ClearHealth Teal Paper (v.3.1)

At the Frontiers of Quantum Medical Science

Published Version: v.3.1

Publish Date: January 22, 2019

clear Health

You are unique, and it is not just your DNA. Each of us and each of our cells have a unique environment. Our genes influence us only in response to cues from within our bodies. How and where we live, love, and play, has a deep impact on how our DNA affects us and how our DNA changes over time and through the generations. These environmental influences[1] on the expression and manipulation of our genes, is a relatively new field of scientific inquiry called "epigenetics"[2].

As we think about general health, it is clear that what we eat and how much we exercise are factors that influence our wellbeing. However, just as our taste preferences for flavor, texture, and sweetness are unique, so is our body's response to disease and the best way to treat it. Health thus precludes a "one size fits all" approach and instead requires medical science to identify and target individual needs and circumstances[3].

Trends in the burden of chronic disease[4] show rapid increases worldwide, this illuminates the need for a paradigm shift in the assessment of illness and the delivery of healthcare.

WHO reported in 2005 that chronic disease contributed ~61% of 58 million total reported deaths in the world, and ~51% of the global burden of disease[5]. In 2007, the WHO predicted that this burden would increase 17%[6] by 2017; they weren't far off: in 2017 the burden of chronic disease was up to 62% globally[7]. This is a worrying trend, not only because chronic disease already affects large portions of the population, but also because they now appear much earlier in life[8] .The world is experiencing sick children and young adults in greater numbers than ever before in our history. There are millions across the globe suffering from "mystery illnesses".

Mounting medical research demonstrates that chronic illness can be tracked to inflammatory processes [9]. Inflammation is the body's response to stress. Whether it be a bacterial or viral

---

[1] Weinhold, B; *Epigenetics: The Science of Change,* Environ Health Perspect. 2006 Mar; 114(3): A160–A167

[2] As an example, an entire Journal of Clinical Epigenetics is devoted to the study of these influences and their impact on health and disease.

[3] This is called precision medicine and "proposes the customization of healthcare, with medical decisions, treatments, practices, or products being tailored to the individual patient. In this model, diagnostic testing is often employed for selecting appropriate and optimal therapies based on the context of a patient's genetic content or other molecular or cellular analysis." (Wikipedia)

[4] Chronic diseases include cardiovascular diseases, cancers, chronic respiratory disorders, diabetes, neuropsychiatric and sense organ disorders, musculoskeletal and oral disorders, digestive diseases, genito-urinary diseases, congenital abnormalities and skin diseases.

[5] Using the metric Disability-Adjusted Life Years (DALY). From http://www.healthdata.org/gbd.

[6] WHO, *Working for health: an introduction to the world health organization,* page 13.

[7] At https://vizhub.healthdata.org/gbd-compare/ with DALY metric for year 2017, non-communicable diseases.

[8] Nearly 25% of all deaths for people under age 20 are caused by chronic diseases.

[9] Hunter, P; *The inflammation theory of disease,* EMBO Rep. 2012 Nov; 13(11): 968–970. See also this Scientific American article for an overview aimed at a general audience. A Google Search will also demonstrate how active this line of thinking is in current medical science.

infection, toxicity, physical trauma, or mental and emotional stress, the body will respond with inflammation to try and mitigate the problem. When the inflammation becomes chronic, the body's systems no longer work synergistically. Disease then becomes even more debilitating and harder to treat because the imbalance triggers more inflammation, and a systemic degrading feedback loop ensues[10].

Unfortunately, current medical science does not yet have the tools to diagnose and treat disease *at this level*. The current approach divides the body into parts (body systems) and physicians are trained to target specific systems, not the body as a whole. But, it is now clear that cells, tissues, organs and body systems interact with each other continuously and in real time. Thus, a new approach is needed that considers all of the complex and simultaneous interactions between body systems in the formation of any diagnosis and treatment protocol.

The last few years have seen an explosion of start-ups and other medical ventures that seek to leverage artificial intelligence and the Internet of Things (IoT) to address this complexity at the individual level[11]. Wearables, like smart watches, track movement and heartbeat, and can even tell you how well you are sleeping[12]. And home appliances are becoming "smarter" every year as more IoT devices are constantly deployed. While this move toward precision medicine is both needed and exciting, it still looks at disease at the symptom level in an attempt to find *coarse* correlations. A method to discover the fundamental causes of inflammation in an individual's body is still at large.

To date, almost all medical interventions rely on targeted biochemistry. This in turn alters symptoms or, in some cases, attacks microbes or cancerous cells that trigger the inflammation. If we compare progress in medical science with physics, an interesting pattern emerges. The discovery of quantum physics drastically improved our ability to use materials in electronics, and to understand and model chemistry and chemical reactions. Modern computer chips are only possible because of progress in our understanding of quantum physics. However, these new discoveries have only partially impacted medical science in the form of medical devices and some computer simulations. MRI, PET and other non-invasive scanning technologies leverage the quantum nature of atoms to give unprecedented insights into the inner workings of our bodies. Quantum physics is also used to computationally model how specific drugs will react with their targets in the body[13].

---

[10] Paul Ridker is a leading researcher in the effects of inflammation on disease. He recently discovered that treating cardiovascular disease with anti-inflammatory drugs had a welcome side-effect: it also cut the rates of lung cancer. This suggests that inflammation was involved in both the cardiovascular disease and lung cancer.

[11] As an example, this blog has a list of its Top 30 medical device blogs to monitor in 2019 (i.e., a blog that summarizes a list of other blogs covering medical devices).

[12] For example Fitbit Versa, Apple Watch, Samsung Gear S3, and many others.

[13] Utkov, H et al. *Using Density Functional Theory Methods for Modeling Induction and Dispersion Interactions in Ligand–Protein Complexes*, Annual Reports in Computational Chemistry Volume 6, 2010, Pages 96-112. Other methods such as coupled cluster are also used, but are limited to smaller molecules.

While certainly impressive, these applications of quantum physics are still disjointed. MRI allows us to detect physical damage and inflammation, but not its cause. Functional MRI (fMRI) can also assess the impact of specific *interventions and influences* on the body and brain. But, for a body that is already diseased and where the damage is already done, these scanning technologies only give us a snapshot of "now". The path that brought the body to that point, as well as cellular-level causes of inflammation, is still missing. This prompts us to search for new applications of quantum science within medicine that will allow us to discover both the cellular-level causes of inflammation *and* the path to recovery for *each individual*.

Specifically, we understand through quantum physics that the chemistry of molecules (including chemical reactions) are quantum in nature. Light also has a quantum nature that allows it to interact with and alter the chemistry of molecules[14]. This field of physics, known as **Quantum Electrodynamics[15] (QED)** is still young, and only simple, academic applications of its possibilities have been investigated. QED opens a treasure-trove of possibilities for the medical sciences because, in theory, it allows the biochemistry of disease to be treated using electromagnetic fields instead of custom molecules that are symptom or purpose specific. QED unifies the applications of quantum physics in the scanning and diagnosis regime with its applications to molecule-specific quantum simulations.

But, as everyone knows, there is no free lunch. Trading a purpose-built tool for a more general one involves a complexity tradeoff. A multipurpose tool is much more complicated than a single-purpose one, and applying QED as a general tool to the medical sciences requires new and creative ways to push the envelope on some of the most complex physics of the century.

ClearHealth is pleased to be a pioneer in this emerging field of next-generation medical science. The frontiers of what is possible in diagnosing and treating disease will expand rapidly in the coming years. You are unique. And it is not just your DNA. Embrace a future where you and your health receive the individualized attention they need and deserve.

---

[14] Schwarz, T. *Reversible Switching of Ultrastrong Light-Molecule Coupling*. Physical Review Letters, 106, 196405 (2011). This is one of several examples of light-induced conformational changes in molecules that affect the chemistry.

[15] See Wikipedia for an overview, “quantum electrodynamics is the relativistic quantum field theory of electrodynamics. In essence, it describes how light and matter interact and is the first theory where full agreement between quantum mechanics and special relativity is achieved.”