COLUMN

Global Advances in Health and Medicine Through Systems Biology: An Example From the Netherlands

利用系统生物方法的：来自荷兰的范例

Avances globales en salud y medicina a través de la biología de sistemas: Un ejemplo de los Países Bajos

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*One ship sails East,
And another West,
By the self-same winds that blow,
'Tis the set of the sails,
And not the gales,
That tells the way we go.*
—Ella Wheeler Wilcox

Globally, healthcare systems are facing problems with increasing healthcare costs due to chronic diseases. Cardiovascular disease, cancer, diabetes, depression, and chronic lung disease are some of the top chronic diseases that put pressure on our healthcare systems and are very difficult to resolve. The chronic diseases mentioned are often lifestyle-related and require a personalized approach. The solutions that we currently have at hand seem to be insufficient in meeting the needs of the patients and of our healthcare systems: the cracks in our systems are showing. Patients with chronic illness and multimorbidity find themselves caught in a web of referrals between medical specialists and conflicting treatment plans. As a result, they are consuming a lot of healthcare without actually reaching their goal: attaining the most optimal quality of life and the least physical burden possible. In short, mechanisms that previously functioned perfectly must now be replaced by new approaches. The supply of the healthcare system no longer meets the demands of society.

Innovations in the field of technology, health economics, and diagnostics are currently developed around the world, enabling new ways of practicing medicine. In the Netherlands, the Sino-Dutch Centre for Preventive and Personalized Medicine (SDPPM) is looking into new ways to improve health and medicine through a model of systems-biology thinking. Systems biology is a biology-based interdisciplinary field of study that focuses on complex interaction within biological systems using a more holistic approach to biological and biomedical research.

The SDPPM was founded in 2010 as a collaboration of scientists from the Netherlands and China. The rudiment of the SDPPM is its vision that systems-based thinking could be the basis for a paradigm shift in healthcare. Our current approaches to obtaining and maintaining good health increasingly prove to be insuf-

ficient for the complexities with which we have to deal. People are increasingly suffering from multimorbidity, making it difficult to find the right treatments. Furthermore, there is not enough focus on taking preventive measures by maintaining a healthy lifestyle. We need to move toward an approach that fits the complexity of these problems. Since diagnosis is the basis of every medical treatment system, it could be useful to investigate the diagnostic tools of medical systems around the world. The SDPPM approach to health innovation is inspired by the possibility that systems biology might contribute to a paradigm shift in healthcare.

Today, the term *diagnosis* has a wide variety of meanings depending on its context. The word *diagnosis* originated from a combination of the Greek words *dia*, meaning “apart” or “split” and *gnosi*, meaning “to learn” or “knowledge.” Therefore, a diagnosis is related to a recognizable separation (or split) from the whole. In a medical context, a diagnosis is typically used to describe a certain condition or syndrome that is characterized by a combination of specific features that occur simultaneously and vary from “normal” functioning. A diagnosis can lead to the recognition of a specific disease or syndrome based on a group of symptoms or signs that characterize an “abnormal” condition.

Concepts of diagnosis are derived from medical theories. Western medical theory takes a linear, reductionistic approach. In this approach, we are interested in the symptoms as objects and their quantitative properties. From a nonlinear, systemic approach, such as Chinese medical theory, we are interested in the underlying relations between symptoms and their qualitative properties. The difference between Western concepts of diagnosis and Chinese diagnosis can be explained by the metaphor of the use of binoculars. A Western-trained scientist uses a pair of binoculars to bring the horizon closer. He wants to use his binoculars to see details. An Eastern scientist, however, takes his binoculars to see the horizon. For example, as the Western scientist zooms in on a person, he is able to see how a hand moves in relation to the arm. Because he sees details, he can analyze and understand the functioning of the wrist. The Eastern scientist can analyze the same person but in a different way. He cannot see how the hand moves in relation to the arm. But he can

see how the person he is analyzing is waving to his wife. If I were to ask the Eastern scientist about the functioning of the wrist, he cannot answer me, because he is not focused on details. If I were to ask the Western scientist why the hand is moving in relation to the arm, he cannot answer me because he cannot see the context. As this metaphor shows, linear and nonlinear diagnostic models could complement each other.

BRIDGING THE TWO MODELS: SINO-DUTCH CENTRE FOR PREVENTIVE AND PERSONALIZED MEDICINE RESEARCH ON TYPE 2 DIABETES MELLITUS

The World Health Organization has identified type 2 diabetes mellitus as one of the biggest health problems of the 21st century. Deaths related to type 2 diabetes mellitus are expected to double between 2005 and 2030. Currently, 346 million people are living with type 2 diabetes mellitus worldwide.¹ From a linear diagnostic point of view, there are 2 types of diabetes: type 1 diabetes mellitus and type 2 diabetes mellitus. Type 2 diabetes mellitus is closely related to lifestyle. Because of this behavioral component, the disorder is very difficult to prevent and treat. Therefore, it is necessary to develop preventive and personalized strategies. A systems approach to this problem could be a solution. Based on this idea, the SDPPM is performing research on the Chinese nonlinear diagnostic system of symptoms related to type 2 diabetes mellitus.

The objective of the research is to investigate whether it is possible to find commonalities between the Western and Chinese diagnostic models. Modern Chinese textbooks provide us with 12 subtypes for the group of symptoms Western medicine defines as type 2 diabetes mellitus. These 12 subtypes are based on phenomenological characteristics. Each subtype can be identified through Chinese diagnosis. Furthermore, each subtype has its own characteristic therapeutic approach and specific lifestyle advice, such as dietary and exercise protocols.

In the research, patients who have been diagnosed with type 2 diabetes are subtyped according to the 12 Chinese clusters of symptoms. After the subtyping, the blood and urine of the patients are analyzed on biomarkers such as hormones, amino acids, and proteins. These biomarkers provide a biochemical “fingerprint” of the subtypes. Based on this “fingerprint,” it is now possible to confirm the subtyping in type 2 diabetes.

Through this research, the SDPPM has been able to show a common ground between Western and Chinese diagnostics. It has been confirmed that type 2 diabetes mellitus can be divided according to the 12 Chinese subtypes. This means that we can now work toward a more personalized and preventive approach for patients living with type 2 diabetes. Based on the Chinese therapeutic approaches, we can now research the possibilities of providing patients with personalized treatments. Furthermore, it will be possible to research prevention strategies for people who are at risk of developing type 2 diabetes mellitus.

CONCLUSION

The systems biology-based research by SDPPM has shown a common ground between Western and Chinese methodology. Systems biology offers a different perspective on the definition of health and provides a new framework through which we can diagnose and treat disease. The concepts of systems biology and systems thinking could support a great leap forward in health innovation. Systems thinking could be the new language forming a bridge between the old and the new paradigms on health and healing. The example of the SDPPM described here is a symptom of a bigger (r)evolution.

REFERENCE

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