

Emerging Opportunity: Cancer Electromagnetic Frequency Therapy

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The cell is a machine driven by energy. It can thus be approached by studying matter, or by studying energy. In every culture and in every medical tradition before ours, healing was accomplished by moving energy.

Dr. Albert Szent-Gyorgyi
Nobel Laureate in Medicine

Summary

The scientific principles of biology and physics are converging to provide novel approaches for the treatment of disease. In contrast to the destructive ionizing effects of conventional radiation therapies, electromagnetic therapy (EMT) acts to reversibly 'tickle' the vibrational frequencies of biological molecules to modify cellular activities. By non-invasively balancing cellular vibratory circuits, EMT can directly influence the body's systemic defense and repair mechanisms. The scientific rationale of EMT is reinforced by the "high tech" method that uses electromagnetic properties of biological molecules to identify new drugs (www.signaturebio.com/wt/sig/mcs). FDA approved EMT devices to reduce pain and stimulate healing are the first developments in this newly evolving field. Recently, international clinic scouts from the National Foundation for Alternative Medicine (NFAM) have identified an increasing trend in the use of non-invasive EMT devices to treat cancer patients outside the United States. If effectiveness can be scientifically documented, EMT has the potential to provide a non-invasive and minimally toxic method to jump-start the body's own tumor rejection process. Clinical experience has documented rapid and "spontaneous" remissions, showing that under the appropriate conditions the disease fighting and repair processes of the body can destroy even the most aggressive cancers. In the future, EMT devices might be able to therapeutically manage cancer by "resetting" the body, similar to the way electrical defibrillators "reset" normal heart function. NFAM has examined the biology and physics of EMT to determine if this non-invasive technology can be explained by accepted scientific principles. The purpose of this document is to demystify the field of EMT for the general reader, and to discuss the great potential of cancer EMT. A more rigorous technical review will

be available from NFAM upon request. Based on the scientific rationale and preliminary clinical results presented, NFAM is seeking financial support to investigate medical records and treatment protocols necessary to generate our website clinic reports for patients and practitioners. Our goal is to identify three clinics to fund collaborative Phase II clinical trials to evaluate the effectiveness of EMT for cancer.

Conceptual Model

Due to the general difficulty understanding how concepts of physics relate to cancer, the following analogy is provided to help conceptualize how EMT interacts with the biophysics of the body. In our cells, DNA acts just as a computer's binary code that runs various programs, and the nucleus is like the hard disk. Imagine that DNA mutations in cancer cells are like software problems (*i.e.* virus, system conflicts, etc). An increase in software errors (*i.e.* mutations) increases the chaos of the system and slows down the computer's overall performance. Simple software problems may only effect one program; however, complex software conflicts can severely affect the operating system and may ultimately cause the computer to freeze in the "on" mode (*i.e.* cancer). Similar to a computer with multiple software problems, cancer cells have at least 5-10 mutations in DNA sequences that regulate cell growth and can get stuck in the "on" mode. Programs that try to fix or "debug" a frozen program work like drug therapies. If the problem is simple, the program (*i.e.* drug) can repair the error. However, if the problems are severe, even the most advanced utilities (*i.e.* drugs) will not be able to fix a frozen system. The only way to get the computer to work again is to reboot by turning off the power and restarting. EMT uses specific frequencies to retune cellular signaling programs and restore optimal cell functions. Normal cells restart following EMT without a problem because their DNA (*i.e.* software) is normal. However, when cancer cells try to reboot, the multiple defects in the DNA (*i.e.* mutations, chromosome alterations and viruses) prevent restart, which would cause tumor cells to stop growing or to die.

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Key Electromagnetic Biophysical Principles

Molecules do not have to touch each other to interact. Energy can flow through...the electromagnetic field...The electromagnetic field along with water forms the matrix of life.

Dr. Albert Szent-Gyorgyi
Nobel Laureate in Medicine

The scientific principles of biology and physics (*i.e. biophysics*) are converging to provide novel approaches for the treatment of disease. Biophysics researchers are finding that physical principles are not limited to non-living objects, but provide the basis for the molecular and cellular signaling in living organisms. This section describes specific examples of the biophysical concepts necessary to comprehend the mechanisms of EMT.

Biophysical research documents that all chemical and mechanical reactions are electromagnetic on the atomic and molecular levels. The scientific rationale of EMT is reinforced by the “high tech” method that uses electromagnetic properties of biological processes to identify new drugs (www.signaturebio.com).

Magnets used in many commercial healthcare products have biophysical properties very different from EMT. A static magnetic field from metallic magnets does not emit electromagnetic frequencies or induce electrical current flow. Static magnetic fields have also been shown to influence biological processes, but will not be discussed in this review. (See Philpott and Kalita, 2000.)

Bioelectrical Interactions: Electrical charge can be either positive or negative. Like charges repel (+/+ or -/-) while opposite charges attract (-/+). Electrical current results from the movement of excess negatively charged ions (*electrons*) from the negative (-) electrode of a circuit to the positive electrode (+). A neutral molecule has no net charge. A battery loses electrical activity when all of the positive charges that can attract ions (*electrons*) are neutralized. The building blocks of proteins can be neutral, positive, or negatively charged. The electrostatic forces between positively and negatively charged amino acids direct and participate the three-dimensional folding of proteins and participates in the regulation of cellular activity. Because intermediates in enzymatic reactions can be electrically charged, modulation of electrostatic interactions by EMT can either increase or decrease the cellular activity of a protein.

Electromagnetic Spectrum: Energy is carried through free space on waves, similar to the way the energy of a stone cast into a pond creates ripples on the water’s surface. It is the way the sun’s light reaches the earth as well as the way invisible infrared light from a bonfire heats our palms. The full spectrum of electromagnetic energy covers a much wider range of wavelengths than those we are able to observe (*i.e. visible light*). The spectrum extends from the very short, such as gamma rays, to the very long, such as radio waves. The frequency of the waves can vary from $\sim .01$ Hertz (*Hz*, *.01cycle/second*) to more than

a 1,000,000,000,000,000,000,000,000,000 cycles per second ($>10^{24}$ Hz). The protein photoreceptors in our eyes can only detect light between 10^{14} and 10^{15} Hz. Basically, we are completely blind to $>99.99\%$ of the electromagnetic spectrum. Nonetheless, these waves are all around us, some passing right through our bodies, others being absorbed and/or reflected. It is hard to realize the extent to which we are bathed in electromagnetic waves. Radio, television, Internet and telecommunications signals are all part of the invisible electromagnetic spectrum. The study of the biological effects of invisible electromagnetic energies has revealed a variety of powerful therapeutic effects. For example, high frequency energy is commonly used by radiation oncologists to kill cancer cells by causing destruction of chemical bonds (*i.e. ionization*). Intermediate EMT frequencies are used in laser surgery to remove tumors. Slightly lower frequency microwaves are used to kill cancer cells via generation of heat (*i.e. hyperthermia*). Low frequency EMT (*below 20,000 Hz*) can produce anticancer effects without ionizing or heating effects.

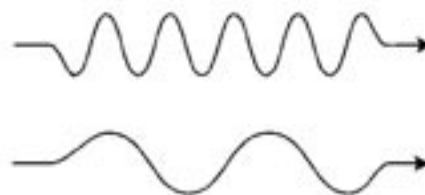


Figure 1. Frequency Wave

Frequency: Frequency is the number of times an electromagnetic wave cycles per second (*Hertz*). A complete sinusoidal wave cycle looks like the letter “S” turned sideways. The higher the frequency, the greater the energy in a single photon (*Figure 1*). While low frequency waves carry less energy they can penetrate solid objects. Surprisingly, wave like properties, similar to those observed in light, are observed in all matter including solid objects. Not only electrons but also all other particles, charged or uncharged, show wavelike characteristics. Until recently, the words of the ‘language of life’ were nerve impulses and chemical reactions, but we now see that there is also a deeper layer of communication underlying these familiar processes. If words are the molecules, frequencies are the syllables that allow the word to be spoken. Specific electromagnetic frequencies have been shown to enhance capillary formation, reduce swelling, diminish pain, increase tensile strength of ligaments, and accelerate nerve regeneration. Furthermore, a shift in frequency can mean the difference between having osteocytes strengthen or break down bone tissue.

Electromagnetic Induced Resonance: Every inanimate and living structure has a certain natural or resonant frequency. This applies to all levels of complexity from the subatomic to whole organisms. When any two objects have

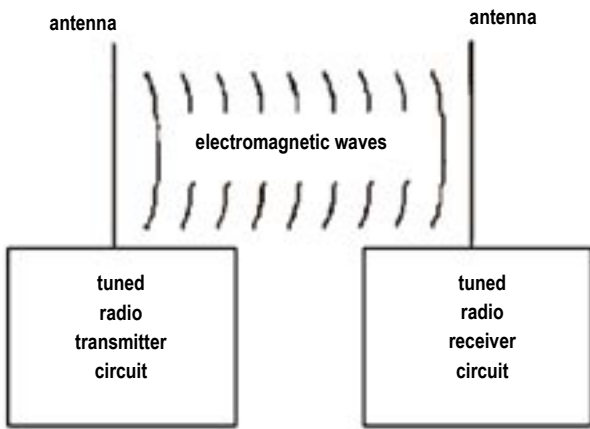


Figure 2. Radio Transmitter and receiver (resonance)

similar natural frequencies, they can interact without touching; their vibrations become coupled and resonate like dancers in perfect step. A soprano shatters a crystal goblet by singing a high note coinciding with the natural frequency of the goblet. The atoms in the glass vibrate so strongly that they cannot hold together, and the goblet breaks. When you tune in to a radio or TV station resonance is used to detect the specific signal (Figure 2). Resonance is also observed in living tissues. The eye contains a protein, rhodopsin, which absorbs light. Specific wavelengths of light cause resonance within the structure of rhodopsin in such a way that a single photon can activate a large shift in molecular structure. This shift triggers a cascade of chemical reactions, the flow of millions of sodium ions across the rod cell membrane, and an electrical signal that is transmitted by the optic nerves to the brain. In a similar manner when a hormone approaches a receptor, the electronic structures of both molecules begin to change. Recognition of a specific hormone by a receptor depends on the resonant vibratory interactions, comparable to the interaction of tuning forks (Figure 3). Activation of the receptor is the final step in an elaborate energetic dance of the electrons within the signal and receptor molecules. In some cases, triggering a receptor with an appropriate electromagnetic field is indistinguishable from triggering it with a hormone.

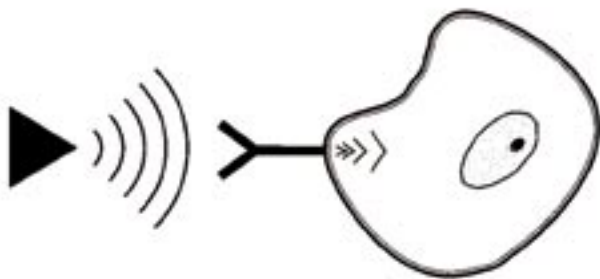


Figure 3. Activating a receptor and a cellular response via an electromagnetic signal

Electromagnetic Effects on Current Flow: A current is an assembly of moving charges. Faraday showed that changes in an electromagnetic field generate electrical current by a process called induction. The alternating current (AC) that we use for electrical power is produced by the induction process in power plants by rotating magnets at 60 cycles per second (60 Hertz). When a charge in a biological molecule moves or rotates, the electric field moves or rotates, and this sets up electromagnetic fields that are radiated into the environment. The opposite is also true: specific electromagnetic frequencies in the environment can be absorbed by a molecule, inducing movements of the component parts. Each component of the organism, even the smallest part, is immersed in, and generates, a constant stream of vibratory information (i.e. electromagnetic frequencies). Therefore, the life giving energy of the body is a complex mixture of both electric and magnetic fields.

Bioelectricity: Living organisms at all levels of complexity both generate and use electrical energy fields for development and regulating life sustaining processes. We truly are “electrical” beings. Bioelectricity arises in cells due to proteins that pump specific ions (e.g. sodium, potassium) across cell membranes to form an electrical potential similar to that found in a battery. The electrical energy fields picked up from the heart (e.g. EKG), retina, muscles and brain (e.g. EEG) arise because of the electrical currents that flow as the cells carry out their activities. Studies show that proteins behave like semiconductors used in computers to rapidly transfer bioelectrical signals. All communication in the body is thought to take place at a physical and atomic level, as infinitesimally weak electrical signals alter cell membrane permeability to allow the transfer of millions of ions back and forth in seconds. Every event in the body, either normal or pathological, produces change in both electrical and magnetic fields.

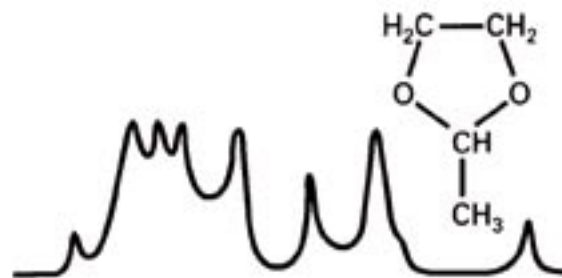


Figure 4. Absorption spectrum of a molecule (fingerprint)

Electromagnetic Profile of Biological Molecules: Precise information on molecular behavior can be obtained using spectroscopy, which is based on the ability of molecules to absorb and emit electromagnetic fields. A molecule contains various charged components: protons, electrons, and side groups such as amino acids. Each of these charged particles has an electric field around it.

Spectrometers are used to measure the emissions and absorption of molecules. The radiation or absorption profile is called a spectrum and every molecule in the body vibrates in a specific way. The spectrum is an electromagnetic 'signature' or 'fingerprint' that is an extremely precise representation of the motions of particles within it (Figure 4). So characteristic are these fingerprints that a chemist can use the spectrum to identify an unknown substance.

Overview of Electromagnetic Therapies

What is urgently needed is to be able to read the language of electromagnetic biocommunication to complement our understanding of the genetic code.

— C.W. Smith 1994

In a real sense, electromagnetic medicine is "Einsteinian" since it is Einstein's discoveries that provide the key insights necessary to understand how energy and matter interact. The science of modern physics and theories of quantum physics have opened a door to serious scientific inquiry into the use of specific electromagnetic frequencies to treat disease. At the atomic scale, physical contact between two molecules has less meaning than how they interact energetically. Biomolecules are similar to electrons in that their energetic subcomponents occupy different frequency modes, which we might call health or disease modes. For the human being whose energetic systems are in a "disease mode," only subtle energy of the proper frequency will be accepted to shift the body into a new mode or steady state of health. By rebalancing the energy fields that regulate cellular physiology, EMT restores order from a higher level of human functioning. Electromagnetic frequency therapies are not magic or superstition; they are scientifically based on biology, chemistry and physics.

Overview Historical Practices

Information from various ancient texts of Indian yogic literature speaks of special energy centers called "chakras." The chakras translate frequency energy into some type of glandular-hormonal output that subsequently affects the entire physical body. Chakras along with acupuncture meridians are now finding validation with the evolution of subtle-energy technologies that can measure their existence and function. Studies by Dr. Valerie Hunt at UCLA found electromagnetic waves from chakras are at far higher frequencies than usually found radiating from other areas of the body. Recent research using a superconducting quantum interference magnetometer shows frequencies emanate from the hands of practitioners of therapeutic touch, Qi Gong, and related methods. The Therapeutic Touch signal pulse at a variable frequency, ranging from 0.3 to 30 Hz, with most of the activity in the range of 7-8 Hz. In other words, the signal emitted by the practitioner is not steady or constant; it 'sweeps' or 'scans' through a range of frequencies. Studies show that nerve regeneration is stimulated at 2 Hz, bone growth at 7 Hz, ligament healing at 10 Hz, and stimulation

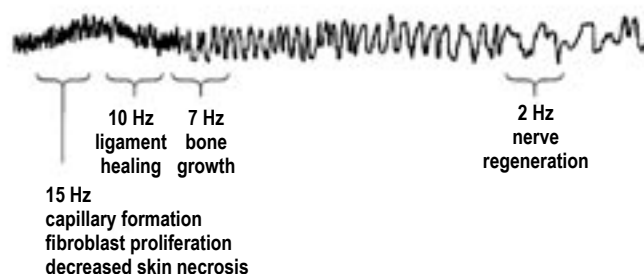


Figure 5. Signal from the hands of a Therapeutic Touch practitioner, showing how the frequency sweeps through the range of frequencies that are used in clinical medicine to "jump start" healing in various tissues.

of capillaries and fibroblasts at 15, 20 and 72 Hz (Figure 5). The evidence shows that practitioners can emit powerful pulsing biomagnetic fields in the same frequency range that biomedical researchers have identified for jump starting healing of soft and hard tissue injuries.

Acupuncture is one of the most ancient (2697 BC) and, until recently, mysterious methods of healing currently in therapeutic use. The acupuncture points on the human body run along a meridian system and deeply through tissues of the body. It has been found that the electrical resistance measured in the skin overlaying the acupoints is lower than the surrounding skin by a factor of approximately 10 to 1. It is suggested that meridian energetic-field inputs influence the signaling of the nervous system by varying the direct current (DC) of surrounding insulator glial cells. These cells influence the nerve's production and transmission of action potential and neurotransmitter release. Western science is now confirming the concepts that have been part of traditional energy medicine for thousands of years.

Current FDA Approved Technologies

If a bone fracture fails to heal there is a good chance that a physician will prescribe pulsed EMT therapy. The external application of specific frequency EMT across a fracture site appears to be all that is needed for the desired healing (Figure 6). EMT can convert a stalled healing process into active repair, even in patients unhealed for as long as 40 years. This therapy has also been shown to reduce osteoarthritis pain with no adverse effects.

Another approved application that has recently come of age is the use of electrical stimulation for the relief of pain. Stimulation of peripheral nerves at a level above the entry of the pain impulse to the spinal cord inhibits pain signaling. Modern transcutaneous nerve stimulators produce weak electrical pulses to skin electrodes, thus, stimulating cutaneous nerves to inhibit sensory information of physical pain to be sent to the brain. Magnetic Resonance Imaging (MRI) produces images of the human body based on changes in the distribution and structure of molecules to high intensity electromagnetic waves. MRI capitalizes on the frequency specific magnetic properties of protons (*hydrogen atoms in water*). In a strong magnetic field, the random distributions of protons resonate and align

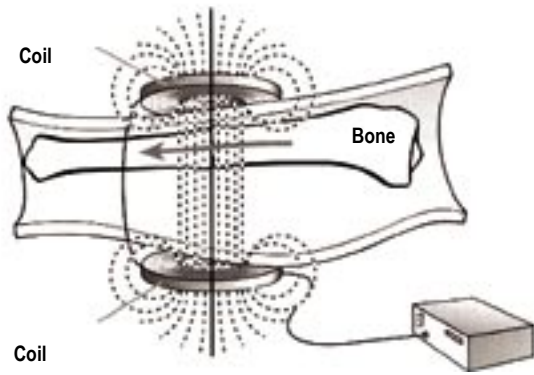


Figure 6. FDA-approved device for bone healing

their axes. When the radio wave beam is suddenly switched off, energy is released from the stimulated protons and is picked up by detectors situated in a circle around the patient in the MRI scanner. For more technical information on the mechanisms of low frequency EMT visit the pulsed signal therapy website (www.certifiedpst.com and www.bioem.f25.com/ricerca.html).

NFAM's Future Perspective

Recently, international scouts from NFAM have identified an increasing trend in the use of non-invasive EMT devices to treat cancer patients outside the United States. While several traditional methods have been shown to produce energetic fields, we feel that reproducibility of these methods would be hard to control for large-scale studies. NFAM has focused on the identification of electromagnetic devices that deliver highly reproducible electromagnetic frequencies that we think merit clinical investigation. EMT fields have advantages over electric fields because they are non-invasive, and can be used to treat both soft and hard tissues simultaneously. Advances in the electronics of EMT devices allow reproducible modulation of the frequency, amplitude (*i.e. strength*) and shape of the energy waves. The frequency, intensity, flux density, wave form shape, and total dose (*i.e. exposure*) all contribute to potential therapeutic affects. The majority of devices identified by NFAM scouts use low frequency electromagnetic energy to stimulate the body's defense and repair mechanisms. These new devices offer the advantages of being non-invasive and minimally toxic compared to the non-specific destructive effects of higher frequencies (*i.e. radiation, hyperthermia*). However, NFAM is also planning to evaluate a few invasive electrical devices that implant electrodes into either a tumor or acupuncture point (*i.e. electroacupuncture*) in order to compare their efficacy to EMT devices. The remainder of this document discusses the effects of low frequency EMT on regulation of cellular function in normal and cancerous cells.

Cancer Electromagnetic Frequency Therapy

I conclude, as I did seven years ago, that our decades of war against cancer have been a qualified failure.

— J.C. Bailar III, (M.D., Ph.D.) Harvard University
at the Vice President's Cancer Panel Meeting

Cancer is the end-result of a series of genetic alterations that modify the control of proteins that promote (*i.e. oncogenes*) or inhibit (*i.e. suppressor genes*) cell proliferation. Conventional chemotherapy and radiation employ non-specific toxic effects to inhibit the proliferation of both normal and tumor cells. Hence, side effects include hair loss, digestive problems and immune suppression. In order to reduce toxicity, current academic and pharmaceutical investigations are focusing on identifying novel methods to reverse cancer specific alterations in oncogenes or suppressor genes. An example of a well-publicized new therapy is the oncogene inhibitor (*Gleevec*). However, this new 'silver bullet' drug is limited because the tumor must contain a specific and rare genetic alteration in order for the drug to be effective and because the general genetic instability makes the tumors resistant to the therapy. In order to target the majority of tumor types and avoid drug resistance, state-of-the-art drug discovery approaches are attempting to upregulate the immune system and inhibit tumor blood supply. Despite effective inhibition of tumor growth in preclinical animal models, many immune enhancement and blood vessel inhibitors have failed to show significant improvement compared to conventional chemo/radiotherapies in human clinical trials.

Specific low frequency EMT has been reported to restore the homeostatic function of genes by controlling cell growth. An assembly of cells, as in tissue or an organ, will have certain collective frequencies that regulate important processes, such as cell division. Normally these frequencies will be very stable. If, for some reason, a cell shifts its frequency, entraining signals from neighboring cells will tend to reinstall the correct frequency. However, if a sufficient number of cells get out-of-step, the strength of the system's collective vibrations can decrease to a point where stability is lost. Loss of coherence can then lead to disease or disorder. While pathology may manifest as chemical imbalance, the underlying problem is electromagnetic. Hence, providing the correct or 'healthy' frequency to entrain the oscillations back to coherence can restore growth control.

Published studies using cancer cell cultures and animal tumor models demonstrate that EMT induces cell death (*i.e. apoptosis*). The correlation between cell membrane potential and cancer cell proliferation was detailed in a classic paper by Cone (1970). Direct measurements showed 6.0-7.5 times higher conductances in tumors compared to normal tissues. The electrical changes arise because rapidly proliferating and transformed cells have lower membrane potential compared with normal cells. The cancer cells transmembrane electrical potential is reduced ($-20mV$) versus normal cells ($-90mV$). This reduction is analogous to a battery that has lost ~80% of its charge. EMT has been shown to modulate the activity of the sodium potassium pump that is responsible for setting the transmembrane potential. Recent studies at Columbia University have mapped the optimal frequencies to

control the activity of numerous enzymes, including the sodium potassium pump (*Bioelectrochemistry* 53:171-4, 2001). The specific cellular machinery (*i.e. DNA response elements*) that turns on and off genes in response to electromagnetic frequencies has been recently identified (*J Cell Biochem* 81:143-8, 2001). Interestingly, several of the genes regulated by EMT have been shown to be important for the growth of cancer cells. Currently, state of the art genomic technologies are being used further to characterize the changes in gene expression induced by specific frequencies.

In addition to direct anti-tumor effects, EMT has been shown to enhance the immune system and inhibit the blood supply of tumors. During the past two decades, the effects of electromagnetic exposure on the immune system have been extensively studied. Similar to a vaccine, specific frequencies can mimic antigen signaling and induce lymphocytes (*T, B, and natural killer cells*) to attack tumor cells. Recent studies at EMF Therapeutics (*Chattanooga, Tennessee, USA*) demonstrated that specific frequencies can inhibit cancer by blocking the tumor blood supply (*Anticancer Res* 21:3887-91, 2001). Thus, EMT can powerfully combat cancer by:

- 1) directly inducing tumor cell death (*i.e. apoptosis*),
- 2) activation of an anti-tumor immune response, and
- 3) starving tumor cells by inhibiting the blood supply (*angiogenesis*).

A critical, technical review of peer-reviewed scientific literature regarding the effects of electromagnetic therapies on cancer is currently being prepared for publication. Please email mneveu@nfam.org if you would like a copy of this document.

Clinic Investigation Status

The most beautiful thing we can experience is the mysterious. It is the source of all true art and all science. He to whom this emotion is a stranger, who can no longer pause to wonder and stand rapt in awe, is as good as dead: his eyes are closed.

— Albert Einstein, Ph.D.

Based on extensive research and networking, NFAM has identified a series of devices that have been developed for controlled delivery of specific frequencies to treat cancer and other degenerative diseases. These devices use frequencies that differ from than those used for treatments currently approved by the FDA. Traditional radiation therapy for cancer uses high frequency ionizing radiation to destroy both normal and tumor cells. Newer FDA approved devices induce specific heating of tissues, termed hyperthermia, to destroy both tumor and surrounding normal cells. In order to introduce new technologies into cancer treatment, NFAM is currently focusing on EMT devices that use low frequencies that do not generate heat (*i.e. hyperthermia*) or ionization (*conventional radiotherapy*).

Several clinics were identified by NFAM international medical scouts, Internet searches, and networking with researchers around the world. These clinics hold the most

promise for further clinical research to establish the efficacy of EMT for cancer treatment. We are in the process of visiting these clinics to examine cancer patient records before and after treatment with the various EMT devices. The clinics that we determine to have the most compelling patient responses (*i.e. tumor regression, increased patient survival*) will be provided funding to perform clinical trials to determine the effectiveness of the treatments.

Because of the large number of clinics and our limited resources, NFAM is currently planning visits only to clinic sites that have the highest probability of successfully completing a rigorous Phase II clinical trial.

NFAM Requirements for Clinic Visits

1. Use unconventional treatment(s) as compared with accepted cancer therapies used in the United States.
2. Provide NFAM with a general description of the treatment method(s) used.
3. Make available medical records that document successful treatment of cancer and diagnosis of cancer prior to the EMT.

The detailed guidelines to evaluate "best cases" is available from the NFAM office.

NFAM Requirements for Clinical Research Including Phase II Trials

1. Sufficient clinical evidence for 5-10 cancer patients documenting successful treatment. Priority will be given to clinics demonstrating effective treatments for cancers with very poor prognosis.
2. Preliminary data on what type(s) of cancer responds, in order to design an optimal phase II prospective trial.
3. Willingness to collaborate with leading Universities on clinical trial design and validation.
4. Adequate facilities for performing imaging and diagnostic studies should be available in the vicinity of the clinic.
5. Ability to treat at least 20 patients with a specific cancer type in 12 months.

Preliminary List of Clinics

Round about the accredited and orderly facts of every science there ever floats a sort of dust-cloud of exceptional observations, of occurrences minute and irregular and seldom met with, which it always proves more easy to ignore than to attend to... Anyone will renovate his science who will steadily look after the irregular phenomena, and when science is renewed, its new formulas often have more of the voice of the exceptions in them than of what were supposed to be the rules.

—William James