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An Engineer-Physiologist's era?

BREAKING NEW GROUND. This new breed that can define the future by combining medicine and data

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If you are interested in biology, become a doctor; If you are good in mathematics, become an engineer. Such has been the dictum for long and is heard in drawing room discussions even today. However, engineering is not only about numerical skills. It is still dominated by fields that have existed for more than a century such as civil, mechanical and electrical, and a recent addition, computer science.

More importantly, little do we realise that well-established protocols drive medical practice, and biology is not at the top of a doctor's mind when he treats a patient. Biology and mathematics undoubtedly play a role in their respective fields. But compartmentalising has its downside.

Why do doctors not think of biology during treatment? Let us take a step back and look at a car. Most of the components in a traditional automobile are made of steel or cast iron. Let us now dissect the role of a mechanic who repairs this car. The mechanic analyses the various subsystems not with a knowledge of steel metallurgy but with an understanding of the functioning of the subsystems. Not that he ignores the material; he looks at the problem at hand and portrays it as a system problem. In simple words, an automobile can malfunction due to many reasons. Though the role of material scientists in auto design is undisputedly high, the designers of the vehicle are mechanical and electrical engineers.

THE HUMAN BODY

Let us replace our automobile with the human body. Like the automobile, our body can be staggered into a hierarchy. The chemical level with molecules and membranes is the building block for cells. We can travel up the hierarchy through tissue, organ and the entire body system. The doctor is our mechanic and corrects the malfunctioning of our system and subsystems, understanding the physiology as the mechanic does by understanding the subsystems. Doctors are not a biologist, though they take the help of biologists through drugs and tests. Let us not take the analogy further. After all, the doctor deals with a much more complex problem!

Good clinical practice requires an excellent understanding of physiology. The traditional view of physiology is to understand the function — an input-output protocol. Another perspective is to look at it from the laws that govern its process — conservation of mass, momentum and energy. These laws form the basis of all engineering systems, be they mechanical, chemical or electrical.

In simple words, an understanding of physiology can be enhanced by learning the principles used in engineering practice. We can state that physiology, at its core, rests not only on biology but also on engineering science. Then, we have the birth of a new branch, Engineering Physiology, engineers with the knowledge of physiology, pathology and treatment protocol, interpreted or developed from underlying engineering science.

Engineering physiologists entering drug development is the way to combine engineering skills with biology, leading to disruptive innovation.

Interdisciplinary teams, quick decision-making, risk stratification, etc., are jargons you hear in the corporate corridors. Little do we realise that clinicians have been practising these doctrines for a long time. Treating a complex case requires multiple inputs from several specialists. The future of medical practice must include an 'Engineering Physiologist'.

To consolidate the ideas, let us imagine a complicated case discussed by a group in a hospital in 2030. This group may include an engineering physiologist. He can construct a digital twin of the patient, test treatment protocols, and explain the pathology and the clinical measurements. This new breed will enhance the treating doctors' understanding of the patient's state.

It is not that the engineer–physiologist will be sitting only in the hospital. If one traces the history of medical product development, many ideas have come from practising physicians. Then a doctor-engineer duo creates a product. We ended up calling these engineers biomedical professionals. Still, in the bridge between the domains, engineers stand at their end and shout out at the doctor at the other hand. Hardly anyone walks the bridge, making the current practice inefficient. Imagine an engineer who has all the knowledge of clinical customs. However, they will not practice but understand the profession in-depth — an engineer who knows the surgical protocol!

FILLING THE GAP

Such a breed does not exist today. Biomechanics is supposed to bring the fields together but remains a research discipline. The national biomedical design is at a cusp. It is in a state where the pharma industry was two decades back. With tight patent control, the field craves for innovation that stems from a good understanding of the domain. The new breed will fill the gap admirably.

Engineering physiologists can don several other roles. It is well recognised in engineering that system function is vital for material development. Engineering physiologists entering drug development is the way to combine engineering skills with biology, leading to disruptive innovation.

Open your newspaper in the morning with a cup of coffee. The application of Artificial Intelligence and data science screams out from every other page, the health sector being at the top of the list. The data analysis in medicine cannot be clubbed with the rest of the fields. Making the doctor community accept results or treatment protocols based on AI/ML is almost impossible without understanding the causal effects. Here is a group of men and women, the engineering physiologists, who can straddle both worlds — data and medicine.

Our top educational institutes must look beyond the classical branches and those with an immediate attraction, like data science. They have to define the future, the domain of study that will lead to a leap in science and engineering and technology. An engineering physiologist with a strong background in mathematics and medical science can define the future of medicine.

Are they prepared for such a disruptive step?

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