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Editorial Open Access

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Editorial

Systems biology as a field continues to grow with PubMed listing 21,352 papers published as of mid December of 2014. The human body can be described as a system of systems and is classified as a complex system. Not only is the intact human a complex system but it is composed of other systems that are also complex systems. The inherent unpredictable nature of complex systems, along with the corresponding failure of scientists and funding agencies to recognize that humans are complex systems, had led to many failures in research in general and in translational research in particular.

West states in where Medicine Went Wrong: Rediscovering the Path to Complexity:

At the end of the 19th century, one of the leaders of physics, Lord Kelvin, cautioned his students against going into science because all the important work had already been done and only engineering questions remained to be answered. There were only a few details to be clarified, such as understanding black body radiation and some paradox regarding the lumeniferous ether. At the turn of the 20th century, the solution to the problem of black body radiation led to quantum mechanics and the resolution of the contradictions regarding the ether gave the world special relativity. So no matter how brilliant the person, predictions, in the absence of theory, should be left in the hands of the fortune tellers, shamans and charlatans [1].

Medical research is still dependent on the reductionist paradigm despite more medical scientists acknowledging that, when studying disease and drug response in humans, the whole is greater than the sum of its parts. Complexity science and evolutionary biology provides the theory West refers to above in terms of explaining the failure of the status quo in drug development and translational research.

The administration of epinephrine to humans suffering from cardiac arrest was based largely on studies in dogs [2]. Studies in humans demonstrated a different outcome from that in canines. For example, Dumas et al. recently "investigate[d] the relationship between pre-hospital use of epinephrine and functional survival among patients with out-of-hospital cardiac arrest (OHCA) who achieved successful" return of spontaneous circulation. They state that an: "adverse association of epinephrine was observed regardless of length of resuscitation or in-hospital interventions performed" [3].

Similar results have been observed with both drugs and diseases among individual humans regardless of sex or relatedness [4-7]. The melanoma drug pembrolizumab has been shown effective in 30% of patients. Recently, Tumeh et al. developed an algorithm that allows these patients to be identified [8]. Crystal et al. developed "cell culture models derived from biopsy samples of lung cancer patients whose disease had progressed while on treatment with epidermal growth factor receptor (EGFR) or anaplastic lymphoma kinase (ALK) tyrosine kinase inhibitors and then subjected these cells to genetic analyses and a pharmacological screen" and "identified effective drug combinations.) The state: "With further refinements, this strategy could help direct therapeutic choices for individual patients" [9].

By studying the human body as a complex system of systems, more information can be gained that will allow physicians to match a specific patient's diseases with a drug that is both safe and effective. Systems biology will play a large role in these advances.

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