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Editorial

Predictive Medicine in Paediatrics

"Medicine is a science of uncertainty and an art of probability", said Dr William Osler more than a century ago. Uncertainty is embraced in art as there is ample room for interpretation, perception, and reflection. Wellbery opined that art is an illustration of an interpretive process that can also apply to the medial context.[1] This process leads to resolution of uncertainty through defining the nature of the piece of art, identification of missing information, recognition of the dynamic nature of interpretation, and acknowledging contributions of other aspects of the context. Notwithstanding, in the twenty-first century, the goal of medicine has moved beyond resolution of uncertainty to striving for accurate medical prediction.

Through identification of patients at risk of developing a certain disease, predictive medicine aims to offer potentials and hopes for timely initiation of preventive measures or therapeutic interventions. Paediatric clinical studies commonly explore outcomes and associations, but less so predictions, as illustrated in this issue of the Journal. Gunes et al performed a retrospective analysis of about 300 overweight and obese adolescents and found relationships between the level of thyroid stimulating hormone and indices of glucose metabolism, although the mechanism is unclear.[2] In other studies, Su et al examined the efficacy and safety of rituximab in the treatment of children with steroid dependent or frequently relapsing nephrotic syndrome,[3] while Yu et al reported the outcomes of 121 adolescents with acute lymphoblastic leukemia treated with the Chinese children leukaemia group protocol.[4] In one study with a predictive component, Coban et al reported that the renal resistive index as assessed by Doppler ultrasonography was highly predictive of the development of kidney injury in children in the intensive care unit.[5]

The concept of predictive medicine is not new. The Framingham heart study, launched in 1948, has provided dataset that not only enable the monitoring of patterns, trends, and outcomes of heart disease, but importantly also allow the prediction of 10-year cardiovascular risk score in an individual.[6] In the paediatric intensive care unit, the PRISM (Paediatric Risk of Mortality) score based on physiological variables has been used for the prediction of mortality.[7] Another example in paediatrics is the use of risk scores based on clinical and laboratory parameters, proposed primarily by Japanese investigators, to predict the development of resistance to intravenous immunoglobulin therapy and development of coronary artery aneurysm.[8] Nevertheless, the predictive value of these scores outside of Japan is limited. This is only one of the many examples that illustrates the challenges of making prediction based on a defined set of data.

Abraham Lincoln said, "The best way to predict the future is to create it". It seems counterintuitive though for one to create a disease for oneself in the distant future as a self-fulfilling prophecy. A more meaningful perspective while reading the statement in the context of medicine is perhaps the need to explore in depth all available data inherent to an individual, in a hypothesis-free fashion, and to understand what these active parameters are and how these active parameters interact with each other for the prediction of future medical events. Much has been said in the previous editorials about the potentials of big data[9,10] and artificial intelligence[11] in the transformation of health care. At an individual level, the advent of precision medicine has prompted development of predictive algorithms based not only on conventional demographic and clinical parameters, but also on the wealth of genomic and wearable sensor-based biometric data,

social data, and personal health data stored in a longitudinal fashion in electronic health records. Evidence of benefits of these predictive algorithms to patients remains, however, to be substantiated.

Amid the expectation and perhaps an inflated expectation of technology-driven advances in predictive medicine,[12] clinicians need to be cognizant of the caveats of making forecast in a branch of science known to be coloured by uncertainties and probabilities. Nonlinear behaviour is the norm in human body systems that operate in a complex dynamic fashion.[13] Given the non-linearity of body systems, the chaos theory could explain why predictive algorithms, even taking in account of an abundant amount of data, may remain imperfect. A tiny variation in one of the apparently trivial initial, yet deterministic, factor may result in significant alteration of outcomes, this being the butterfly effect that underlies the chaos theory. As paediatricians, we are mindful that if we were to forecast, we would be trying to predict outcomes in the distant future of our patients well beyond their childhood. Prediction is never easy. The regulatory bodies in North American and UK are treating artificial intelligence- and machine learning-based clinical decision software as medical device, which requires scrutiny by due processes before and after marketing.[14,15]

Predictive medicine in paediatrics remains in its infancy. There is no doubt that scoring systems that have been developed for different cohorts of paediatric patients have defined roles in risk stratification. Nevertheless, even with iterations of prediction models, evidence that predictive algorithms may translate into better clinical care and alteration of outcomes of patients remains to be seen.

YF Cheung
Chief Editor

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