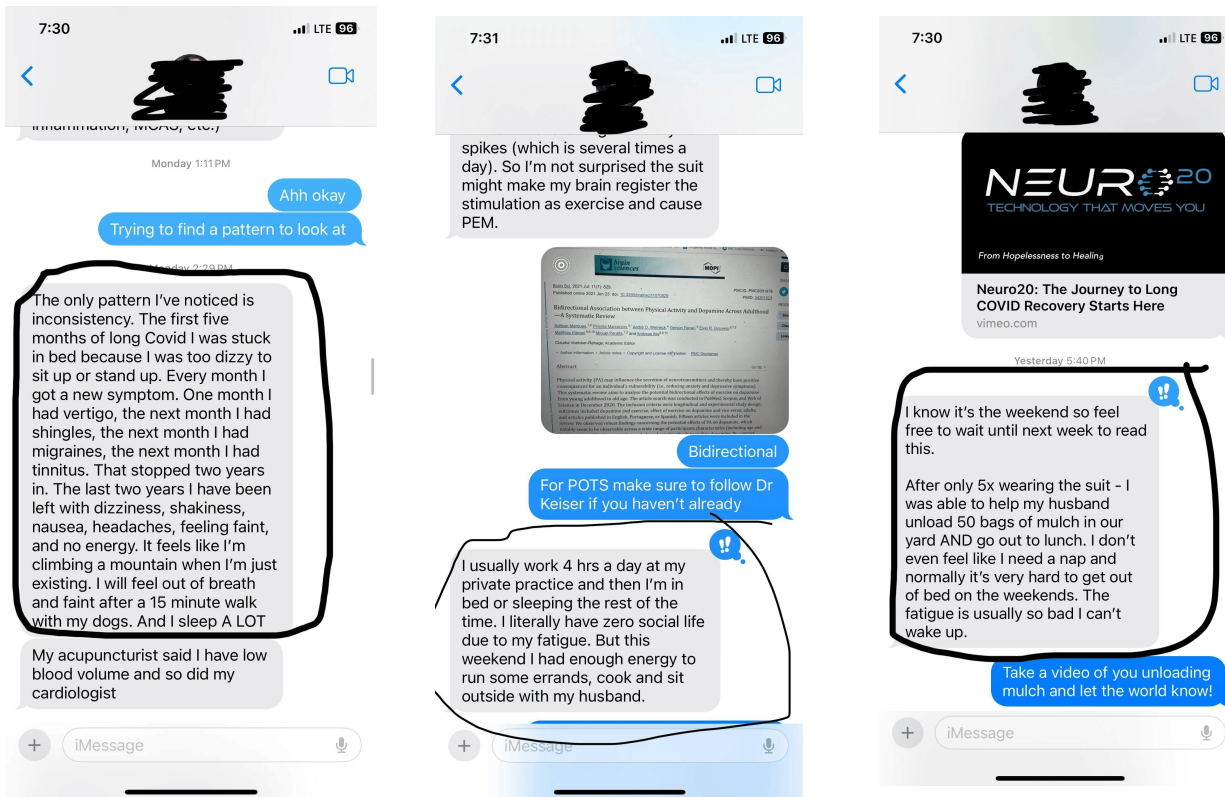
[43 Days / 7 Treatments: From Barely Walking to Mowing the Lawn](#)

How do we explain these changes when the only change from previous standard treatments was Neuro20?

Meet Amanda!

Amanda is a healthcare provider who has struggled with Long COVID for over four years. Initially able to function partially, her symptoms progressed to the point she could only visit or treat two patients consecutively before immediately needing a nap or becoming ill for hours, after which she could finally return to work and repeat this process. The American Disability Act recognizes Long COVID as a disability, allowing workplace accommodations to keep people in the workforce. Amanda is a mental health provider with a strong will, yet she could not overcome the multiple symptoms that had her bedridden and unable to socialize with friends due to fatigue.

So how is the outcome described below possible in only two weeks of treatment? (See screenshots of Amanda's texts below)



What is the Common Thread?

Ryan... A patient suffering two and a half months from Long COVID which left his brain with

difficulty making memories, while needing support 100% of the time to live independently; yet now able to mow his entire backyard with ease after a month of Neuro20 treatment?

Amanda... A patient suffering four plus years from Long COVID who is a mental health practitioner who could not stand upright for more than two hours; yet now is spreading mulch and seeing major gains within only two weeks of Neuro20 treatment after all else failed?

Enter Neuro20: Whole-Body Electrical Stimulation

With Neuromodulators being the ["key ingredient" to allow the motor system multiple pathways to create output](#)⁴⁸, their absence or dysfunction may explain why patients get stuck "in the loop" of Autonomic Nervous System Dysfunction (ANS). For years, the benefits of electrical stimulation have been known, but they have not made a significant impact on conditions like Long COVID or other neurological diseases. All research to date used a 1-to-1 ratio of electrical stimulation — one body part with one electrical system. We have never had the opportunity to look at stimulating multiple parts of the body simultaneously because the technology did not exist, so obviously, there were insurmountable limitations to examining this approach to rehabilitation of any condition.

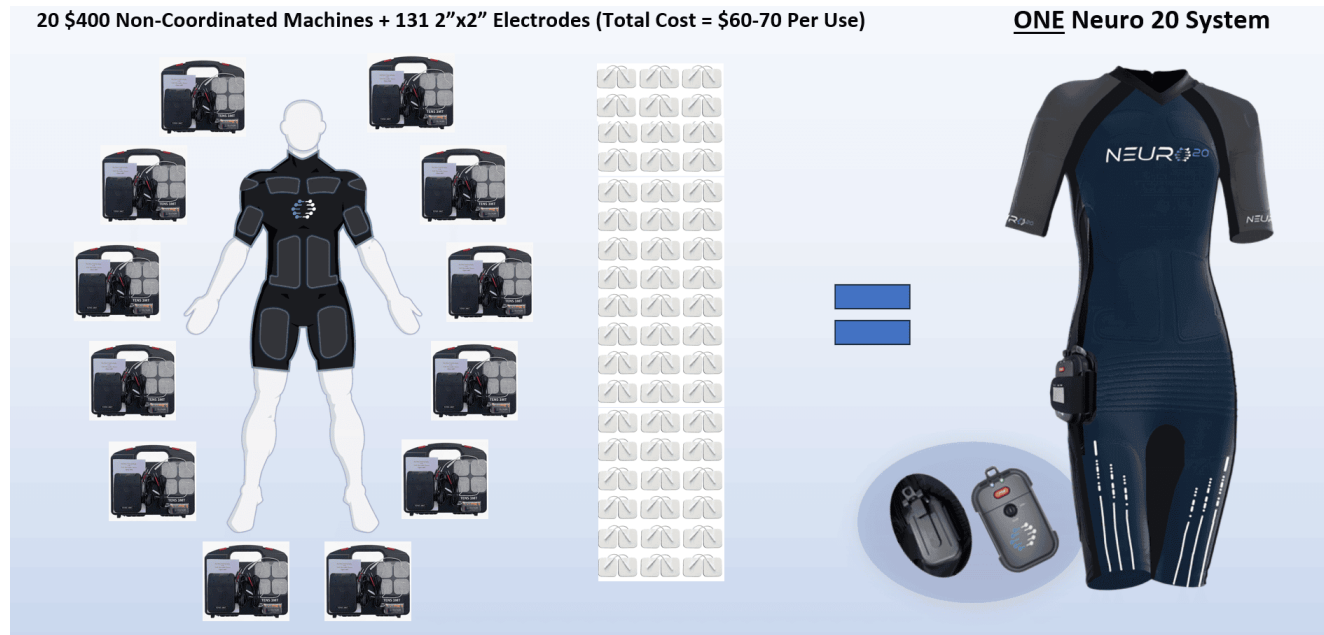
The Neuro20 PRO System

WHOLE BODY ELECTRICAL MUSCLE STIMULATION - Regulatory standards - ISO, IEC, CE, RoHS, Biocompatibility, QMS FDA

- Machine Washable** - Includes a 'NEURO20 WASHING BAG'.
- Bluetooth, 100 meters range, indoor/outdoor/water resistant**
- Easy slide and guide USB-C connection** - Shows a USB-C port on the suit and a control device.
- Cable free unrestricted movement**
- Anti-Microbial**
- 20 contoured electrodes for 44+ muscles** - Shows two views of the suit with electrode placement.
- 7 Unisex Sizes**

Why Has This Not Been Done Before?

Replicating the Neuro20 PRO System would require 20+ individual machines and the equivalent of 131 2"x2" electrodes at a cost of \$60-70 per use (just for the electrodes).



Additionally, these devices could never be timed to perform functional tasks, and the time commitment to set up and operate them would exceed what health providers are willing to invest. This is why the medical community has not discovered the power of whole-body EMS... there was no practical tool to generate the results.

FDA Clearance (First to Market)

Another reason we have never seen whole-body electrical stimulation have an effect in the medical market is something even more simple...the technology was not cleared by the FDA for medical use for unhealthy muscles.

Where other products failed and resigned themselves to FDA clearance for Over the Counter (OTC)/Non-medical approvals, Neuro20 instead pushed through to build a *cleared* system that was designed intelligently for medical application.



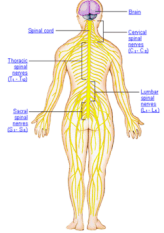

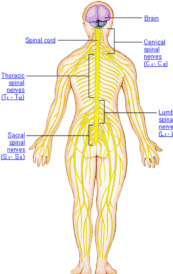
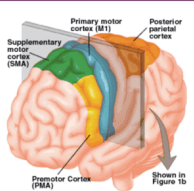
The attention to safety, anti-microbial fabrics, large contoured electrodes to reduce irritation to skin, and patterned stimulation to mimic specific movements are just the tip of the iceberg

of what a medical whole-body EMS device should be.

What Was Actually Needed to Make Change

To date, we have not seen the systemic effects and changes that Neuro20 is having with patients simply because of the following logic:

WHAT WAS ACTUALLY NEEDED TO MAKE A CHANGE

			<p style="margin: 0;">■ ■</p> <p>1 Sensory Tract + 1 Motor Tract</p> <p><u>Results</u> = What you know about EMS</p>
		 <p style="font-size: small; text-align: center;">Figure 1: Motor Cortex</p>	<p style="margin: 0;">■ ■</p> <p>44 Sensory Tracts + 44 Motor Tracts</p> <p><u>Results</u> = Change never seen before</p>

Electrically stimulating one sensory/motor tract can demonstrate local improvements. It stands to reason that stimulating more segments could have a greater effect. This is why full-body cardiovascular activities show the best results in making people "feel good." Simply said, *"The more parts of the body you use at the same time, the better you feel."*

The amount of energy entering the spinothalamic tract decreases with each passing step through the skin/fat/muscle, nerves traveling to the spinal cord, and moving up to the head, etc. For this reason, a 1:1 system's ability to induce potential changes at the neuronal level would not be seen as there is not enough aggregation of activity.

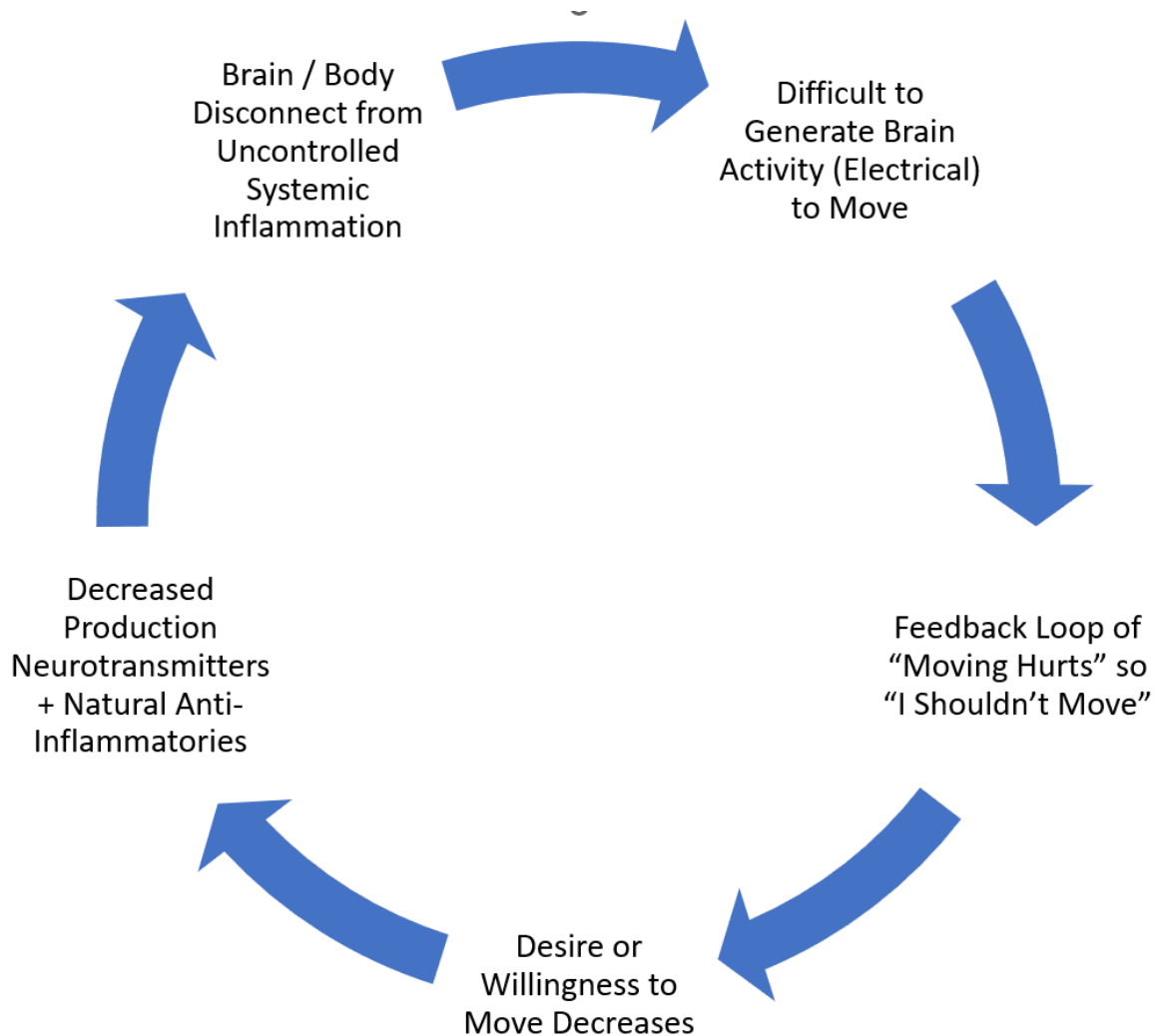
Neuro20 PRO and its 20 contoured pads allow control of intensity to each body part, providing the appropriate therapeutic stimulation without over-fatiguing the system. The amount of electricity (intensity) needed to stimulate the quadriceps is much greater than that needed for the deltoids to achieve the same effect. An individualized approach allows

various body parts to be "dosed" with the correct amount of stimulation to create a therapeutic effect without the negative consequences.

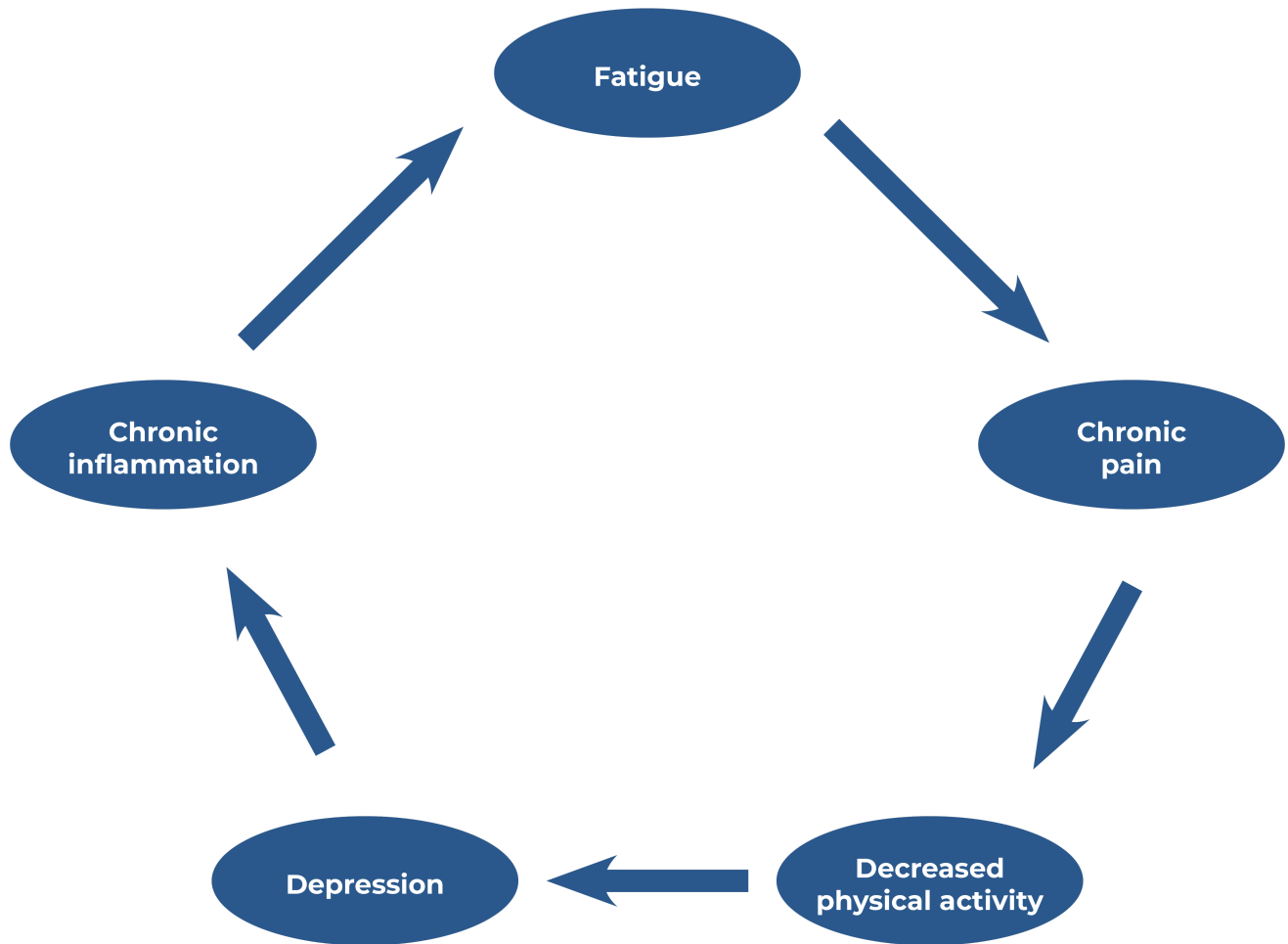
The dopaminergic response ([as well as serotonin and noradrenalin](#))⁴⁹ to exercise does not occur simply because we work out a body part. The brain responds more effectively to whole-body activities to create plasticity and adaptation. Enough activity must be created to produce the intended effect, and to date, a 1:1 system of stimulation has not been sufficient. Recent results suggest Neuro20 has achieved the right dosage of electrical input, frequency of use, and direct impact on the Sympathetic and Parasympathetic Nervous Systems to help stabilize the effects of ANSD to make systemic changes to *REVERSE* the cycle affecting Long COVID patients.

Breaking Down the Cycle/Proposed Mechanisms for Neuro20

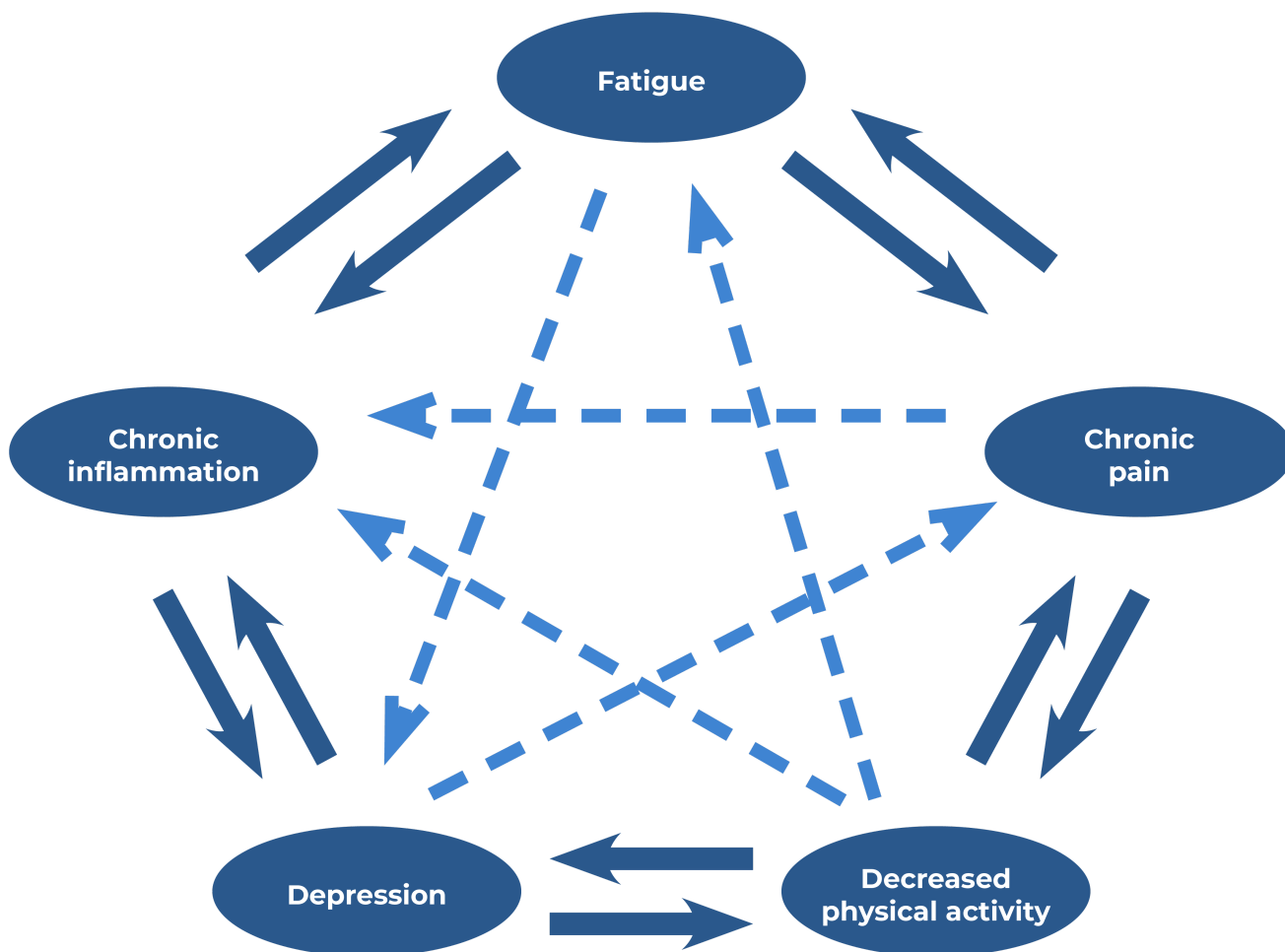
This following diagram is a simplistic version of a complicated condition:



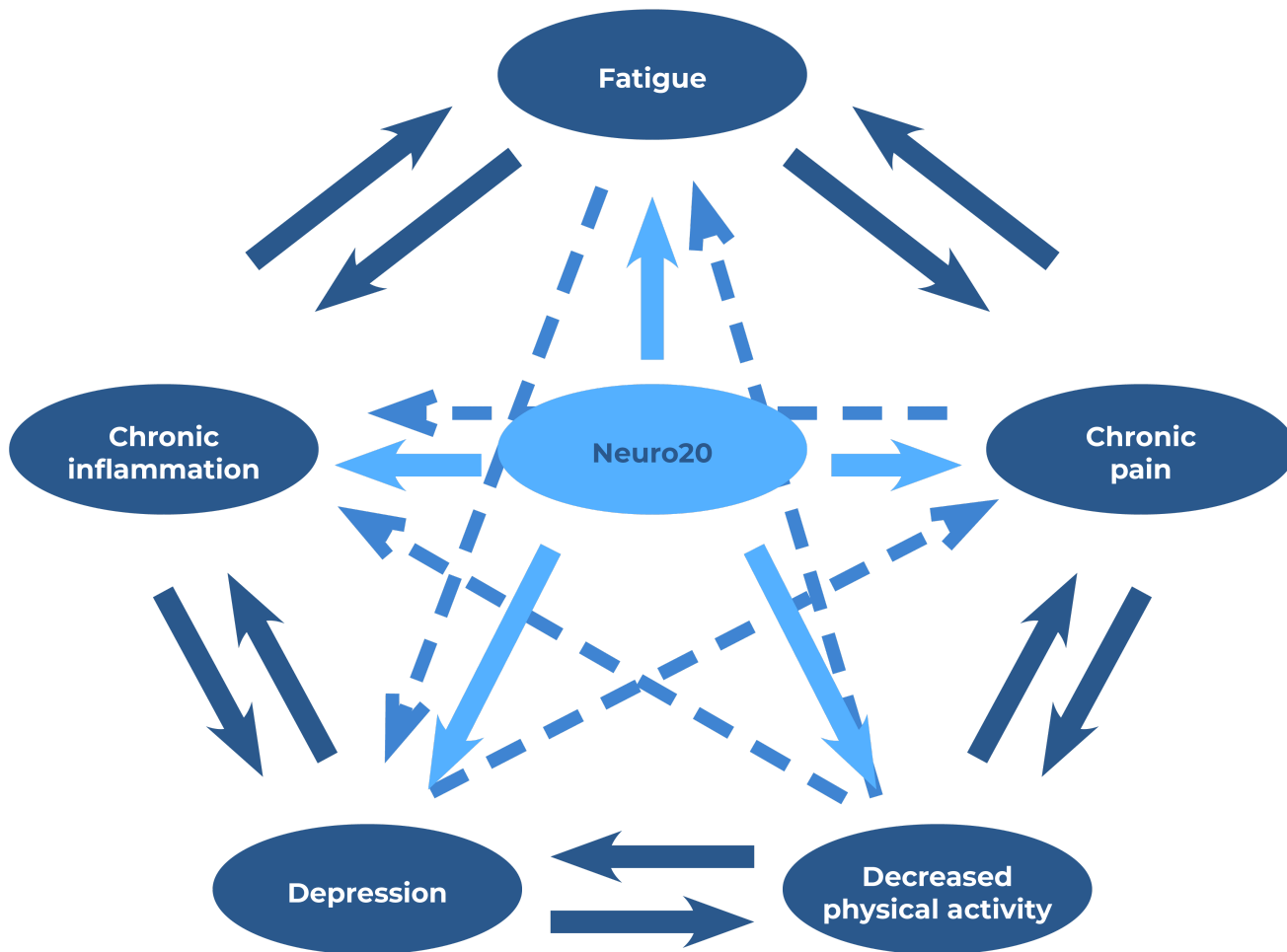
With Neuro20, we are observing immediate improvements in movement, balance, coordination, and muscle activation as well as decreased spasticity. We are also witnessing lasting positive effects on cognition, mood, and stamina as well as a reduction in the aches and pains typically associated with chronic inflammation. In short, Neuro20 is providing the catalyst to allow other treatments to become more effective to progress healing with Long COVID patients specific to being able to support the Autonomic Nervous System. Now, the combined effects of the treatments (earlier in the white paper) become profoundly stronger as Neuro20 acts as the physiological mechanism to potential modulate the nervous system at the **Brain, Nervous System, and Body.**



Long COVID Cycle (Part 1) - In this diagram, we show the "vicious" loop that occurs with systemic conditions that affect movement. While this is a simplification, this diagram shows that each problem cycles into the next, creating a never-ending cascade of problems that are hard to unwind from.



Long COVID Cycle (Part 2) - In this diagram, we show that with Long COVID is different than the traditional "vicious cycle" as a cycle is only TWO dimensional in nature while Autonomic Nervous System Dysfunction (ANS) is THREE dimensional, resulting in a more accurate descriptions as a **"VICIOUS SPHERE"**.



Long COVID Cycle (Part 3) - In this diagram, we show where Neuro20 comes in. Because the Neuro20 whole-body electrical muscle stimulation (WBEMS) system is influencing so many parts of the body at the same time, this creates the catalyst to "unwind" the cycle of ANSD. The "**Vicious Sphere**" of dysfunction at the ANS can be balanced to create a more homeostatic internal environment to MANAGE progress from.

The combination of everything above fits the scientific narrative for Neuro20 to make tremendous improvements in a complicated condition. Diagnostic studies in Long COVID patients have not been consistent nor particularly helpful in making a consistent treatment plan. Patients with Long COVID commonly show no changes in EMG results nor in nerve

conduction velocity, indicating the pathway from brain to muscles is working. The associated inflammation may be characterized in part by elevated white blood cell counts, erythrocyte sedimentation rates, positive anti-nuclear antibody (ANA) levels, D-dimer levels, and C-reactive protein levels, among others. In most of these patients, diagnostic testing has been negative. Despite this, the combination of progressive fatigue, motor impairment, and challenges in performing daily tasks (ADLs and IADLs) creates a "downward spiral" for patients, with [almost 50% unable to work full-time](#)¹.

Proposed Mechanisms for Neuro20's Effectiveness

The following is a detailed course of how Neuro20 is *hypothesized* to produce the changes being observed in Long COVID patients, specific to its potential effects on the Autonomic Nervous System (ANS). Please note, *this is a hypothesis, and the purpose of this white paper is to generate more appropriate clinical research into the actual mechanisms.*

For a Visual **AND** Audio guide to the *Hypothesis of How Neuro20 Works*, please click use this link -> <https://neuro20.com/neuro20-hypothesis/>

For access to the presentation (without Visual/Audio) please use the **same** link above and scroll down past the video presentation.

Dr. Keith J. Cronin has narrated this [11 minute video](#) to help provide additional clarity on the functions of Neuro20 and shows also a working hypothesis of how the product can be used as a proper protocol, specific to condition, to spark interest in clinicians and universities conducting research. It is the stance of this presentation that once Neuro20 is added to help balance the Autonomic Nervous system, that systemic changes at the physiological level, traditional treatments with anti-inflammatories, anti-depressants, pharmaceuticals, counseling, nutraceuticals, alternative therapies, and physical therapy will become significantly more effective.

Conclusion

Neuro20 PRO is FDA cleared as a Class II Medical Device for the following **6 Indications**:

DEPARTMENT OF HEALTH AND HUMAN SERVICES Food and Drug Administration Indications for Use	Form Approved: OMB No. 0910-0120 Expiration Date: 06/30/2023 See PRA Statement below.
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510(k) Number (if known)
K223797

Device Name
Neuro20 PRO System

Indications for Use (*Describe*)

The Neuro20 PRO System is intended to stimulate muscles in order to improve or facilitate muscle performance.

Other indications for use include:

- Re-educating muscles
- Increasing local blood circulation
- Maintaining or increasing range of motion
- Relaxation of muscle spasm
- Retarding or preventing disuse atrophy

With respect to the proposed mechanisms for how Neuro20 is positively affecting the body, it becomes clearer to relate the above indications to the benefit of a patient with Long COVID.

By creating an electrical interface to balance the Autonomic Nervous System, progress can be made by **stimulating muscles to improve performance**₁ throughout the entire kinetic chain of the body with Neuro20 whole-body electrical muscle stimulation (WBES). The device then can allow for a proper **muscle re-education**₂ to start between the brain and body. With 20 pads on the body, the effects of **increased local blood circulation**₃ are more profound than traditional benefits using a 1:1 device on a single body part which creates a homeostasis that is encouraged to **maintain and increase range of motion**₄ through many joints of the body. This restoration of normal body dynamics reduces the effect of abnormal feedback systems associated with a chronically ill body, supporting the **relaxation of muscle spasm**₅ to encourage pain-free movement to generate the benefits of a "positive feedback loop", creating a foundation of experiencing "reward" from activity. Finally, when utilized on a regular basis, Neuro20 helps **prevent disuse atrophy**₆ by creating an internal environment to encourage muscle growth, endurance, and overall functionality with daily living.

Long COVID is both a **brain, nervous system, and body** problem. Neuro20 is not a mental health device, but the connections between exercise, physical health, and mental health are

already well-established in the medical community. For decades, those experiencing Myalgic Encephalomyelitis / Chronic Fatigue Syndrome (ME/CFS) have struggled, trying combination treatments with the similar complicated responses seen with Long COVID. In the past 4 years, Long COVID has created an explosion of people "stuck" in the same loop as ME/CFS patients, resulting in an ongoing and growing burden on the American healthcare system and economy.

Neuro20 offers a physical modality that has never been seen in healthcare before to "energize" the recovery of patients facing such challenges by breaking the "**Vicious Sphere**".

Neuro20 whole-body electrical muscle stimulation (WBEMS) is potentially transforming our understanding and approach to chronic disease conditions affecting **brain, nervous system, and body**. Research previously showed the benefits of EMS, but the technology to address the entire body with FDA clearance for medical patients was lacking. We are now on the verge of a potential medical breakthrough that could help tens of millions of people recover who are currently resigned to a life of pain, social stigmatization, and disability.

In summation, Neuro20 is offering a new treatment tool in the battle to restore people to their optimal function and ability to live their lives to the fullest. Long COVID is just **ONE** of the many conditions that is seeing improvement with this incredible technology. This technology will allow healthcare practitioners to re-examine a science that we have known so well for over 50+ years in a completely new light.

The time to discover new potential is here.

LINKS

Neuro20 Website - www.neuro20.com

Neuro20 FDA Filing - https://www.accessdata.fda.gov/cdrh_docs/pdf22/K223797.pdf

About the Author

Dr. Keith J. Cronin is a respected physical therapist and the EVP of Commercialization for Neuro20 Technologies. He has authored multiple CEU courses on various topics, including ACL Rehab, Injuries to the Foot/Ankle, Patellofemoral Rehab, Best Techniques for Rehabilitation, Throwing Athletes, Mechanical Taping, and Activation of the Posterior Kinetic Chain. He is also a reviewer for the International Journal of Sports Physical Therapy. Dr. Cronin joined Neuro20 in November 2023 to leverage his experience in commercializing medical products and capital raising. He quickly realized the product's potential extended far beyond the orthopedic and sports space to neurological and immune-based movement disorders. Since early 2024, Dr. Cronin has been collecting information from Neuro20 patients across a wide range of conditions including:

- Long COVID
- Incomplete Spinal Cord Injury
- Complete Spinal Cord Injury
- Stroke
- Multiple Sclerosis
- Cerebellar Ataxia
- Chronic Pain
- Parkinson's Disease
- Bilateral Amputee

From this information, a pattern of improvement emerged, leading to the creation of this document and protocols. This white paper was created to introduce the medical community to a new therapeutic device with the capacity to create significant change in management of Autonomic Nervous System Dysfunction (ANSF). Although these case studies are anecdotal, Dr. Cronin hopes this paper will encourage medical providers and researchers to re-examine the massive potential of electrical muscle stimulation (EMS), particularly when coordinated with intelligent technology (Neuro20) that utilizes over 20 contoured pads (electrodes) to have an impact that is brand new to healthcare.

Bibliography

1. Joi, P. (2024, 03 19). *Nearly 7% of Americans Struggle with Long COVID as Infections Surge*. Retrieved 06 01, 2024, from <https://www.gavi.org/vaccineswork/nearly-7-americans-struggle-long-covid-infections-surge>
2. CDC. (2024, 03 14). *Post-COVID Conditions*. Retrieved 06 07, 2024, from <https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects/index.html>
3. CDC. (2024, 06 04). *ME/CFS Basics*. Retrieved 06 06, 2024, from <https://www.cdc.gov/me-cfs/about/index.html>
4. Neuroscience News. (2024, 01 17). *COVID-19 May Infect Dopamine Neurons*. Retrieved 28 05, 2024, from <https://neurosciencenews.com/dopamine-covid-25475/>
5. Benson, F. (2024, 01 08). *Long-COVID Can Destroy Your Ability to Exercise – Now We Know How*. Retrieved 06 02, 2024, from https://www.iflscience.com/long-covid-can-destroy-your-ability-to-exercise-now-we-know-how-72339?fbclid=IwAR3aPI28G439gkjlbl2UNUSBM2l3mLwJfUs3rJjaUHBd8KRSDFMXDTvB06M_aem_ATixJ36YFcPbR7wJOd8sip9EbjR-dfdElnAicLE1lziQKsf5sclLgb9FHdV7_aihZLo#ispxtxqhb3m2hq8bu
6. Marques, A., Gouveia, É., Werneck, A., Ferrari, G., Kliegel, M., Marconcin, P., Ihle, A., & Peralta, M. (2021, 06 23). *Bidirectional Association between Physical Activity and Dopamine Across Adulthood—A Systematic Review*. Retrieved 29 05, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8301978/>
7. Helbing, Cornelia and Angenstein, Frank. (05 2020) Science Direct - *Frequency-Dependent Electrical Stimulation of Fimbria-fornix Preferentially Affects the Mesolimbic Dopamine System or Prefrontal Cortex*. Retrieved 29 05, 2024, from <https://www.sciencedirect.com/science/article/pii/S1935861X20300486#:~:text=Thus%2C%20electrical%20stimulation%20of%20the,%5D%2C%20%5B32%5D%5D>.
8. Penn Medicine News. (2023, 10 16). *Penn Study Finds Serotonin Reduction Causes Long COVID Symptoms*. Retrieved 06 07, 2024, from <https://www.pennmedicine.org/news/news-releases/2023/october/penn-study-finds-serotonin-reduction-causes-long-covid-symptoms>
9. CDC. (2024, 06 04). *ME/CFS Basics*. Retrieved 06 06, 2024, from <https://www.cdc.gov/me-cfs/about/index.html>
10. Stone, Will. (2024, 01 09) NPR - *A Discovery in the Muscles of Long COVID Patients May Explain Exercise Troubles*. Retrieved 29 05, 2024, from https://www.npr.org/sections/health-shots/2024/01/09/1223077307/long-covid-exercise-post-exertional-malaise-mitochondria?fbclid=IwAR2DtED6EH331i6UwxHKhxj969C0WzRgwUBr1D0v4m7GanqOgY4djaqKhxE_aem_AZ1YUG9NG3jK6zIF11oQ4jIUQbcG00AADuaHmCxKD9IKoLVTz4Jc6QTXity3h5lzQQ8
11. MedPage Today - *Long COVID Blood Tests Show Distinct Immune and Hormone Function*. Retrieved 06 01, 2024, from <https://www.medpagetoday.com/neurology/longcovid/106485>
12. Yale University. (2001, 03). *Antidepressants Shown to Promote New Cell Growth in the*

- Hippocampus*. Retrieved 06 07, 2024, from <https://medicine.yale.edu/news/yale-medicine-magazine/article/antidepressants-shown-to-promote-new-cell-growth-in/>
13. Parepally, J., Smith, Q., & Mandula, H. (2006, 05). *Brain Uptake of Nonsteroidal Anti-Inflammatory Drugs: Ibuprofen, Flurbiprofen, and Indomethacin*. Retrieved 05 030, 2024, from <https://pubmed.ncbi.nlm.nih.gov/16715377/>
 14. Hodkinson, D., Zelaya, F., Renton, T., Williams, S., O'Daly, O., Wooldridge, C., Howard, M., Thacker, M., & Khawaja, N. (2015, 07). *Cerebral Analgesic Response to Nonsteroidal Anti-Inflammatory Drug Ibuprofen*. Retrieved 06 04, 2024, from https://journals.lww.com/pain/fulltext/2015/07000/cerebral_analgesic_response_to_nonsteroidal.17.aspx
 15. McNamara, D., & MA. (2023, 12 19). *More Evidence Suggests That 'Long Flu' Is a Thing*. Retrieved 25 05, 2024, from <https://www.webmd.com/cold-and-flu/news/20231219/more-evidence-suggests-that-long-flu-is-a-thing>
 16. Mayo Clinic. (n.d.). *Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS) - Symptoms and Causes*. Retrieved 06 07, 2024, from <https://www.mayoclinic.org/diseases-conditions/chronic-fatigue-syndrome/symptoms-causes/syc-20360490>
 17. Devendorf, A., Jackson, C., Sunnquist, M., & Jason, L. (2019, 09). *Approaching Recovery from Myalgic Encephalomyelitis and Chronic Fatigue Syndrome: Challenges to Consider in Research and Practice*. Retrieved 06 02, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5930162/>
 18. Healthline. (2022, 08 26). *How to Best Treat Chronic Fatigue Syndrome*. Retrieved 06 07, 2024, from <https://www.healthline.com/health/chronic-fatigue-syndrome-treatment#newest-treatments>
 19. Mayo Clinic. (n.d.). *COVID-19 Drugs: Are There any that Work?* Retrieved 06 07, 2024, from <https://www.mayoclinic.org/diseases-conditions/coronavirus/expert-answers/coronavirus-drugs/faq-20485627>
 20. Lin, Y., Pien, H., Devi, H., Tsai, B., Sheu, J., Wen, S., Sundhar, N., & Huang, C. (2023, 09 09). *Development and Evaluation of a Novel Chromium III-Based Compound for Potential Inhibition of Emerging SARS-CoV-2 Variants*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10559739/>
 21. Catalán, I., Alfaro, I., Valero, R., Campos, L., Blasco, J., Buj, A., Muñoz, S., Rincón, J., García, M., Martí, C., & Piqueres, R. (2023). *Nirmatrelvir/Ritonavir as a Possible Treatment for Long-COVID*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10586732/>
 22. Wang, S., & Xu, C. (2023). *Hydroxychloroquine: Is there a Role in Long COVID?* Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9874177/>
 23. Bramante, C., Buse, J., Liebovitz, D., Nicklas, J., Puskarich, M., Cohen, K., Belani, H., Anderson, B., Huling, J., Tignanelli, C., Thompson, J., Pullen, M., Siegel, L., Proper, J., Odde, D., Klatt, N., Sherwood, N., Lindberg, S., Wirtz, E., ..., Boulware, D. (2022, 12 23). *Outpatient Treatment of Covid-19 with Metformin, Ivermectin, and Fluvoxamine and the Development of Long Covid over 10-Month Follow-up*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9810227/>

24. Mohamed Hussein, A., Makhlof, N., Makhlof, H., Ibrahim, M., Kholief, K., Abd-Elaal, H., & Sayed, I. (2022). *Value of Montelukast as a Potential Treatment of Post-COVID-19 Persistent Cough: a Non-randomized Controlled Pilot Study*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9476462/>
25. O'Kelly, B., McHugh, T., Woo, J., Vidal, L., Avramovic, G., & Lambert, J. (2022, 07 03). *Safety and Efficacy of Low Dose Naltrexone in a Long Covid Cohort; an Interventional Pre-post Study*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9250701/>
26. Cohen, A., Davids, J., Leslie, K., Bligh, S., Kava, L., McCorkell, L., Schurman, E., Jaudon, T., Haas-Godsil, J., Vogel, J., Lizars, G., Crausman, S., Lewis, D., Sran, S., & Peluso, M. (2023, 09 20). *Impact of Extended-Course Oral Nirmatrelvir/Ritonavir (Paxlovid) in Established Long COVID: Case Series and Research Considerations*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10543503/>
27. Tosato, M., Galluzzo, V., Calvani, R., Ciciarello, F., Coelho-Júnior, H., Marzetti, E., Picca, A., Pais, C., Zazzara, M., Saveria, G., & Landi, F. (2022, 08). *Nutraceuticals and Dietary Supplements for Older Adults with Long COVID-19*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9212635/>
28. Kyriakopoulos, A.M., McCullough, P.A., Nigh, G., Seneff, S. (2023, 09 23) - *Proteolytic Targets for SARS-CoV-2 Spike Protein Degradation: Hope for Systemic Detoxification*. Retrieved 06 07, 2024, from <https://www.jpands.org/vol28no3/kyriakopoulos.pdf>
29. Hulscher, N., Procter, B., Wynn, C., & McCullough, P. (n.d.). *Clinical Approach to Post-acute Sequelae After COVID-19 Infection and Vaccination*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10663976/>
30. McCullough, P.A., Wynn, C., Procter, B.C. (2023) - *Clinical Rationale for SARSCoV-2 Base Spike Protein Detoxification in Post Covid-19 and Vaccine Injury Syndromes*. Retrieved 06 07, 2024, from <https://www.scienceopen.com/document?vid=288acf48-4de3-4ebc-8a9c-abc04275848a>
31. Barletta, M., Marino, G., Spagnolo, B., Bianchi, F., Falappone, P., Spagnolo, L., & Gatti, P. (2022, 08 22). *Coenzyme Q10 + Alpha Lipoic Acid for Chronic COVID Syndrome*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9395797/>
32. Batista, K., Cintra, V., Lucena, P., Manhães-de-Castro, R., Toscano, A., Costa, L., Queiroz, M., de Andrade, S., Guzman-Quevedo, O., & Aquino, J. (2021, 11 13). *The Role of Vitamin B12 in Viral Infections: a Comprehensive Review of its Relationship with the Muscle–Gut–Brain Axis and Implications for SARS-CoV-2 Infection*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8689946/>
33. Hikmet, R., Wejse, C., & Agergaard, J. (2023, 11 13). *Effect of Vitamin D in Long COVID Patients*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10671780/>
34. Vollbracht, C., & Kraft, K. (2021, 03 31). *Feasibility of Vitamin C in the Treatment of Post Viral Fatigue with Focus on Long COVID, Based on a Systematic Review of IV Vitamin C on Fatigue*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8066596/>
35. Guloyan, V., Oganessian, B., Baghdasaryan, N., Yeh, C., Singh, M., Guilford, F., Ting, Y., & Venketaraman, V. (2020, 09 25). *Glutathione Supplementation as an Adjunctive Therapy in COVID-19*. Retrieved 06 07, 2024, from

- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7601802/>
36. Zheng, M., Schultz, M., & Sinclair, D. (2022, 04). *NAD+ in COVID-19 and Viral Infections*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8831132/>
 37. Robbins, T., Clark, C., Sankar, S., Magar, A., Patel, K., Randeve, H., Sharma, K., Ali, A., Gonevski, M., Baitule, S., & Kyrou, I. (2021, 11). *Hyperbaric Oxygen Therapy for the Treatment of Long COVID: Early Evaluation of a Highly Promising Intervention*. Retrieved 06 01, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8806311/>
 38. Ballen Medical Wellness. (2023, 11 07). *The Best IV infusion Therapy to Help with Long Covid Syndrome (LCS)* » ballenmedical.com. Retrieved 06 07, 2024, from <https://ballenmedical.com/best-iv-therapy-for-long-covid-treatment-denver/>
 39. Roy Barman, S., & Jhunjhunwala, S. (2024, 01 09). *Electrical Stimulation for Immunomodulation*. Retrieved 06 03, 2024, from <https://pubs.acs.org/doi/10.1021/acsomega.3c06696>
 40. Utrero-Rico, A., Laguna-Goya, R., Chivite-Lacaba, M., Lumbreras, C., Lalueza, A., Almendro-Vazquez, P., Paz-Artal, E., Ruiz-Ruigómez, M., Arrieta-Ortubay, E., Aguado, J., González-Cuadrado, C., & Serrano, A. (2021, 10 26). *A Short Corticosteroid Course Reduces Symptoms and Immunological Alterations Underlying Long-COVID*. Retrieved 05 25, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8614904/>
 41. Cleveland Clinic. (n.d.). *Long COVID*. Retrieved 06 07, 2024, from <https://my.clevelandclinic.org/health/diseases/25111-long-covid>
 42. Besnier, F., Bérubé, B., Malo, J., Gagnon, C., Grégoire, C., Juneau, M., Simard, F., L'Allier, P., Nigam, A., Iglésies-Grau, J., Vincent, T., Talamonti, D., Dupuy, E., Mohammadi, H., Gayda, M., & Bherer, L. (2022, 03 31). *Cardiopulmonary Rehabilitation in Long-COVID-19 Patients with Persistent Breathlessness and Fatigue: The COVID-Rehab Study*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8998214/>
 43. Al-Jabr, H., Hawke, L., Thompson, D., Clifton, A., Shenton, M., Castle, D., & Ski, C. (2023). *Interventions to Support Mental Health in People with Long COVID: a Scoping Review*. Retrieved 06 07, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10280822/>
 44. Loftus, M. (2024, 03 13). *Long COVID: 'Will We Get Better?'* Retrieved 06 06, 2024, from https://news.emory.edu/features/2024/03/emag_long_covid_13-03-2024/
 45. Chaney, R., Wirtz, J., Martin, A., Prigent-Tessier, A., Leger, C., Méloux, A., Quirié, A., Fontanier, E., & Garnier, P. (2024, 01). *Cerebral Benefits Induced by Electrical Muscle Stimulation: Evidence from a Human and Rat Study*. Retrieved 06 04, 2024, from <https://www.mdpi.com/1422-0067/25/3/1883>
 46. Romo-Nava, F., Datta, A., McNamara, R., Buijs, R., DelBello, M., Awosika, O., Fleck, D., Guerdjikova, A., Basu, I., Welge, J., Patino, L., Frye, M., McElroy, S., Blom, T., Georgiev, G., Guillen, A., & Mori, N. (2024, 03). *Effect of Non-Invasive Spinal Cord Stimulation in Unmedicated Adults with Major Depressive Disorder: a Pilot Randomized Controlled Trial and Induced Current Flow Pattern*. Retrieved 06 03, 2024, from <https://pubmed.ncbi.nlm.nih.gov/38123726/>
 47. Hahn, A., Moeller, S., Braatz, F., Schlausch, A., Ekmann, M., Westerlund, M., de Chelle, G., & Mayr, W. (2024, 02 26). *Effects of a Full-body Electrostimulation Garment Application in a*

- Cohort of Subjects with Cerebral Palsy, Multiple Sclerosis, and Stroke on Upper Motor Neuron Syndrome Symptoms.* Retrieved 06 01, 2024, from <https://pubmed.ncbi.nlm.nih.gov/38354212/>
48. Sharples, S., Humphreys, J., Whelan, P., & Koblinger, K. (2014, 06 16). *Dopamine: a Parallel Pathway for the Modulation of Spinal Locomotor Networks.* Retrieved 10 30, 2024, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4059167/>
49. Lin, T., & Kuo, Y. (2013, 01 11). *Exercise Benefits Brain Function: The Monoamine Connection.*