Toward disease-specific therapies in mind-body cancer research: reverse engineering, epigenetic feedback and in vitro/ in vivo combination protocols

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It is now appreciated that the essence of cancer may not be in specific driver genes but in the dynamics of cells traversing state spaces and shifting between different attractors […]. While these state spaces are commonly thought of in terms of transcription (gene-regulatory networks), the data on bioelectricity in cancer suggests that another important concept may be the physiological state space.
(Chernet and Levin, 2013)

Bioelectric states appear to be powerful master regulators that trigger complex downstream cascades (self-limiting and self-organizing patterning modules) without the need to micromanage the process.
(Chernet and Levin, 2013)

ABSTRACT: Although we have significant experimental evidence demonstrating that specific meditation forms correlate with particular effects on biological targets, mind-body therapeutic applications are still very rudimentary and poorly standardized, consisting of little more than exercises designed to trigger a parasympathetic response. If the sole physiological effect of meditation were related to the relaxation response, then indeed most forms of meditation would be expected to work in similar ways and achieve similar results. But as we have explored in a previous panel discussion anchored by Michael Persinger and his group [*Bajpai et al., Journal of Nonlocality, II-2, 2013*], the convergence of photobiology and qigong experimental research indicates that specific brainwave patterns correlate with specific biophoton emission frequencies, microtubule conformational states and biological effects, both at the level of the operator's body and in remote targets. Of greatest clinical interest is the ability of focused intent to produce target-specific, directional effects, while leaving control samples unaffected – a feature that has been documented by over a hundred *in vitro* and *in vivo* controlled qigong experiments and corroborated by several hundred Random Event Generator (REG) studies conducted at Princeton and other university labs. While the physical modeling of such remote effects is still speculative, the potential applications are sufficiently intriguing to warrant an empirical leap ahead of the theoretical staging. If cancer is "a disease of geometry" due to a "misregulation of the field of information that orchestrates individual cells' activities towards normal anatomy", as Chernet and Levin argue [*Chernet and Levin, J Clin Exp Oncol 2013, S1*], could we find a way to design and calibrate specific meditation forms to predictably achieve intended electromagnetic effects at a biological target (such as a tumor)? The present paper proposes a general approach that might take us a step closer to tailoring such targeted mind-body interventions through the use of reverse engineering, rapid-expression epigenetic feedback and an *in vitro/ in vivo* combination protocol.

KEYWORDS: cancer, epigenetic, biophysical, reverse engineering, meditation, quantitative real-time PCR-based gene expression analysis, DNA microarray, feedback, low level laser therapy, biophoton emission, EEG, mind-body medicine

I. Background: Scientific Method or a Brief Course in Miracles?

It is no longer a matter of debate that the processes responsible for normal cellular function and tissue architecture are under the control of more than local molecular mechanisms [Levin 2011, 2012, 2013; Hamblin 2008; Karu 2008, 2011; Smith 2013; Huang et al. 2009; Becker 1985, 1990; Popp and Chang 1998; Popp 2002; Bajpai et al 2013; Ho 1993; Rahnama at al 2011; Tafur et al 2010; Vedral 2011]. The ability of weak electromagnetic fields, either of endogenous origin or applied via therapeutic magnetic or laser stimulation, to modulate the expression of genetic material, is now well recognized. From orthopedics to oncology, bioelectromagnetics has revolutionized the way in which we think about healing mechanisms [Hamblin 2008; Karu 2008, 2011; Smith 2013; Huang et al. 2009; Sidorov and Chen 2006]

In a recent article, Chernet and Levin [2013] provide an excellent review of the experimental evidence and theoretical developments framing the biophysical aspects of regulatory cancer mechanisms. The electromagnetic environment of the cells is composed of steady-state endogenous ion currents, resting potentials and electric fields produced by the activity of ion channel and pump proteins across cell membrane. It is known that changes in the transmembrane potential are important determinants of cell differentiation and proliferation – even mature CNS cells can be induced to enter mitotic states by prolonged depolarization. In addition, altering the transmembrane potential can produce transcriptional changes by regulating the movement of serotonin, calcium, and inositol triphosphate through gap junctions, controlling the transport of small signaling molecules like serotonin and butyrate across membrane exchangers, and modulating the activity level of phosphatases such as PTEN. Disruption of membrane gradients can compromise tissue architecture (anatomical order) during carcinogenesis, while the altered function of ion channels correlates with cell response to anti-growth signals, abnormally high replicative potential, prolonged angiogenesis, avoidance of programmed cell death, tissue invasion and metastasis. Finally, healthy neighboring tissues appear to exert a cancer-suppressive effect on cells, as is the presence of normal innervation – both of which indicate that long-range signaling is involved in normal cell function and tissue patterning information. {Chernet and Levin, 2013].

But understanding the significance of weak endogenous electromagnetic fields and membrane gradients on genetic expression is a far cry from being able to harness their regulatory controls. As the authors of the review describe this challenge, "*biologists are beginning to explore the idea that cancer is not a genetic disease of specific loci but rather a kind of attractor in a multi-dimensional transcriptional space describing cell states […]: "The topology of the attractor is the 'invisible hand' driving the system functions into coherent behavioral states: they are self-organizing structures and can capture the gene expression profiles associated with cell fates*"; therefore "*the true impact of bioelectricity in cancer will only occur when we understand and target the storage of patterning information in physiological networks that is misprocessed in cancer*" [Chernet and Levin, 2013]

While the complex downstream/upstream regulatory loops influenced by the body's electromagnetic fields make mathematical modeling of this problem a slow and arduous undertaking, there is one tool that might provide an empirical shortcut to practical therapeutic applications. Indeed, the challenge of photomedicine and other forms of

electromagnetic therapeutics is not only to understand the mechanisms of action and appropriate dosage of the radiation, but ***to deliver it to the right locus*** [Bajpai et al, 2013]. The interaction of externally applied fields with various tissues is limited by factors like absorption, scattering and loss of coherence, drastically reducing the clinician's ability to provide an effective dose at the target tissue [Karu, 2011].

In contrast, mind-body therapies seem to possess a well-documented ***target specificity feature*** [see extensive literature reviews in Benor 2001, Delanoy 2001, Sidorov and Chen 2006, Nawalinski 2012, Bajpai et al. 2013] that is as remarkable as it is difficult to explain within the current physics framework. Hundreds of controlled experiments have by now demonstrated that human operators focusing on an *in vitro* or *in vivo* (chemical reactions, cell cultures, animal models or isolated human subjects) target can produce statistically significant effects at the target, ***while leaving the controls unchanged***. These effects include the acceleration of seed germination and plant growth rate [Grad 1965; Miller 1972; Nicholas 1977; Saklani 1988, 1990; Hu et al. 1989; Zhou et al 1989; Scofield and Hodges 1991; Jin et al 1994; Pan 1995; Haid and Huprikar 2001]; intent-correlated, directional mutagenesis [Nash 1984; Shan et al. 1990; Pei et al 1994; Bai et al 2000;]; structural changes in erythrocyte cell membranes [Braud 1979, 1990; Sun et al. 1990] as well as in the conformation of various bio-molecules, such as polyglutamic acid, polylysine, metallothionein, and RNA , blood plasma cAMP, vitamin C, liver cancer cell DNA, dipalmitoyl phosphatidylcholine and liposomes, components of *Escherichia coli* bacteria, and various intracellular biomolecules [Cheng 1987; Guo et al 1989; Zhou et al 1989; Feng 1994; Chu et al 1998; Li et al 1998; Yan et al 1999; Chu et al. 2001] , together with some RNAs [Chu et al. 1998, 2001]. Hammerschlag [Hammerschlag et al, 2012] discusses a review of 20 non-touch therapy randomized controlled trials, 65% of which reported at least one statistically significant biomarker effect. Changes in the conformation of DNA and RNA samples have been found under the effect of conscious intent (external qi) by Lu Zuyin [1989] and Sun et al. [1988] as indicated by changes in the samples' ultraviolet absorption curve. In a related experiment, Zhang et al. **[**1990] studied the effect of emitted qi on the nucleic acids of chick red blood cells and found a two-fold increase in DNA and 12-fold increase in RNA content. And a 2012 paper published in Molecular and Cellular Biochemistry [Yan et al, 2012] identified 39 genes whose expression was changed by external qigong in small-cell lung cancer line NCI-82, inducing apoptosis of cancer cells while repressing their proliferation, metastasis and glucose metabolism.

Statistically significant anti-tumor effects were documented by a number of in vitro qigong studies on lung cancer cells [Chen 1992]; liver cancer cells [Zhang et al. 1996; Li et al 1998]**;** K_{562} leukemia cells [Yang et al. 1990; Lee et al. 2001]; gastric adenocarcinoma [Feng et al. 1990], nasopharyngeal carcinoma [Chen et al 1990, 1992, 1996; Cao et al. 1993] and breast cancer cells [Chen et al. 2001], which were all negatively affected by the emitted Qi of an experienced practitioner [Nawalinksi 2012]. Control cultures were unchanged by mock emissions from non-practitioners. According to Nawalinski's review , "*at least 30 papers dealt with the positive effects of EQT on animals with solid tumors and blood / lymph neoplasms. Unspecified tumors in mice, 4, 42, 43, 44, 46, 53, 84, 99, 100, 101,102,103,104,105,106 gliomas,40,41 hepatocarcinoma,45 nasal carcinoma,96 sarcoma,48,52 melanoma,49,50 lung cancer,49,50,51 leukemia,47 lymphoma,224 and mammary cancer 51 were resolved successfully, or if the treated animals died, they had lived longer and/or were healthier than controls 42, 43, 44, 47, 48,50,51,52,53,99,100,101. Unspecified tumors in mice,4,42,43,44,46,53,84,99,100,101,102,103,104,105,106 gliomas,40,41 hepatocarcinoma,45 nasal carcinoma,96 sarcoma,48,52 melanoma,49,50 lung cancer,49,50,51 leukemia,47 lymphoma,224 and mammary cancer 51 were resolved successfully, or if the treated animals died, they had lived longer and/or were healthier than ontrols.42,43,44,47,48,50,51,52,53,99,100,101. Necropsy and microscopic findings on the animals included improved immunological functions with enhanced natural killer (NK) cell activity,4,41,46,102,103,104,105,106 smaller tumor volume,42,43,44,45 lower metastatic rate,42,43,44 nuclear condensation and fragmentation,45 vacuolated mitochondria,45 and tumor cytolysis.46 Improved NK cell activity in vitro against K_{562} myelogenous leukemia cells by Qi treatment was further enhanced when a mixture of the NK and K_{562} cells were treated with Qi together 3"* [Chu et al. 1989; Feng et al. 1988; Liu and Ou 1989; Lin et al. 1989; Shao et al. 1990; Zhou et al. 1990; Li et al 1990; Lei et al. 1991; Zhao et al. 1991; Li et al. 1992; Chen 1993; Qian

et al. 1993a,b, 1998; Qian and Shen 1993; Feng 1994; Qian et al. 1994, 1998; Guan and Liang 1995; Chen et al. 1995, 1997; Feng et al. 1996; Zhao et al. 1998; Cao et al. 1998; Chen et al. 2002; Nawalinski 2012]. Electron microscopy studies of malignant tissue extracted from laboratory animals treated with external qi have repeatedly shown clear histological signs of apoptosis and/or reversal of cancer features, when compared to controls. Shao et al. [1990] looked at qigong-treated mice with implanted S180 sarcoma and reported that the averaged diameters of cells and nuclei, the ratio of nucleus to cytoplasm and the number of tumor cells division phase and Ag-NOR counts in nuclei in the sarcoma of EQT treated mice were all much less than those in the controls ($p < 0.001$). They also found that in the EQT treated mice a great number of sarcoma cells showed atrophy, degeneration, and pyknosis or karyolysis, while some membrane structures such as mitochondria appeared to be injured. Related results include the ability of emitted qi to increase NK cell and K cell activities [Li et al. 1992] and to enhance the number of active osteoclasts and the quality and quantity of both fibrous and bony callus tissue in laboratory rabbits [Jia et al. 1988].

An equally intriguing feature of mind-body and mind-matter interactions is the ***directionality of the effect***. Examples include an intent-correlated increase/decrease in the growth rate of in-vitro cancer cell cultures like human nasopharyngeal carcinoma cell line (CNE-2), human breast cancer cell lines, lung cancer cells (SPC-A1), liver cancer cell line (BEL-7402), erythroleukemia (K562), promyelocytic leukemia, CNE-2, SGC-7901 gastric adenocarcinoma, spleen cells of mice and lung tumor cell line (LA-795), etc. [Chen et al. 1990, 1995, 1997; Shah et al. 1999; Chen and Yount 2002; Chen et al. 2005]; bi-directional effects on the growth of bacterial cultures such as E-coli [Feng et al. 1982; Nash 1982] and Salmonella typhimurium [Rauscher and Rubik 1983]. Chien et al. [1991] looked at the bi-directional effects of external qi on FS-4 human fibroblasts and found that "facilitating" qi produced a 1.8% increase in cell growth rate in 24 hrs, 10-15% increase in DNA synthesis and 3-5% increase in cell protein synthesis in a 2 hr period. With "inhibiting" qi, cell growth decreased by 6% in 24 hours, while DNA and protein synthesis decreased respectively by 20-23%, 35-48%.

Rein and McCraty [1994] reported a 250% change in DNA conformation, directly correlating with the intent of a healer from a distance. The directional winding/unwinding of DNA under specific intent has been repeatedly demonstrated by Rein and his team over a number of years and experimental set-ups, with some samples showing more denaturation than could be obtained via normal heating or mechanical means [Benor 2001]. Similar changes in the conformation of DNA and RNA samples have been found under the effect of conscious intent (external qi) by Lu Zuyin [Lu 1989] and Sun et al. [1988] as indicated by changes in the samples' ultraviolet absorption curve.

Perhaps the most striking illustration of directional, localized effects on biological targets is a series of experiments on in vitro DNA samples conducted by Glen Rein and Rollin McCraty at the HeartMath Institute. In these controlled studies, (see McCraty, Atkinson and Tomasino) human operators were asked to increase or decrease the rate of DNA denaturation in solution samples either held by them or kept in a laboratory 0.5 miles away. The experimental subjects were trained in generating high ECG coherence rates according to the HeartMath protocol and measured by fast Fourier transform techniques, with the coherence ratio determined by the percent of coherent to non-coherent epics during the two minutes of recording. The denaturation rate was measured using UV spectroscopy. While individuals who showed low coherence ratios, although in a calm state of mind, were unable to change the conformation of DNA, all subjects trained in the HeartMath technique were able to produce high coherence rates and significant DNA changes ($p<0.01$), with one individual demonstrating an effect size that was three times larger than the maximal thermal and mechanical perturbation known to be possible. The winding and unwinding of DNA reflected the pre-stated directionality of intent, and in one protocol involving three identical aliquots of DNA, two samples were denatured to different degrees while the third one was left unchanged, as intended. Of additional interest here is a second experiment conducted by Rein and Laskow [Benor 2001, p. 159], in which they showed that four different visualizations (healing intentions) by the same claimant healer produced distinct magnetic signatures and corresponding biological effects on tumor cell cultures.

In an intriguing illustration of mind-directed target specificity, Nawalinski describes an experiment in which a "*thermogram recorded the development and progression of heat down a practitioner's arm from shoulder to palm to fingertips and then into the body of a patient from a distance of one meter, raising his body surface temperature by three centigrade degrees"* [Lin et al. 1980; Chen 1980].

As difficult as they are to accept by Western medical practitioners trained in a classical physics mindset, these target specific, directional and frequently nonlocal (remote) effects are documented by over 300 published reports and meta-analyses, primarily in Chinese, Japanese and US journals [Sancier 1996 a,b, 1999; Chen and Yeung 2002a,b; Chen 2004; Gerber et al. 2006; Chow and Tsang 2007; Lee et al. 2007; Xin et al. 2007; Guo et al. 2008; Bobby et al. 2009; Horowitz 2009; Lee et al. 2009; Ng and Tsang 2009; Rogers et al. 2009; Jahnke et al. 2010; Chen et al. 2012; Nguyen et al. 2011; Alraek et al. 2011]. Radin [Radin, 1997 p. 151-152] reports a meta-analysis of over a hundred controlled DMILS studies, with a cumulative probability exceeding one trillion to one. Finally, it is interesting to note that such DMILS experiments are corroborated by, and represent essentially a biological mirror of standard mind-machine studies looking at PK effects on random effect generators - which have by now been demonstrated with a statistical probability of over a trillion to one (see Jahn and Dunne 2005, 2011; Carter 2007; and Radin, 1997, p. 140)

Collectively, these studies suggest that conscious intent may act by increasing the rate of cell-specific transcription and translation responsible for specialized functions, as well as modulating other important physiological aspects. But what is the primary interface between conscious intent and living processes? In his review, Nawalinksi cites a number of proposed mechanisms, including the improvement of immune functions [Wan et al. 1990; Zhang 1995]; increasing microcirculation and improving the elasticity of blood vessels [Wang et al. 1989; Shen and Gao 1995]; raising the pain threshold [Wang et al. 1989; Zhang et al. 1990]; and regulating the metabolic system through the cerebral cortex and the central nervous and cardiovascular systems [Chen and Yeung 2002a]. The configuration of various molecules (see above) has been shown to be under the influence of EQ intent, as have the rates of various reactions involved in life processes (such as the oxidation of glucose, which Ren [1990] demonstrated that Qigong healers can speed up by 400%, with the controls showing no such accelerated reaction [Nawalinski 2012]. What can account for these apparently nonlocal and multi-faceted effects?

While the exact mechanism of action of healing intent remains a major theoretical challenge, one observation of interest is that both metabolic reactions and genetically-driven functional changes could be explained on the basis of molecular configuration changes – and that such structural changes and gene expression profiles are partly under the influence of their electromagnetic environment.

A number of biolectromagnetics studies illustrate this principle: In a 2002 study, Tofani et al.. found a statistically significant inhibition of tumor growth (40%) and increase in survival time (31%) when mice bearing a subcutaneous human colon adenocarcinoma (WiDr) were exposed to 70min/day 5.5mT magnetic fields with 50 Hz modulation for 4 weeks; a decrease in tumor cell mitotic index and proliferative activity and increase in apoptosis were also observed - with no adverse or abnormal effects [Tofani et al. 2002]

In a similar study reported by Simko et al. [Simko et al. 1998], extremely-low frequency EMFs (0.1-1mT, 50Hz) applied continuously for 48-72 hrs resulted in increased micronucleus formation and apoptosis in transformed cell lines (human squamous cell carcinoma SCL II), but no adverse effects in normal, non-transformed cells. Cell death induction consistent with apoptosis was also reported in two transformed cell lines (WiDr human colon adenocarcinoma and MCF-7 human breast adenocarcinoma) that were exposed to 1mT magnetic fields modulated by 50Hz ELFs). Cells with daily exposure of 70 min. for 4 weeks showed significant tumor growth inhibition (up to

50%) by the end of treatment. No toxic morphological changes were observed in renewing, slowly proliferating or static normal cells. [Tofani et al. 2001]

Zhou et al. [Zhou et al. 2002] have shown that a 72 hr exposure of HL60 cells to 50Hz, 0.1-0.8 mT magnetic fields resulted in an increased transcription level for tumor necrosis factor receptor p75 and interleukin Il-6Ralpha mRNA expression.

Zhao [Zhao 1994] examined the promotion of DNA synthesis in PDL fibroblasts under exposure to 0.14T magnetic field for 10,40,60,120 min/day x 1week, comparing these to similar treatments every other day. Remarkably, he found that the cellular DNA contents increased proportionally with exposure time in the daily-treated samples, while no significant changes were found if the treatments occurred on alternate days. He concluded that the magnetic field had a cumulative, threshold-dependent and time-delayed effect on DNA synthesis.

Blank and Soo [Blank and Soo 2001] reviewed evidence that EM fields interact with the activity of the cell membrane enzymes Na,K-ATPase and cytochrome oxidase in a frequency-dependent manner - but argued that, in addition, large electron flows known to exist within the stacked base pairs of DNA could interact directly with EM currents and lead to gene activation [Blank and Godman 1997]. One finding that supports this contention is that DNA transcription in cell-free solutions can be activated by electromagnetic fields [Blank and Goodman 1998].

Finally, in a 2011 paper published in the British Journal of Cancer, Zimmerman et al. showed that growth of HCC and breast cancer cells was significantly decreased by very low intensity electromagnetic fields in HCC-specific and breast cancer-specific modulation frequencies (27.12 MHz). The same frequencies did not affect proliferation of nonmalignant hepatocytes or breast epithelial cells. Inhibition of HCC cell proliferation was associated with downregulation of XCL2 and PLP2. In the article's discussion section, the authors state: ***"The specificity of modulation frequencies is exemplified by the fact that two sets of similar modulation frequencies (breast cancer-specific and randomly chosen) within the same range, that is, from 100Hz to 21kHz, did not affect the proliferation of HCC cells. Similarly, the proliferation of breast cancer cells was affected only by breast cancer-specific modulation frequencies, but neither by HCC-specific nor by randomly chosen modulation frequencies. The fact that >50% of the modulation frequencies from these three programs differed by <1%, provides strong experimental evidence that the biological effects are only mediated by a combination of narrowly defined, tumor-specific modulation frequencies."*** [Zimmerman et al., 2011; auth. italics]

It is interesting to note that many of these studies specifically report finding no adverse effects on normal cells exposed to the same EM fields.

At the same time, studies by Zimmerman and Beck show that healers' hand and brain frequencies measured during active "healing states" sweep a 0.3-30 Hz range, with most activity in the 7-8 Hz area. These frequencies, which show a remarkable consistency across multiple healing traditions, closely overlap the electromagnetic specificity windows used in clinical and laboratory applications to enhance neural regeneration (2 Hz); bone growth (7 Hz); ligament healing (10 Hz) and capillary and fibroblast proliferation (15, 20 and 72 Hz) [Oschman 1997].

Robert Becker, a pioneer in the study of weak endogenous electromagnetic fields, used hypnotized subjects to demonstrate that they could decrease or increase the DC potential of specific areas of the body depending on the suggestion given (a suggestion of numbness in the left arm resulted in no response to a pinprick stimulus and a drop to zero in the DC potential, while the pinprick response/DC potential remained almost unchanged for the right arm; the change in voltage was "exactly the same as that seen in standard chemical nerve block" [Becker, 1990 pp 90-91].

Both local and distant mental interactions have been shown to produce unusual EM signatures. Magnetic signals up to 105nT were found by Wu et al. during Qi emission by qigong practitioners [Lin and Chen 2002]. Unusually high static charges (up to 221 volts) from the bodies of healers and psi-gifted people were reported by Watkins, Hochenegg, Shallis and Green [Becker 1990, p. 157]. Nakamura measured an increase in biophoton emission intensity from the hands of practitioners in the qigong state [Nakamura et al. 2000]. Wallace found that human biophoton emissions could be increased by subjects at will and measured up to 100 times stronger emissions from the hands of gifted subjects compared to controls [Rubik 2000]. High surges in the magnetic field surrounding healers, or significant effects on distant magnetic sensors, have been published by Ullman, Watkins, Puthoff and Targ, Zimmerman and Ostrander, and Schroeder [Benor 2001 p. 168; Sidorov 2001; Wortz et al. 2002].

Of particular interest is a study by Xu and Zhao [Hu and Zhao 1987] , in which they inserted fine probes into the veins of a leaf and detected field potentials before any intervention; when a Qigong healer emitted Qi to the leaves the potential was several times stronger. Heat lamp controls (35 degrees C) and treatment by a non-practitioner produced no effect.

Can these special meditative practices or mental states produce therapeutically significant changes in gene expression? In [Sidorov et al, 2013] we have discussed several recent papers which show that different forms of meditation/visualization produce different gene expression profiles [Chien et al. 1991; Achterberg and Rider in 1992 NIH report; Rein and McCraty 1994; Li et al., 2005; Ravnik-Glavac et al., 2012; Qu et al., 2013]. In a study reminiscent of the Simontons' cancer therapy (see below), Achterberg and Rider showed that training patients in cell-specific visualization of either T lymphocytes or neutrophils resulted in statistical increase in cell blood levels correlating with the type of imagery employed . And in a recent paper published in Molecular and Cellular Biochemistry, Yan et al. [2012] identified 39 genes whose expression was changed by external qigong in small-cell lung cancer line NCI-82, inducing apoptosis of cancer cells while repressing their proliferation, metastasis and glucose metabolism.

How are these results to be interpreted, or indeed incorporated into modern medical practice? As discussed in a previous paper (Bajpai et al, 2013), Western medicine has come to terms with the idea that meditative practices trigger a non-specific "relaxation response" that produces general beneficial effects through the biochemical and neurohormonal activation of the parasympathetic system - but the experiments described above are not only ***directional*** (that is, correlating with a positive or negative intent), they are also producing statistically significant ***effects on remote targets while leaving control samples unaffected***. Clearly, something other than the relaxation response must account for such mechanisms of action in what has been called Distant Mental Interactions with Living Systems (DMILS) or, in Traditional Chinese terminology, External Qi therapy.

In his 2012 comprehensive review of Qigong medical practices and research, Nawalinski [2012] describes the three major characteristics of External Qi therapy as defined by the Chinese Society of Qigong Science:

1. EQ exists only when a well-trained Qigong practitioner enters into the Qigong state of mind (A specific state of mind or a state of tranquility during Qigong practice or Qi emission); it does not exist among ordinary people nor in a practitioner in an ordinary state of mind;
2. EQ can travel a distance from the practitioner and affect the distant objects to produce measurable signals;
3. EQ is directional and can be applied to a specific target far away while not affecting the objects nearby or those very close to the practitioner where his intention is not focused.

The "Qigong state of mind", or the focused intent required to achieve such well documented mind-matter interaction effects, is a virtually universal observation in all healing and meditative practice traditions, as well as their modern experimental investigation. Western science has only very recently begun to address the complex theoretical and

methodological challenges posed by this empirical approach to the mind-body problem (see Bajpai et al. 2013 for a discussion on biophysical models and research strategies). But what is encouraging at this point is that new investigative tools (such as real-time, PCR-based gene expression analysis) and the emergence of new theoretical paradigms (such as quantum biology and epigenetics) are finally available to help us connect these empirical dots and design powerful new experimental models. Is meditation able to modulate the local electromagnetic environment of the body? Can it deliver effective therapeutic frequency signals to the targeted organ or tissue? And can we combine mind-body research with cellular biology technology to train patients in the ideal meditation form for their specific condition?

Our central thesis, as described in [Sidorov and Chen, 2006; Bajpai et a. 2013] is that the mechanism of information transmission between mental intent and target tissues in mind-body therapies must involve specific EEG frequencies that propagate along a continuous brain-body semicrystalline matrix of microtubules, chromatin and other macromolecules; and that in turn modulate body-wide biophoton fields and microtubule arrays, such that large-scale coherence and interference phenomena become instrumental in creating loci of above-threshold, effective biophoton intensity, capable of regulating genetic expression and metabolic pathways in accordance to low level laser therapy (LLLT) mechanisms of action. Given the evidence that biophotons can travel along nerve fibers and microtubules similar to laser wave guide conduction [see Rahnama et al, 2011; Sun et al, 2010; Bajpai et al, 2013], the specific targeting of given body areas may be a simple matter of utilizing the normal motor pathways associating conscious intent with that body part in order to transmit the biophoton frequencies to the specified area. Once there, these photons may act simply through ROS-mediated biochemical signaling mechanisms, or by field-modulated changes in chromatin unfolding or condensation - exposing or suppressing specific genes based on the operator's intent. Furthermore, we have hypothesized that long-term meditation creates reinforced and persistent epigenetic changes which in effect remodel the brain/body structural continuum in a way that increases overall coherence and conductance, facilitates large-scale synchronization, minimizes dissipative processes and increases sensitivity to minimal stimuli.

Based on the biophysical considerations discussed above and on recent experiments showing that meditation can trigger rapid genome-wide transcriptional changes spanning a wide array of functional ontologies [Ravnik-Glavac et al., 2012; Qu et al., 2013; Li et al., 2005], we have previously proposed that meditation could exert different therapeutic effects by the propagation of specific electromagnetic waves which modulate the local environment of proteins and chromatin, initiating conformational changes in critical regulatory signaling regions, which trigger the expression of specific genes. The challenge at this point is to determine if and how we could progress from an ancient, intuitive healing art to a more predictable, effective and quantitative science, in a true synthesis of mental, biophysical and molecular biology technologies.

II.Toward a biophysical dialogue with cancer: targeting the key oncogenes

There are over a thousand documented cases of "spontaneous cancer remission" in the medical literature [Challis and Stam, 1990; Radin, 2013 p. 60-61]. These were cases where patients had been diagnosed on the basis of X-ray imaging, biopsies and other conventionally accepted technologies, and had refused treatment, failed to obtain any, or were treated with methods that were considered non-curative (palliative) by the medical community. In all these documented cases the patients fully recovered. While tentative mechanisms proposed for such unusual disease evolution range from immunological and endocrine to surgical, necrosis, infection, or operative trauma, one other

possibility that has been suggested repeatedly by attending physicians familiar with these cases is the psychological factor [Challis and Stam, 1990].

In the 1970's, radiation oncologist Carl Simonton, who was director of the Cancer Counseling and Research Center in Dallas, TX, conducted a four year, uncontrolled pilot study involving a group of patients with what was diagnosed as incurable malignancies, who were taught to practice guided imagery along with their prescribed medical treatment. These imagery exercises, which may include scripted scenarios such as a walk on the beach or visualizing one's immune cells combating the tumor cells [Church, p 67], have been used for hundreds of years in traditional Chinese Medicine like Qigong. 245 patients were enrolled in the trial and received 5 to 10 days of group and individual counseling. The intervention techniques that were described in the study reports were: relaxation, guided imagery, imagery drawings, evaluating and changing inner beliefs (belief work), a program of physical exercise and education regarding diet [Simonton et al. 1992a,b].

Two papers were co-authored by Carl Simonton and Stephanie Matthews-Simonton, describing the outcome of the study. One article evaluated 75 patients with either breast, lung or colon cancer [Simonton and Matthews-Simonton, 1980]; the second presented outcome measures of 123 patients [Simonton and Matthews-Simonton, 1981]. Although the sample size selection criteria are not addressed and the study's conclusions have been challenged **[**Vanschoubroek et al. 2013**],** the reported "median survival time" for each cancer type, when compared with the "median national survival time" (based on several publications), is rather impressive: *"For breast cancer, the intervention group showed a median survival of 35 months, compared to 16 months. For bowel cancer, the median survival of the intervention group patients was 21 months, in the control 11 months. For lung cancer, results were presented from 14 months for intervention group and 6 months for the comparison group."* **[**Vanschoubroek et al. 2013**].**

Although the Simontons' experiments are considered to be of poor methodological quality, their preliminary results are intriguing, especially in light of the newer, controlled qigong and DMILS studies(see above). Why these results were not pursued in a more formal manner by the research community is difficult to say. But emerging data from a number of separate disciplines suggests that the time has come to take another look at these mind-body correlations with newly available technology and methodologies.

As advances in genomics have accelerated over the past few decades, so has our understanding of cancer mechanisms and our ability to develop tailored, patient-specific chemotherapies. In a couple of recent articles, [CUMC 2013a,b] researchers at Columbia University's Department of Systems Biology describe their approach as a "reverse engineering" attempt to identify genes and gene pairs that are critical for the survival of the tumor, but not for that of normal cells; once these key regulatory sequences are identified for particular cancer lines, the next step is to find FDA-approved drugs which interfere with the expression of those genes. Because many of these control points are shared among multiple types of cancer, these "common vulnerabilities of the cancer cellular machinery" can be exploited to design effective therapies for a variety of tumors, regardless of the original mutations that triggered the disease. For example, Califano (one of the researchers heading this effort) mentions the combined activity of two genes, CEBPB and STAT3, which is required for the survival of the most aggressive glioblastoma, but not for normal cells, even though the two genes are not mutated in these tumors. As Califano explains, *"Since the completion of the Human Genome Project in 2003, it has become increasingly clear that most phenotypes — the observable traits of an organism — do not result from single genes or isolated events. […] Rather, they emerge from the interaction of thousands of molecular components under the control of a complex cell-regulatory logic. If this regulation is disrupted — for example, through a set of genetic and epigenetic factors, such as mutations, infection, and inflammation — the resulting cascade of events may cause disease. The challenge for biologists is to learn how*

all the components of a given system — the cells, proteins, genes, and epigenetic factors that influence the genes — work together to produce specific phenotypes and thus to identify the master regulators of the disease that may be targeted with drugs. Interestingly, very few of the master regulators that we have experimentally validated are directly genetically or epigenetically altered. This suggests that the gene we eventually want to target to cure cancer could be different from the ones that start it" [CUMC 2013a].

Other regulatory oncogenes include growth factors, receptor and cytoplasmic tyrosine kinases, cytoplasmic serine/threonine kinases, regulatory GTPases and various transcription factors. Of particular interest to mind-body cancer therapies is the fact that deregulation in chromatin remodeling and the associated epigenetic instability has been correlated with a number of cancers (including breast, colorectal and pancreatic cancer), as a result of widespread silencing of tumor-suppressor genes [Wang et al. 2007; Estreller 2008; Sharma et al. 2010; Huang and Estreller 2010; Jones et al. 2012].

One especially promising approach pursued by the CUMC team is the strategy of cutting off a tumor's fuel supply by interfering with its metabolic pathways. To support their accelerated proliferation, cancer cells have to reprogram the normal metabolic functions, which results in particular ways of utilizing glucose to produce energy and synthesize the necessary building blocks [CUMC 2013b]. The rationale for this approach, according to Vitkup (a researcher at the Columbia University Medical Center and one of the study's co-authors), is that "*cancer cells usually have multiple ways to turn on their growth program. You can knock out one, but the cells will usually find another pathway to turn on proliferation. Targeting metabolism may be more powerful, because if you starve a cell of energy or materials, it has nowhere to go."*

From a qigong point of view, this strategy may be the gateway to the design of tumor-specific, quantifiable mind-body therapies. As discussed above and in several previous papers, some forms of qigong appear to exert a powerful effect on metabolic pathways, producing a decrease in fasting insulin and insulin resistance, changes in energy metabolism, insulin secretion and inflammatory pathways, as well as stress-related gene expression [Tsujiuchi et al. 2002; Xin et al. 2007; Dusek et al. 2008; Liu at al. 2008; Horowitz 2009; Xin et al. 2009; Baars 2013; Bajpai et al. 2013; Bhasin et al. 2013; Sidorov et al. 2013]. The possibility that infrared-range endogenous biophotons generated by healing meditations can be fed directly into the mitochondrial respiratory chain, much like the healing mechanisms of low level laser therapy [see Bajpai et al., 2013, Sidorov et al. 2013] suggests that one of the pathways through which Qigong exerts its positive effect may be related to its action on certain metabolic switches. Furthermore, in a key review published in Integrative Cancer Care, He and Chen describe an approach that reportedly has been used with success by thousands of advanced cancer patients in China and other countries – involving, in addition to Qigong training and 5-6 months of intensive daily meditation (guided visualization), a *15-day Bigu-type fast* [Nawalinski 2012; also see Roy 2000].

But if variations in cancer cell and host genotypes can wipe off the statistical significance of a new drug, necessitating a subpopulation-specific, customized trial [see CUMC 2013a], then could the same be true for mind-body interventions? ***Just as in Zimmerman's study [Zimmerman 2012], specific electromagnetic frequencies may be locally required to undermine the survival of specific cancer cells: are we clustering together too many non-specific mental healing techniques, without regard to the characteristics of the conditions we are trying to treat? And conversely, could a reverse-engineering approach be used to identify the most effective meditation forms for particular cancers?***

While previous biofeedback techniques have focused on achieving particular brainwave topological maps or physiological thresholds, we propose that there may be an optimal meditation "form" (combination of cognitive, emotional and physiological parameters) that biophysically controls the expression of master regulatory gene complexes with key roles in the control of particular diseases such as cancer or diabetes – and that future biofeedback protocols should be developed around the patient's ability to modulate the expression of these genes by

learning to achieve these disease-specific physiological forms. The primary logistical obstacle is of course that neither direct biophoton measurements nor real time genetic expression analysis can be readily performed on a live patient's tumor: what we need is a more accessible, less invasive technique that allows us to study the effects of mental modulation on the tumor itself. Is such a methodology conceivable at all? As we will show later on, there is some experimental evidence suggesting that the answer to this question may be affirmative. For the moment, however, let us define our overall scope:

The goal of a targeted mind-body research program would be to identify the most relevant epigenetic changes to activate for each specific condition, as well as the meditation protocols and biomarker profiles best correlating with these changes; then to use patient tissue samples as an in vitro, real-time test of the patient's meditation effectiveness, feeding that data into a computerized biofeedback loop so that patients can slowly modulate their mental status until the optimal effectiveness window is achieved, as indicated by changes in the sample's biophysical and genetic expression signature. In other words, what we need is a new methodology that allows us to understand the effect of specific meditations on standardized cell samples, as if testing new drug formulas at the pre-clinical stage; then evaluate the effectiveness of these meditations on each patient, after a preliminary training period, in a way that is non-invasive, practical and sustainable.

Such aims may seem utopian at first glance: cancer is an enormously complex and protean entity and even conventional medicine faces a daunting task when trying to identify broadly effective chemotherapies for a particular type of tumor. But as we continue to identify the key processes and oncogenes required for tumors to survive and escape the body's defense mechanisms, targeting these common regulatory genes may provide a more effective mind-body therapeutic strategy. This new cancer paradigm shows that while the tumor regulatory landscape is complex, comprising hundreds of genes, many tumors share similar control mechanisms. ***With the advent of new systems and computational biology tools [CUMC 2013a,b], we may be able to identify such common control mechanisms and target these by mentally modulating the expression of their key genes, "tuning" patients' biofeedback instruments to the proper window (as indicated by biophoton emission detectors [van Wijk et al. 2006], local electromagnetic detectors such as the Transverse Shear Mode Sensor, TSMS [Cheran 2012] or rapid gene expression analysis such as quantitative real-time polymerase chain reaction (QRT-PCR) technologies [Jozefczuk and Adjaye 2011]).***

As a first step, such an approach could involve experienced qigong practitioners, asking them to promote or inhibit the expression of these particular genes in a number of *in vitro* cancer tissue targets. Such studies have been successfully performed before (see Section I), and could be accompanied by measurement of various biophysical parameters at the level of the operator's body and target, such as biophoton emissions (BPE). ***Assuming, as argued above, that gene expression may be partly regulated by the local electromagnetic environment, an overlap matrix could be creating correlating successful suppression of specific oncogenes with these target-level and body-level BPE measurements, informing the future selection of biofeedback windows.***

The primary methodological challenge, however, remains the ability to isolate the tumor-level measurements from the complex environment of the body. Even more difficult than the selection of key regulatory, intent-sensitive epigenetic targets is the problem of finding non-invasive ways to monitor the actual therapeutic effect of a patient's meditative practice. In Ravnik-Glavac's study, blood samples were extracted at 1 to 15 hours ***post-meditation*** and micro-array analysis was conducted to quantify the expression of approximately 2200 genes. A similar approach was used by Su Qu's team, but blood samples were collected immediately after the meditation sessions. While a few such blood sample analyses are possible at the initial "meditation calibration" and training stage, they are impractical on an ongoing basis – for the weeks, months or even years of daily practice required to combat the initial cancer or prevent a recurrence, when the patient's mental focus may drift to less or possibly completely ineffective states. Another real concern may be that the cancer cells may react differently to the local electromagnetic

environment produced by the mental modulation than normal blood cells or other, more accessible tissues such as mouth swab cells or skin/mucosal samples. With these considerations in mind, we believe that the ideal tissue to evaluate for epigenetic response to healing intent during the calibration and follow-up monitoring phases would be an *in vitro* sample of the tumor itself, collected surgically or by other extraction means, which is maintained alive under optimal laboratory conditions for the duration of the treatment (or at least the calibration stage), with possible repeat confirmation of the original cell line genetic integrity or comparison with follow-up biopsy samples, as a genotypic drift may spontaneously occur after a certain amount of time either at the *in vivo* or the *in vitro* sites.

Of course, while such a theoretical approach may provide a more accurate assessment of the epigenetic response, we are faced with a fundamental and very practical obstacle: no one could possibly advocate obtaining the number of repeat biopsies required to titrate the meditation form, train the patient in achieving reasonably replicable physiological states and then monitor its successful daily implementation. Unless a reasonable alternative methodology can be identified, the entire notion of a target-specific, quantitative and predictable mind-body adjunctive cancer therapy is destined to fail.

There is however a small body of experimental evidence suggesting that a ***physiological correlation exists between a human donor's state of mind and in vitro cells previously extracted from that donor.*** In his landmark book on biocommunication experiments [Backster 2003, p. 107-122), Cleve Backster describes a number of studies he performed by inserting EEG type electrodes into isolated cultures of human oral leukocytes, red blood cells or sperm cells and recording the changes in the electrode tracing while the human donor underwent various experiences at a remote location. In one such experiment, human sperm cells were isolated in a room about 40 feet away from their donor. When the donor crushed a capsule of amyl nitrite (a fast acting vasodilator) and touched, then inhaled the fumes, the chart tracing of the immersed electrode recorded a swift and powerful reaction, compared to the minimal activity recorded before and after this event. In another experiment, human leukocytes were collected from a donor's mouth according to dental research protocols, centrifuged and kept alive in a test tube into which Backster inserted a gold electrode connected to EEG type instrumentation. The cells not only reacted to a simple mental intention to inflict self-harm, but showed powerful, time-correlated reactions to a variety of other mental stimuli (i.e. erotic photos, war footage, emotionally charged family situations, rage) as well as to the death of other cells (p. 112-114, 117,118). The separation between the live cell samples and their donor ranged from a few meters to in excess of 10 miles. These oral leukocyte studies, started in 1972 as a follow up to Backster's previous biocommunication experiments with plants and bacteria, were successfully replicated at his San Diego lab in the presence of several top officials from the U.S. Army Intelligence and Security Command in January 1983 and March 1983, followed by successful replications at the agency's Washington, DC headquarters in July 1983 – including demonstrations of human cell biocommunication over 12 and 50 mile distances (p. 114-115). A report of these experiments was published in the refereed International Journal of Biosocial Research (p. 115). In 1986, members of the Committee on Techniques for the Enhancement of Human Performance, put together by the National Research Council, were able to witness first-hand the strong reaction registered by *in vitro* cells collected from Col. John Alexander as he started to deliver a lecture in a distant classroom. Further experiments conducted by the HeartMath Institute and in collaboration with Dr. Myra Crawford of the University of Alabama School of Medicine (p 131, 144-146) demonstrated the same results, while replications involving Dr. Brian O'Leary showed that such correlations with their donor's emotional state persisted for almost a day, even when the donor had left town and was 300 miles away (p. 127).

Unfortunately, as in the Simontons' case, these highly intriguing results have received relatively little attention from the Western medical research community. If such (possibly entanglement-based) correlations can be confirmed by other research groups, then an empirical basis exists for developing a more transparent, minimally invasive and practical methodology to calibrate, train and monitor a patient's disease-specific meditation practice. ***Our working assumption is that if qigong meditation forms can produce intended epigenetic changes in*** *in vitro* ***samples, they***

can probably achieve the same in the meditator's own body, provided the patient is trained to maintain the right focus on their tumor. A preliminary, time-correlated imagery/gene expression analysis using real-time quantitative PCR-based epigenetic expression assays as well as secondary verification with DNA micro-array technology could be used on multiple tissue samples at the time of initial mental calibration to identify key oncogene epigenetic response to various meditation forms and guide the patient toward the most effective ones. Such gene target selection could be informed by existing molecular biology data, along with previous in vitro studies using experienced claimant healers, as described in a previous section; and should follow a brief, non-specific meditation training course teaching all patients how to achieve the basic relaxation states, as well as general target focus mental techniques (tumor location imagery).

III. Modulating the CNS – Biophoton Field – Genetic Axis: rapid epigenetic feedback training and *in-vitro/in-vivo* combination therapy

General Protocol Proposal

Step 1. Overlap Matrix

To narrow the field of potential electromagnetic profiles worth testing for a given cancer type, we suggest starting with advanced therapeutic touch and qigong masters asked to treat such tumors *in-vivo* or *in-vitro* (in laboratory animals or in cancer cell cultures). The electromagnetic spectrum of biophoton emissions in the healers' proximity and at the target during the window of healing intent transmission can then be compared for all participants, and also correlated with changes in the expression of all genes known to play a role in the survival of that specific tumor: are there similar meditation forms and biophoton emission profiles that are found to be effective?

This overlap matrix can then be used to identify the most common biophoton frequencies and epigenetic changes associated with positive healing outcomes in such healing models (i.e increase in cancer apoptosis rates), which can then be transferred to a feedback training protocol.

Step 2: Rapid epigenetic feedback training and *in-vitro/in-vivo* combination therapy

Based on Backster's leukocyte response experiments and preliminary qigong cancer research, we hypothesize that a culture of in vitro cancer cells previously extracted from a patient will respond to the patient's mental state in ways that are similar to the in vivo effects on the tumor itself; in other words, that if a particular meditation form results in certain epigenetic changes at the level of the organism or tumor in vivo, then the isolated tumor may exhibit the same changes.

We therefore propose that pre-extracted tumor samples be subjected to real-time PCR-based gene expression analysis as well as BPE measurements, while patients practice the meditation forms identified in Step 1, modulating their intent and focus until the desired gene expression changes are observed in the extracted tumor cells. The operator's BPE spectrum should also be identified at the point of epigenetic switching (based on time-correlated analysis).

Patients could then be trained to focus on their tumor and modify their mental focus until this particular BPE range is achieved and maintained for a pre-specified period, with repeat measurements of genetic expression profile in previously extracted, cultured tumor cells, until an effective mental/physiological state can be consistently replicated and sustained. At that point patients should be instructed to continue the meditation exercises on a daily basis in their own home, ideally in combination with BPE-based biofeedback instrumentation to assist with keeping the mental focus within the effective range (BPE parameters could include both frequency and intensity of emissions) .

This approach would allow patients the benefit of a real-time feedback based on rapid gene expression analysis, until they are able to reproduce the effective state of mind. ***However, since gene expression assays are impractical as a clinic- or home-based feedback monitoring technology, we strongly recommend that bioelectromagnetic markers such as biophoton emissions or real time TSMS readings be used at the target tissue sample and at specific patient body points, to be correlated with effective meditation forms, as based on the epigenetic/EM signature overlap matrix described above. Such target-specific bioelectromagnetic markers may be the ideal type of long-term, real-time biofeedback technology, as it is non-invasive, user-friendly and a real reflection of the electromagnetic environment generated by the mental exercise.*** Target-level genetic and biophysical markers could then be used for initial feedback in a clinic setting meditation practice, where the conditions exist to maintain the patient's tissue sample as a living culture; while body-level BPE windows, previously correlated with the intended epigenetic effects, could be used for home meditations.

IV. Discussion

It is obvious that the arguments and proposals above raise as many questions as they answer:

1. What is the role of brain wave synchronization and increased connectivity observed with long term meditators? Why is a rich multi-sensorial imagery so often used in healing visualization - could it be a practical way to entrain as much of the brain as possible into synchronous activation, in order to increase the intensity of EM radiation (BPE) reaching the target?

2. How much biophoton radiation could theoretically be triggered by a healing meditation state? Is there a full body coherence induced by meditation, with greater depth of penetration and interference effects/EM intensities at "speckle" points [Karu 2011]? How much amplification of BP radiation could be produced by constructive interference at the target if coherent photons are transmitted by neural fibers wave guide, perineural and MT-mediated mechanisms, as discussed in [Bajpai et al. 2013]?

3. Can the BPE overlap matrix empirically based on healing meditation techniques be then used to identify ideal dosimetry windows for exogenous low level laser therapies?

4. Can patients be trained to direct their healing intent to specific areas of the body by BPE feedback techniques?

However, based on the evidence presented in the preceding discussion, we would like to argue that there are significant advantages to the expansion of the mind-body therapeutic research agenda into related fields such as epigenetics, biophotonics and quantum biology. It is our belief that if we can demonstrate an increased patient ability to produce specific changes in gene expression with intensive meditation practice, we may be able to develop optimized protocols that target particular genes and disease pathways, rather than rely on the ill-defined existing spectrum of meditations and its generalized, possibly sub-optimal relaxation response. Such specialized protocols

may also include a localization/tissue targeting component, based on available evidence that qigong practitioners can direct their effects to particular body areas.

A body of research showing large scale randomized longitudinal trials in which self-healing ability or beneficial changes in gene expression can be statistically increased through the systematic practice of standardized meditation protocols would produce not only a more predictable basis for low-cost, high effectiveness adjunctive treatments, but also an ***enhancement in placebo effects*** through a change in patients' belief system and increased expectation. Rather than persisting in the misconception that healing ability is limited to a small number of exceptionally gifted individuals (and even there, subject to erratic manifestation), we can try to develop a quantifiable and systematic approach to mind-body mechanisms, using recent breakthroughs in low level laser therapy, photobiology and epigenetics. Feedback therapies based on EEG mapping are difficult to correlate with specific therapeutic effects, or at least have not been thoroughly investigated from that perspective. We believe that by focusing instead on the connection between EEG, biophoton spectra, body-wide coherence/conductance and chromatin conformation we may be able to deepen our understanding of the connections between mental states and their effects on the body. Therefore, from a methodological standpoint, we feel that it is imperative to develop more standardized protocols than the current norm. While the use of uniform cell lines and other biological tissues has meant a major leap forward in external qigong research methodology, it would be advisable to combine these with a "mental dosimetry" protocol component – an ability to quantify the healing intent applied to the target, whether by measuring operator biophoton emissions, EEG/EKG/GSR (galvanic skin response) parameters, or a complex function relating all of the above. This would allow a bench-top approach to the preliminary development of specific mental protocols, looking at their impact on targeted epigenetic expression, in much the same way we develop new drugs at a preclinical, laboratory stage - bypassing the confounding organism variability inherent to animal and especially human models.

V.Conclusion

Mind-body healing has deep cultural roots spanning thousands of years and almost every human tradition – but as a modern science integrated within the acceptable norms of Western medicine, it is still at an embryonic stage. Should we encourage its growth through the development of a fully funded, well recognized interdisciplinary research program, as we have previously advocated [Bajpai et al, 2013] , we must be prepared for much confusion and many setbacks in the early stages, as well as a certain degree of frustration on patients' part. Are these risks worth the potential benefits? Are the technologies and methodology of conventional medicine not sufficient to reach a definitive solution to the war on cancer?

If the past half-century is any indication, the prospects of such a breakthrough using only molecular biology frameworks seem deeply discouraging [Kolata 2009; Rosenthal and Merajver 2012; Elliott et al. 2014]. As Chernet and Levin persuasively argue in their review [2013], a systems-based, biophysical approach to cancer appears to be both essential and imminent, a view with which the current author fully agrees, in light of the evidence presented above. However, what shall remain a challenge even when the appropriate EM dosimetry issues are resolved is the problem of effective target delivery [Bajpai et al, 2013]. The ability of healing intent to act in a target-specific, non-iatrogenic, homeostatic manner may prove to be the most valuable aspect of non-conventional medicine, even though we may not yet be able to understand the physical mechanisms behind it. Combined with the impending fiscal cliff faced by healthcare systems all over the world, the benefits of such inexpensive preventative and adjunctive therapeutic approaches to major diseases such as cancer or diabetes are well worth the relatively modest investment in a such a new research program.

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