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Quantum Information Medicine: Bit as It—The Future Direction of Medical Science: Antimicrobial and Other Potential Nontoxic Treatments

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Abstract

Experimental evidence has accumulated to suggest that biologically efficacious informational effects can be derived mimicking active compounds solely through electromagnetic distribution upon aqueous systems affecting biological systems. Empirically rigorous demonstrations of antimicrobial agent associated electromagnetic informational inhibition of *MRSA*, *Entamoeba histolytica*, *Trichomonas vaginalis*, *Candida albicans* and a host of other important and various reported effects have been evidenced, such as the electro-informational transfer of retinoic acid influencing human neuroblastoma cells and stem teratocarcinoma cells. Cell proliferation and differentiation effects from informationally affected fields interactive with aqueous systems are measured via microscopy, statistical analysis, reverse transcription polymerase chain reaction and other techniques. Information associated with chemical compounds affects biological aqueous systems, sans direct systemic exposure to the source molecule. This is a quantum effect, based on the interactivity between electromagnetic fields, and aqueous ordered coherence domains. The encoding of aqueous systems and tissue by photonic transfer and instantiation of information rather than via direct exposure to potentially toxic drugs and physical substances holds clear promise of creating inexpensive non-toxic medical treatments.

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Keywords

Quantum Information, Antimicrobial, Electromagnetic Field, Nontoxic, Coherence Domain

1. Introduction

The photon is the quantized unit, the single quantum of the electromagnetic field. We propose that this field can be encoded with quantum information associated with drugs and chemical compounds and that this information, may then be used to affect biological systems, mediated through aqueous systems. Therefore, we must first establish that photonic expression can be encoded. Technological advancements in radio communication and remotely connected quantum memory have successfully demonstrated and utilized the capacity for photons to be encoded and transport quantum information with great efficiency [1]-[3]. As we propose this encoding to be efficacious in affecting biological systems at room temperatures, next, evidence of quantum effects and processes in such systems is required, to advance these notions. Quantum *entangled processes* and *informational exchange* are now known to be dynamic contributors in biological systems at room temperatures [4]-[7] and by way of empirically rigorous Time Dependent Density Theory models, have been demonstrated as primary contributors to the evolution of life itself from photosynthetic prebiotic kernel systems in the Isua Greenstone Belt in Greenland some 3.7 - 3.85 billion years past [8] [9]. There is further longstanding evidence of the delicate connectivity between photonic expression, and biological processes. What is now known as the coherent biophoton field (please think of the life's work of Fritz Popp), was first discovered by Alexander Gurwitsch while working with onion roots in 1922 as "mitogenetic radiation" in the UV range, exemplifying his concept of "morphogenetic fields". In Popp [10] we read: "…a single photon may suffice to trigger about 10^9 reactions per second since the average reaction time is of the order of 10^{-9} seconds and provided—in addition—that it is directed in a way that it delivers the right activation energy as well as the right momentum at the right time to the right place. This means that a surprisingly low photon intensity may suffice to trigger all the chemical reactions in a cell." Electromagnetic fields can be mathematically defined as informationally interactive with biological systems [11] [12]. Based upon this evidence, we conclude that given the correct conditions (at room temperatures) *photons can be informationally encoded and via quantum processes can and do affect biological systems*. Next one must ask: "Is there further direct evidence of this assertion, and how does it relate to water?".

First, it must be established that electromagnetism does indeed affect aqueous systems. Water state, pH, hydrogen bonding, and water magnetic "memory" are affected by electromagnetism [13]-[16]. Extremely Low Frequency Electromagnetic Fields (ELF-EMF) affect water via alteration of the lower energy part of the stretching absorption band (~3250 cm^{-1}) relating to coherent fully hydrogen bonded populations [17]. There is a great deal of evidence from experimental physics, chemistry and biology supporting the notion of water as a primary mediator of biological effects induced via electromagnetic means into living systems [18]. These specific diverse dynamic interactivities include many biological systems, as has been established experimentally. Pollen germination, tobacco plant resistance to pathogens, seed hydration and germination, techniques such as photoluminescence spectroscopy used to determine the activity of pulsed fields on the "bubble/water interface," magnetic field effect simulation, and other experiments abound [19]-[28].

It seems clear from this vantage, that aqueous systems may well be the primary mnemic interface for electromagnetic/photonic quantum informational transfer from active compounds into biological systems. Does a practically applicable effect potentially exist for more complex organisms? Based on this evidence, we must ask: "Is there empirical/experimental support and demonstration of these notions applied within a specific, relevant, pharmacological biomedical context?".

Notable scientists have utilized these techniques to good result [29]. Under the name of Pharmacological Frequency Transfer, (Tranferimento Farmacologico Frequenzali) or TFF, Dr. M. Citro and a host of esteemed confederates report success in a multitude of examples relating to animals and humans, in many experiments. Citro reports dramatic success in molecular informational transfer of drug effects. Serious infections appear to be overcome with transferred information alone. The first reported case is that of a cat, which by way of informational transfer from antibiotics (absent the drug), was cured of a severe case of *Haemobartonella.* Bovine administrations with successful outcomes are reported by Vignoli [29]. The list of reports and applications is extensive, and human applications, according to Citro, include 150 cases involving: antibiotics, anti-inflamma-

tories, analgesics, benzodiazepine, bronchodilators, progestin, opiates, hormones and other compounds. Emilio Del Giudice of the University of Milan, and Giuliano Preparata University of Milan, propose the means substantiating the effect, is that of coherence sustained through the (EM mode wavelength sized) Coherence Domain (CD) [29]. Please see below for our elaborations upon this theme.

This author [R. N.] had deduced the probable existence of this phenomenon by way of theory and a-priori reasoning some three years past. The experimental findings of the J. Antonio Heredia-Rojas group and the Alberto Foletti research team have provided direct functional demonstration of these principles.

2. Method and Results, Two Experiments: The J. Antonio Heredia-Rojas Group and the Alberto Foletti Research Team

2.1. The J. Antonio Heredia-Rojas Group

For more detail, see the source study [30], condensed/augmented here:

We have been and are involved in detailed evaluation of antimicrobial effects ascribed to the transfer by resonant electromagnetic means of information associated with source antimicrobial molecules into aqueous memory. We recently demonstrated that by transferring metronidazole (a well known cytotoxic drug against parasites) information to water samples via an electronic amplifier (bio-resonance therapy BRT device), the growth of axenically-cultured trophozoites of *Entamoeba histolytica* and *Trichomonas vaginalis* was significantly inhibited, compared with those cultures treated with sham electro-transferred water samples [31]. Furthermore, we observed that by transferring amphotericin B information to water samples by a BRT apparatus, the growth of cultured *Candida albicans* was significantly inhibited [32]. These results suggest that it is possible to transfer and store biological information to pure water, and that water sample that has undergone such an information transfer, can effectively interact with other biological systems, such as amoeba and yeasts.

The aim of this study [30] was to evaluate the antibacterial effect of water samples transferred with electronic information of vancomycin, a well-known drug against *methicillin-resistant Staphylococcus aureus* (MRSA), by using a bio-resonance therapy (BRT) device on bacterial cultures. MRSA cultures were treated with vancomycin electro-transferred water samples, vancomycin (4.0 and 8.0 μg/mL), sham electro-transferred (water to water) and non-transferred water samples (medium alone). Growth inhibition was evaluated in liquid and solid culture medium, spectrophotometrically and by CFU determination respectively. The obtained data showed that by transferring vancomycin (4.0 and 8.0 μg/mL) information to water samples, the growth of cultured MRSA was significantly ($p < 0.05$) inhibited (up to 35%), compared with those cultures treated with electro-transferred water to water or cultured in medium alone (0% growth inhibition).

Reagents, culture media, and microbial strain:

Before testing, nutrient agar tubes were placed at room temperature for 2 hr, and then a bacteria inoculum was transferred to a nutrient broth (BD Bioxon) tube and aerobically incubated at 35˚C for 24 hr. From this, a nutrient agar plate was inoculated and incubated at 35˚C for 24 hr, and colonies were isolated and suspended in 0.85% NaCl solution. The bacteria suspension was prepared by adjusting its turbidity to match the 0.5 McFarland 635 nm standard in 0.85% NaCl solution. To determine cefoxitin strain resistant, the disc diffusion method was used. In brief, 9-cm diameter Petri dishes were prepared with 10 ml of Müeller-Hinton agar medium (BD Bioxon) and inoculated with an embedded Q-tip of the 0.5 McFarland suspension, described above, plated on the agar surface. After drying in a sterile hood, 6-mm diameter disks soaked with 15 μl of cefoxitin were used as controls. The dishes were incubated at 35˚C for 24 hr.

Bacterial growth inhibition was determined as the diameter of the inhibition zones around the discs. The growth inhibition diameter was an average of four measurements, taken at four different directions. Tests were performed in triplicate.

Transmission apparatus:

The equipment used for electronic transmission comprised a bio-resonance therapy oscillator device, Bicom version 4.4 by Regumed (Regulative Medizine Technik GmbH, Germany) serial number 202057299.

Vancomycin transmission to water:

The source flask containing 4.0 and 8.0 μg/mL of vancomycin respectively, in a total volume of 25.0 ml of bi-distilled water were placed (separately) inside the input coil coupled to a bio-resonance amplifier, whereas in the output coil, a flask containing 25.0 ml of pure bi-distilled and sterile water was allocated at room temperature. Vancomycin solutions and bi-distilled water were sterilized by filtration. The oscillator was then turned on

for the 15 min transmission period; during this procedure, parameters such as power, voltage, capacitance and impedance remained constant. Thus, the nature of the source flask (vancomycin versus vehicle) was the only variable. According to the bioresonance device manufacturer, a specific program labelled as #196 was used for electronic transmission substance to substance. At the end of the transmission period, the flasks were kept away from light and stored at room temperature for 1 h before being used in bioassays. For bioassays, 500 µL of transferred-water or sham-treated water were added to each culture tube.

Experimental Design:

The experiments using axenically cultured MRSA included the following treatment regimens and controls: a) cells treated with electronically-transferred 4.0 µg/mL; and b) 8.0 µg/mL vancomycin water samples, as explained above; c) cells treated with sham electrotransferred water samples, this is transferring the information from pure water to water, used as the control for a possible artifact effect induced by the bio-resonance device on water samples; d) cells treated with non-transferred water, or medium alone, as a negative control; e) cells treated with 4.0 µg/mL of vancomycin as a positive control and; f) cells treated with 8.0 µg/mL of vancomycin as a positive control. Three cultures were included for each treatment regimens and controls. In all experiments in which transmitted vancomycin was compared with transmitted vehicle, the source flasks were randomized and blinded before each experiment. Therefore, the observed effect cannot be attributed to uncontrolled systematic factors (operator bias, temperature, time…) but to the independent variable, the content of the source flask.

Antimicrobial activity of electronically-transmitted vancomycin to water:

We selected *methicillin resistant S. aureus* since it is a bacterium that is resistant to many antibiotics and is associated with nosocomial infection, particularly nosocomial pneumonia, surgical wound infection, and bloodstream infection. The percentage of microbial growth inhibition by electronically-transmitted vancomycin to water in liquid medium by spectrophotometry was determined as follows: One milliliter of MRSA suspensions (106 CFU/ml) was added to 4-ml (10 × 75 mm) round-bottom screw cap borosilicate culture tubes containing 0.5 ml Müeller-Hinton nutrient broth (BD Bioxon) (5 × 105 CFU/ml, final bacteria concentration). After this, 0.5 ml vancomycin at 4 µg/ml and 8 µg/ml were independently added to 3 of these culture tubes; 0.5 ml electronically transmitted vancomycin to water at 4 µg/ml and 8 µg/ml were independently added to another three of the culture tubes, and bacterial suspensions treated with sham electro-transferred water samples and non-transferred water, considered as medium alone (negative control), to a final volume of 2 ml for all culture tubes. Treatment and control culture tubes in triplicates were then incubated for 24 hr at 35˚C, after which optical densities at 625 nm were read in a Turner SP-830 spectrophotometer (Barnstead, Dubuque, IA, USA). For CFU determination, 100 µl of 1:10-8 dilutions of the treatment and control culture tube microbial suspensions used in the preceding experiment, were plated in nutrient agar (BD Bioxon) by surface spreading using a sterile glass rod. Plates were then incubated at 35˚C for 24 hr and colonies were counted in a colony counter.

Please see [30], for details and statistical analytic methodology.

Results and conclusions:

The results of the present study agreed with others suggesting that signals could be transferred to target cells or aqueous systems by an oscillator (BRT instrument) when coupled to two electromagnetic coils, demonstrating the same biological activity, thus mimicking the biological function of the original chemical active molecule [33]. Furthermore, we have previously observed *E. histolytica* and *T. vaginalis* trophozoites growth inhibition after treatment with metronidazole electro-transferred water samples, using a BRT device with identical characteristics and conditions of the apparatus used in the present study [31]. Moreover, we demonstrated that it is possible to transfer drug information to water molecules following the same protocol of transference "substance-to substance" and using the same BRT device in an antifungal model; a significant antimicrobial effect was observed in cultured *Candida albicans* (ATCC 32354 strain) previously treated with amphotericin B-electronically activated water samples [32].

In conclusion, our in vitro study suggests that water samples that are electronically transferred with vibration sustained information of vancomycin are capable of inhibiting growth of axenically cultured *methicillin resistant S. aureus*. Although the level of current scientific advancement is currently insufficient to recommend any particular mode of new treatment, *we may deduce the biological effects of informational quanta alone are demonstrable, and experimentally repeatable.*

2.2. The Alberto Foletti Research Team

For more detail, see the source study [33], condensed/augmented here:

We have been conducting extensive and detailed research into the biological influence of specific electromagnetic fields and resonant informational molecular transfer for many years [34]-[38]. The results are unambiguous: there is a clear influence which can be experimentally derived and repeated. We will detail a few of our results here [33], demonstrating to the reader instantiated quantum informational effects of medically active compounds on cell growth and differentiation. Information associated with molecular influence upon biological systems can be substituted for the active compounds so as to mimic the effects of the source molecule as evidenced in experiments. The implications of using quantum information, instead of chemical compounds, may lead to important new insights defining future medical practice [39] [40]. Drug effects without associated toxicity or cost are potentially implied, alongside possible new routs of administration. Further investigation is indicated.

We have tested human neuroblastoma cells (LAN-5) and NT2/D1 stem teratocarcinoma human cells utilizing an array of advanced analytical procedures including reverse transcription polymerase chain reaction, contrast microscopy, and statistical analysis so as to ascertain the precise influence or lack thereof derived from electromagnetic informational transfer of retinoic acid.

Retinoic acid, a well-known chemical differentiating agent, was placed at room temperature in the input coil connected to an oscillator (VEGA select 719), while culture medium for human neuroblastoma cells (LAN-5) and NT2/D1 stem teratocarcinoma human cells were placed into the output coil and exposed to signals for 1 hour. At the end the oscillator was switched off and LAN-5 neuroblastoma and NT2/D1 stem teratocarcinoma cells were seeded, respectively, into the medium conditioned as reported into an incubator under controlled conditions. After 5 days of incubations, cells were examined by different strategies such as morphological and biochemical parameters… Cells seeded in the electronically conditioned medium received physical information generating a statistically significant decrease in metabolic activity and changes in phenotypical structure with protrusion typical of differentiated neuronal cells [33].

Cell cultures: LAN-5 cells and NT2/D1 stem teratocarcinoma human cells were grown in RPMI (Gibco Laboratories, Scotland) supplemented with 10% fetal calf serum (Gibco Laboratories, Scotland) and antibiotics (110 IU/mL of penicillin and 0.1 mg/mL of streptomycin) at 37˚ +/– 0.3˚C, and 5% CO_2 as carbon source and subcultured twice a week at a 1:5 ratio. For every experiment, control and exposed cells were taken from the same flask.

Transmission apparatus (**Figure 1**): For the transmission experiments to cells, the input coil was operated at room temperature and was coupled via a homemade amplifier (Gain 0.25 dB from 1 to 100 Hz maximum output voltage 20 V p-p, maximum output current 1A, maximum power 20 W rms) to a wave generator: VEGA select 719. The output (target) coil was placed in the cell incubator. The target coil was made of 85 turns of 2-mm copper wire, 17 cm long and 9.5 cm wide and was fed at 100 mV from the wave generator. The source tube containing RA was placed inside the input coil. The target coil in the incubator contained RPMI LAN-5 cells and NT2/D1 culture medium. In the wave generator, the electronic signal corresponding to RA was superimposed on a 7-Hz sinusoidal frequency carrier modulated at 3 kHz. From the wave generator, the signal was fed into the cell incubator where the target coil was placed to irradiate the RPMI LAN-5 cells and NT2/D1 culture medium for the LAN-5 cells inside it. During the experimental procedure, the electrical parameters remained constant.

Metabolic activity and proliferation by WST assay: LAN-5 and NT2/D1 cells were seeded to cell culture medium electronically conditioned with RA. The experiment was repeated three times. The quantification of LAN-5 and NT2/D1 metabolic activity, as an index of cellular proliferation, was performed by a colorimetric assay based on oxidation of tetrazolium salts (Cell Proliferation Reagent water-soluble tetrazolium salt (WST)-1; Roche Diagnostics, Basel, Switzerland). Cells were cultured for up to 5 days in a normal humidified incubator in the presence of the RA-EMIT-conditioned medium (exposed), or in normal medium (control) and they were analyzed by means of the formazan dye every 24 hours. WST reagent diluted to 1:10 was added in the wells at 4 hours, and at 1, 2, 3, and 6 days after plating, and then incubated for 2 hours in a humidified atmosphere (37˚C, 5% CO_2). Quantification of the formazan dye produced was performed by absorbance measurement at 450 nm with a scanning multiwell spectrophotometer (Biotrack II; Amersham Biosciences, Little Chalfont, UK).

Immunofluorescence: For immunofluorescence staining, the cells were grown in Labtek chamber slides. The cells were then washed with phosphate-buffered saline (PBS) with Ca/Mg and fixed with absolute ethanol for 5 minutes, then incubated with the specific monoclonal antibodies, anti-200-KDa neurofilaments (Sigma) appropriately diluted for 1 hour at room temperature. Cells were then washed three times with PBS and incubated

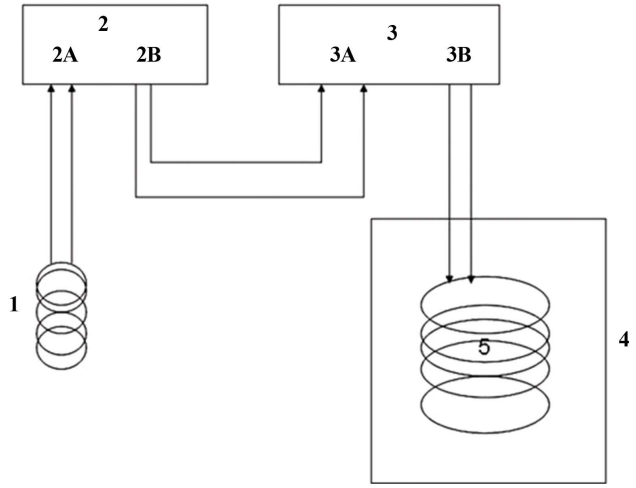

Figure 1. Experimental apparatus and assembly. 1—Source signal coil, 2—Electronic amplifier, 2A—Input signal in the electronic amplifier, 2B—Output signal from the electronic amplifier, 3—Wave generator, 3A—Input signal in wave generator, 3B—Output signal from wave generator, 4—Cell incubator, 5—Target coil. Used with permission of the journal of alternative and complementary medicine.

with fluoresceinated antimouse IgGF(ab')2 fragment (Sigma), (appropriately diluted) for 1 hour at room temperature.

Reverse transcription polymerase chain reaction:

Total RNA was extracted from cells using TRIzol Reagent (Life Technologies, Merelbeke, Belgium) according to the manufacturer's instructions. Typically, 5 - 10 μg total RNA per 10 cm^2 dish of cell culture was obtained. Reverse transcription polymerase chain reaction (RT-PCR) was used to evaluate relative mRNA levels of neurofilament protein (NF-200) in control and RA-EMIT conditioned medium exposed LAN-5 and NT2/D1 cells. One microgram (1 μg) of total RNA was used to synthesize first-strand cDNA with random primers using 100 U of ImProm-II TM RT-PCR kit (Promega, Madison, WI) according to the manufacturer. The reaction was also carried out in the absence of reverse transcriptase (RT) to check for genomic DNA amplification. The NF-200 subunit-specific primers used for PCR were: 5'-aagtgaacacagatgctatgcg-3' 5'-ctgtcactccttccgtcacc-3'. The 18S was used as internal controls, because these genes are uniformly expressed during development. The subunit-specific primers used for PCR were as follows: 5'-tttcggaactgaggccatgattaag-3' 5'-agtttcagctttgcaaccatactcc-3'. An aliquot (2 μL) of RT reaction was PCR-amplified in a final volume of 50 μL, by using 20 pmol of each primer, 200 μmol/L of each dNTP, and 0.5 U of Taq DNA polymerase (T. Aquaticus, Amersham-Pharmacia). PCR was carried out in a Bio-Rad I Cycle instrument. The thermocycling conditions for each pair of primers were as follows: denaturation at 95˚C for 3 minutes followed by 30 cycles of denaturation at 95˚C for 30 seconds, annealing for 45 seconds at 62˚C, elongation at 72˚C for 1 minute and a final polymerization step at 72˚C for 5 minutes for NF-200 and 20 cycles for 18S. The amount of template and the number of amplification cycles were preliminarily optimized for each PCR reaction to avoid conditions of saturation. Aliquots (5 μL) of the reaction products were run on 1% agarose gels containing ethidium bromide (0.5 μg/mL) to mark and visualize the PCR products. Gels were then photographed under UV light with a Versadoc (Bio-Rad) instrument. These experiments were replicated three different times.

Results:

Electronically transmitted RA EMIT-conditioned medium effect on LAN-5 and NT2/D1 cell metabolism: The cell growth rate was analyzed by the cell proliferation reagent WST-1 both in LAN-5 and NT2/D1 cells as control (not grown in electronically transmitted RA-EMIT-conditioned medium) or grown in electronically transmitted RA-EMIT-conditioned medium. An inhibition in the cell metabolism in the cells grown in electronically conditioned RA-EMIT medium was statistically ($p < 0.01$) significant after 5 days' exposure (**Figure 2**).

Electronically transmitted RA EMIT-conditioned medium effect on LAN-5 and NT2/D1 cell morphology: By phase contrast and scanning electron microscopy LAN-5 and NT2/D1 control cells appeared small, polygonal, without neurite-like structures. The exposure to electronically transmitted RA-EMIT-conditioned medium induced morphological changes toward a more neuronal phenotype: The cells were stretched out and rich

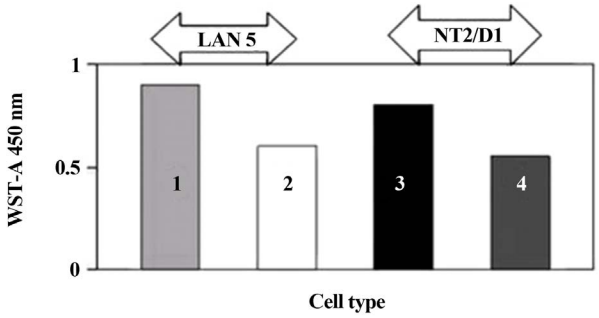

Figure 2. Electronically transmitted retinoic acid Electro Magnetic Information Transfer (RA-EMIT) conditioned medium effect on human neuroblastoma cell (LAN-5) and NT2/D1 cell metabolism. The cell growth rate was analyzed by the water-soluble tetrazolium salt (WST-1) both in LAN-5 (1) and NT2/D1 (3) cells as control (not grown by RA-EMIT medium) or grown by RA-EMIT-conditioned medium (2, 4). A statistically significant inhibition in cell metabolism ($p < 0.01$) was detected after 5 days' culture. Used with permission of the journal of alternative and complementary medicine.

in neurite-like structures with blebs, mimicking the same effect induced by RA treatment (**Figure 3**).

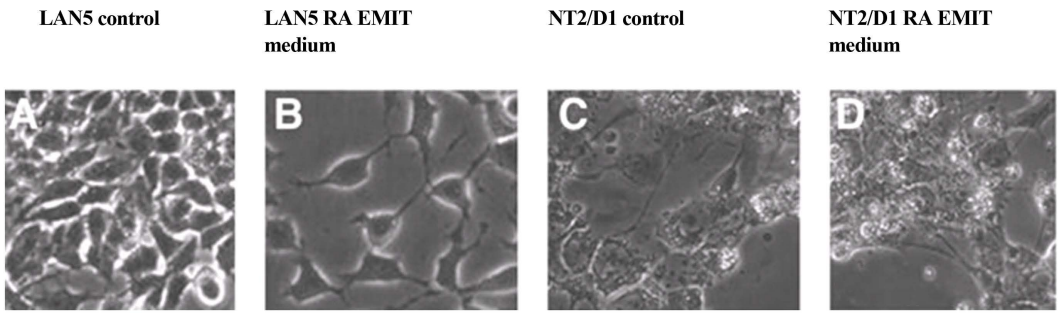

Figure 3. Electronically transmitted retinoic acid (RA)-conditioned medium effect on human neuroblastoma cell (LAN-5) and NT-2/D1 cell morphology by contrast microscopy. EMIT, Electro Magnetic Information Transfer. Contrast microscopy of LAN-5 cells in absence (A, C) or presence (B, D) of electronically transmitted RA-conditioned medium on LAN-5 and NT2/ D1 cell. The differentiation effect in (B, D) is shown by the presence of neurofilaments between cells. Used with permission of the journal of alternative and complementary medicine.

Electronically transmitted RA EMIT-conditioned medium effect on LAN-5 and NT2/D1 on neurofilament expression: **Figure 4** shows the indirect immunofluorescent analysis of control and exposed LAN-5 and NT2/D1 cells with anti-200 neurofilaments. While control cells were slightly or not positive for NF 200 (CTR), the neurofilament protein became more fluorescent after exposure to the RA EMIT-conditioned medium (EXP). The same results were achieved by RT-PCR analysis for mRNA expression coding for NF-200 (**Figure 5**).

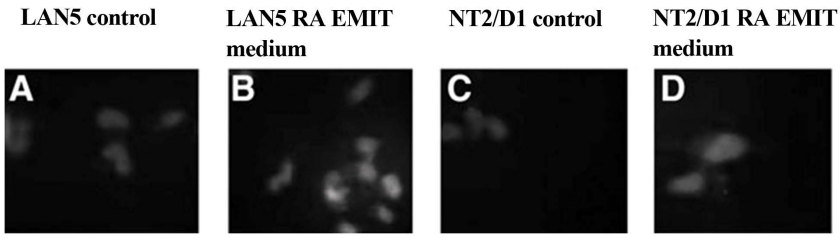

Figure 4. Electronically transmitted retinoic acid (RA)-conditioned medium effect on human neuroblastoma cell (LAN-5) and NT-2/D1 cell by NF-200 indirect immunofluorescence (red fluorescence; shown in black and white) of LAN-5 cells and NT2/D1 in absence (A, C) or presence of electronically transmitted RA-Electro Magnetic Information Transfer (EMIT) conditioned medium (B, D). Used with permission of the journal of alternative and complementary medicine.

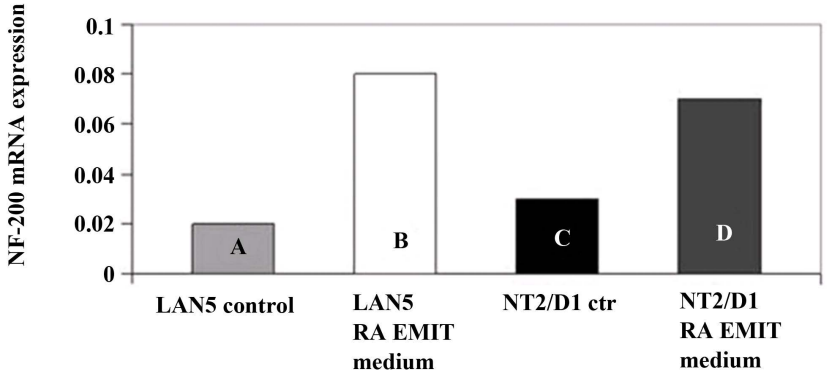

Figure 5. NF-200 mRNA reverse transcriptase polymerase chain reaction (RT-PCR) analysis on electronically transmitted retinoic acid (RA) effect on human neuroblastoma cell (LAN-5 cell) and NT2/D1 cells. Left bars (A, B): NF-200 mRNA RT-PCR analysis on control LAN-5 cells and RA Electro Magnetic Information Transfer (EMIT)-conditioned medium cultured. Right bars (C, D): NF-200 mRNA RT-PCR analysis of control and electronically transmitted RA-EMIT medium effect on NT2/D1 cells. Used with permission of the journal of alternative and complementary medicine.

Conclusion: Cell morphology and growth respond to information associated with RA, in like fashion to exposure to the RA molecule. It appears deductively sound to assert: Information affects biological activity [39] [40].

3. Theoretical Explanation, General Background

Nobel Laureate Dr. L. Montagnier and associates have suggested that quantum electromagnetic informational effects sustain many disease processes [41]. These quantum processes involve the idea of a *Coherence Domain*, (CD). Please think of a CD as a dynamic aqueous structure, which uses the special properties of water, such as its electron dynamics and organized response to electromagnetic fields, to receive electromagnetically encoded information at a low frequency, and sum the resultant excitations, so as to foster the redistribution of that information at frequencies which may affect biological systems. A CD is a pool of quasi-free electrons, functioning as a semi-conductor, where coherent excitation creates a spectrum of coherent excited levels from resultant coherent quasi-free electron vortices, the magnetic dipoles of which are aligned with external/terrestrial magnetic fields. Coherent vortices have no internal friction and hence a long lifespan, so additive excitations sum to a vortex whose rotational frequency is the sum of the frequencies of the component vortices. The CD is thereby able to transform ambient noise, namely an ensemble of a large number of low frequency excitations, into a unique high frequency excitation [42]. "When the oscillation frequency of the CD matches the oscillation frequency of some non aqueous molecular species present on the CD boundaries, these "guest" molecules become members of the CD and are able to catch the whole stored energy, which becomes activation energy of the guest molecules; consequently, the CD gets discharged and a new cycle of oscillation could start" [41]. Here, it appears we may have the mechanism whereby the correct frequencies [11] [12] for biological interactivity are achieved and distributed.

> "*The CD is a self-produced cavity for the em field because of the well-known Anderson-Higgs-Kibble mechanism… which implies that the photon of the trapped em field acquires an imaginary mass, becoming therefore unable to leave the CD. It is just this self-trapping of the em field that guarantees that the CD energy has a finite lower bound. Because of this self-trapping the frequency of the CD em field becomes much smaller than the frequency of the free field having the same wavelength… In the case of liquid water, the CD… includes an ensemble of almost free electrons which are able to accept externally supplied energy and transform it into coherent excitations* (*vortices*) *whose entropy is much lower than the entropy of the incoming energy*" [41].

In biological systems almost all water is within a fraction of a micron or less from a surface or molecular backbone and so is: *interfacial water*, which behaves in a quantum way, where the Coulomb law of electrostatics does not apply. In these circumstances, like charges attract. Biology itself depends on this, so as to allow the accumulation of tissues from negatively charged cell bodies [42].

Water Memory—J. Dunning-Davies: Quantum Information, Thermodynamics and Coherent Ordered Domains

***Historical Background*:**

People have speculated for some time over whether substances, such as water, actually have a memory. However, it was in 1988 that a truly staggering article appeared in the journal *Nature* purporting to report the experimental observation of this property assumed by many to be merely an attribute of animals, particularly humans. The article in question [43] by a team, headed by Dr. Jacques Benveniste, claimed to have observed that extremely dilute biological agents were still capable of triggering relevant biological systems. In fact, they even claimed this to be so in the absence of actual physical molecules of the agents concerned. Some of the experiments had been reproduced in laboratories other than Benveniste's and members of these laboratories co-signed the article. However, this article provoked a flurry of comment and resulted in the experiments being rerun under the "scientific" eyes of a fraud detector, a journalist and a magician. Presumably by "a journalist" was meant the editor of *Nature*, but that person was by training a physicist and might have been expected to have had some elementary knowledge of information theory and that it had been applied to physical systems. Although a relatively old subject in its own right at that time, information theory had been coming into physics via such books as that of Brillouin [44]. It might have been thought by some that this fact would have introduced a more cautious note into some of the condemnation of Benveniste's work.

The article itself appeared in the issue of the journal for the 30th June 1988 and the ensuing furor was such that the then editor of *Nature* summed up his reading of the situation and called a halt to further correspondence in the issue of 27th October 1988, after allowing Dr. Benveniste a chance to answer his critics. What really caused the furor? The answer is best summed up by the "Editorial Reservation" which appeared with the original article. This said that "readers of this article may share the incredulity of the many referees who have commented on several versions of it during the past several months. The essence of the result is that an aqueous solution of an antibody retains its ability to evoke a biological response even when diluted to such an extent that there is negligible chance of there being a single molecule in any sample. There is no physical basis for such an activity." In the later commentary, attention was drawn to the fact that one of the concerns of the editor of *Nature* was that the publication of the paper was "certain to excite the interest of the homeopathic community". Given this, therefore, it is surprising the article ever appeared in print, but appear it did even though it was stated there was no physical basis to explain the claimed phenomena.

It is this final statement which is now called into question with the appearance of an article purporting to give the biophysical basis of the Benveniste experiments [45]. From this vantage, the general mechanism of Quantum Information Medicine may be implied.

***Theoretical Background*:**

The basis of information theory is now well-established. Following the approach of Brillouin (44), if P denotes the number of states in a system, then the information memory capacity (denoted by I) in 'bits' is defined to be

$$I = \ln P , \tag{1}$$

where, if a problem is considered with N different independent selections, each corresponding to a binary choice (0 or 1), the total number of possibilities is

$$P = 2^N \tag{2}$$

and so the information is:

$$I = N \ln 2 . \tag{3}$$

Alternatively, the entropy function of statistical thermodynamics is given by

$$S = k \ln P , \tag{4}$$

where k is Boltzmann's constant.

It follows that, for the above expression for P,

$$S = k \ln\left(2^N\right) = kN \ln 2 \tag{5}$$

Further, it may be noted that the first and second laws of thermodynamics may be combined into the equation

$$dU = TdS + d'W\,, \tag{6}$$

where dU denotes the internal energy, T the absolute temperature and $d'W$ the work done on or by the system. In terms of memory capacity, this becomes

$$dU = \left(kNT\ln 2\right)dN + d'W \tag{7}$$

and it is seen immediately that the energy required to add one bit of memory to the system is given by

$$kT\ln 2 = \partial U/\partial N \tag{8}$$

where the partial derivative is evaluated with the work term held constant.

It might be noted that heat capacity is necessarily a positive quantity [46] and, therefore, this last equation leads to the realisation [45] that a program written using ΔN bits of system memory dissipates energy of at least $[kNT\ln 2]\Delta N$. As noted previously, this constitutes an irreversible bound on a classical computation imposed by the second law of thermodynamics.

This brief introduction to some of the basic ideas of information theory and the link with statistical thermodynamics provides one part of the basis for the promotion of the idea that water possesses memory. The second part derives from a detailed study of some of the properties of water itself.

***Properties of Water*:**

Water is such a commonly available and apparently straightforward liquid that most take for granted and the popular picture, derived from standard chemistry, of it being composed of an oxygen atom attached to two hydrogen atoms belies a quite detailed, complex structure. Standard textbook chemistry has an enviable history of genuine scientific success but it is actually confined by a simple scheme of charges interacting via static Coulomb forces; that is, it is totally reliant on electrostatics and omits all mention of electrodynamics and the consequent radiation field. It is this basic neglect which is responsible for the inability to recognise phenomena which are, in fact, dependent on that radiation field. This is doubly unfortunate since physicists and engineers are only too aware of this cause and effect since it is due to this dynamical effect that so many modern-day appliances work; for example, the electric light on which we all depend and the wifi connections which are assuming increasing importance in our lives. It has been speculated that a goodish percentage of effects in condensed matter physics make use of the radiation field in one way or another but it still doesn't seem to have found a place in much of basic chemistry.

This paper ([45] and references cited there) draws attention to the fact that water has been shown to contain electric dipole ordered domains due to a condensation of photons interacting with molecular dipole moments. These ordered domains yield an unusually high heat of vaporisation of water per molecule and this has been shown to imply a high degree of memory storage capacity. In a similar manner, it has been shown that the partial entropy per molecule of an ionic species dissolved in an aqueous electrolyte implies a large number of bits of information per ion. This number is, in fact, so high as to lead to the expectation of such ions being attached to an ordered water domain. This state of affairs allows for semi-permeable membranes which may either permit or forbid the passage of an ion through a small gap. This would be expected to depend in part on the state of order in the ion attachment. Such a situation, based on information or, equivalently, entropy, indicates a program for biological cells analogous to polymer DNA based programs. It is ion flows through membranes in nerve cells which allow human memory storage in nerve cell networks in the human brain. These possess roughly the same magnitude for biological information capacity density and it well surpasses the comparable figure for commercial computer memory devices.

It should be noted also that the magnetic properties of water are again of great interest. In fact, a coherent ordered domain in water shows almost perfect diamagnetism, although the total diamagnetism in water is weak. This follows due to the magnetic flux tubes being capable of permeating normal water regions just as they can permeate type two superconductors via their normal regions. Trapped magnetic flux tubes may also carry information and give some directionality to what would otherwise be isotropic pure water.

The domains in water also exhibit a rotating electric dipole moment. If an electric field is applied, strings of electric dipole aligned water domains are formed and many such strings form a dipolar field bundle of strings. If the field is applied by employing a voltage between two electrodes then the bundle will start at one electrode and continue to the other. These strings will have an effect on the entropy and, therefore, on the information capacity

of the water memory. Further, according to the two fluid model of water structure, an ion could flow with virtually no friction through the bundle of strings from one electrode to the other.

Finally, it should be noted that, if the bundles of these strings are orthogonal to an applied magnetic field, ionic transport resonance effects can occur between the time varying part of the magnetic field and the cyclotron frequency associated with the uniform part of that field.

***Implications*:**

It follows that the ordering of water through coherent domains yields sufficient structure for truly significant memory capacity. This view receives support from statistical thermodynamics and information theory. It is seen that ordered water domain polarized string bundles affect ionic motion and this can act as switches in networks of nerve cells. Many of these actions should be measurable by employing magnetic resonance imaging techniques.

What are the consequences of all this? To answer the objection: "*There appears to be no active chemical producing the effect*," we need but remember the possibility of dynamic effects having a part to play, a point well illustrated by the case of a magnetic recording tape. In the investigation [45] it was found that, using electromagnetic theory, the existence of electromagnetic domains in water was confirmed. These are actually small ferro-electric structures within which electric fields are trapped. Hence, water is ferro-electric and it is this which is fundamentally responsible for many intriguing properties of water, including its memory. This general theoretic approach appears to be indicative of the likely mechanism responsible for the proposed effects of *Quantum Information Medicine*.

4. Discussion Points: Possible Implications for Future Medical Practice

The following possibilities are just that: *possibilities.* The situation as it stands concerning our knowledge beyond the clear experimental evidence at present is plain: *We do not know*. Please review the following speculations with care, and assess the potential to be explored.

Unexplored Potential Benefits:

The future potential for inexpensive nontoxic drug-effect treatments, the possible alleviation of chronic pain and addiction are implied alongside of delivery of the ***effects*** of drugs into the brain which themselves, cannot cross the Blood-Brain Barrier (BBB). Future treatment strategies which currently remain undeveloped are therefore implied for diseases such as OCD and Parkinson's. Addiction of all sorts, from tobacco to heroin, may possibly be ameliorated. Drugs may potentially be subject to quantum replication yielding many doses from one dose of active substance. Those who are economically disadvantaged may, if this potential is realized, then have access to the effects of drugs which would not otherwise be available to them. *New approaches to antimicrobial therapies are implied*. Chronic pain, may potentially be addressed with information and so, perhaps without recourse to, or with less dependence on, addictive drugs. These potentials remain untested.

A Few General Points:

1) The BBB prevents many molecules from crossing into the system of the brain, so 5-HT cannot be delivered for OCD, and dopamine cannot be delivered in cases of Parkinson's. Many neuropeptides are also unavailable as vital therapeutic aids [47]; 2) Addiction requires the administration of the very substance which creates the imbalance, be tapered in many doses to ease withdrawal, or, the pain of deep withdrawal results; 3) Protein folding is interactive with water structure [48]. These techniques affect water structure. Each drug has a (structured) water signature [48]. Long term research may well focus on defining the unknown relation between protein folding, water structure, electromagnetic distribution of quantum information, cancer and Alzheimer's.

These conditions/problems one and all *may* be amenable to this approach. Water easily gains access across the BBB, and/or a field may be directly applied. So, the entangled information associated with a drug or compound may be substituted for a drug, perhaps morphine, or, dopamine. Now, as water (or a field) easily passes through or bypasses the BBB entirely, once encoded with the information and active effects of dopamine… a positive effect on Parkinson's is conceivably possible. Those neuropeptides which are currently undeliverable, with their subtle levels of behavioral specificity [47] may now potentially also be available as therapeutic aids.

Perhaps, for chronic pain treatment and other such applications, a combined approach using the entangled information associated with a large dose in combination with a small dose of a real drug may be demonstrably effective. It is possible that addictive drugs may be avoided entirely. *Non-toxic informational drug effects may potentially help those afflicted with chronic pain*.

Quantum replication ("cloning") is implied: *A single dose of a drug may produce thousands of informational doses.* Drug costs could be reduced.

Potential for Addictive Amelioration:

1) Addiction is created by the substitution of an external compound for an endogenous compound.

2) Addiction's resultant self-sustaining homeostatic imbalance is reinforced with each additional usage of the drug.

3) As a drug such as Methadone is addictive and the process of withdrawal without a substitute drug is a slow one, the treatment itself in both cases fosters the problem, and often fails. Imagine the number of people using nicotine patches.

4) We propose that it may be possible to treat addiction in a new way which does not create the very problem it seeks to cure. The symptoms of withdrawal may well be quieted without a drug which creates more imbalance or the terrible pain of withdrawal, which leads to taking more drug to soften the blow or relapse. The addict may be administered water or a field infused with entangled information derived from their drug of choice. Their pain is thus reduced, and the problem not reinforced with more drug. This potential, now remains unavailable and untested.

Nobel Laureate Luc Montagnier recognizes the vital connectivity between quantum and biological processes [41] [49]. We believe he is correct.

Science has discovered many worthy and important things. There was a ~1.1 billion dollar cost for the vital discovery of gravitational waves, as reported by *Scientific American* [50].

We submit to the reader, that an equally important and even more *practical human benefit* could come from detailed, stepwise, conservative experimentation to derive reliable replicable results in this new area: *Quantum Information Medicine.*

5. Conclusion

Experimental evidence has accumulated which implies that the effects of drugs may be instantiated by electromagnetic means into living systems as a function of quantum informational processes affecting aqueous systems utilizing ordered water coherence domains. Detailed experimental and theoretic pursuit of these topics should be advanced in order to curtail the prohibitive cost and toxicity of many current medical treatments. The presence of pharmacological effects derived solely from information associated with an active compound has now been demonstrated repeatedly. The time has come to look deeply and closely into developing these potentially safe and efficacious modes of treatment. *Quantum Information Medicine* may prove itself effective against a diverse plethora of human pathologies. The intersection between quantum physics and biology, in our view, holds great promise [51] and may represent the future of medical practice itself. Detailed investigation and experiments must be closely conducted to ascertain the potentials and limits of this new approach.

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