Editorial: Health Engineering for Urgent Challenges in Cardiovascular Disease

DESPITE remarkable and unprecedented progress in improving cardiovascular care, cardiovascular disease (CVD) still remains the leading cause of mortality and morbidity worldwide [item 1) in the Appendix], [item 2) in the Appendix]. According to the World Health Organization, CVD accounted for 17.9 million deaths globally in 2018, becoming the most non-communicable disease cause of death as seen in Figure 1 [item 2) in the Appendix]. With the increase in aging population, the prevalence of all CVDs is projected to continue to rise over the next decades, expecting to account for >23.6 million deaths per year by 2030 [item 3) in the Appendix], if no effective and preventive measures are taken.

It is reported that the prevalence of CVD has also increased in children and young adults in recent decades [items 4)–6) in the Appendix]. Alongside concerning increasing mortality trends, cardiovascular spending has risen steadily over the past 2 decades in many countries especially in the United States [item 1) in the Appendix], [item 7) in the Appendix]. The American Heart Association and American Stroke Association estimate that costs for all aspects of CVD in the United States totaled $318 billion in 2015 and spending for all cardiovascular conditions is projected to continue to rise [item 7) in the Appendix]. Facing the world's largest and costliest healthcare burden of CVDs, many diverse stakeholders in cardiovascular health worldwide share the sense of urgency for change and are looking into new ways to address the society's most pressing and unmet grand challenges in public health [item 1) in the Appendix]. It becomes clear that the paradigm is shifting from the current passive treatments at the late stage towards the prevention of cardiovascular diseases.

The advancement of health engineering aims to provide new tools for the early prediction, early prevention, early diagnosis, and early treatment of chronic diseases especially cardiovascular diseases by helping patients to monitor and improve their fitness and health conditions [item 8) in the Appendix]. Four core enabling technologies in health engineering have joined forces to solve some of healthcare's biggest problems and to assist in alerting these CVD trends: 1) wearable technologies including flexible sensing and soft robotics worn on or in the body to help users stay in shape, monitor their CVD risk factors, detect life-threatening conditions and even provide on-site CVD therapy; 2) micro-nano-biosensors for ultra-sensitive detection of biomarkers that pertains to CVDs; 3) multi-modal and multi-scale medical imaging technologies for precise evaluation of the vulnerability of blood plaque; and 4) artificial intelligence (AI) and healthcare robotics for integrating all the information obtained using the sensing and imaging technologies with transitional markers and genetic information for early identification of vulnerable CVD patients. It is believed that an AI-based healthcare system will be pushing for affordable solutions to reverse these CVD trends.

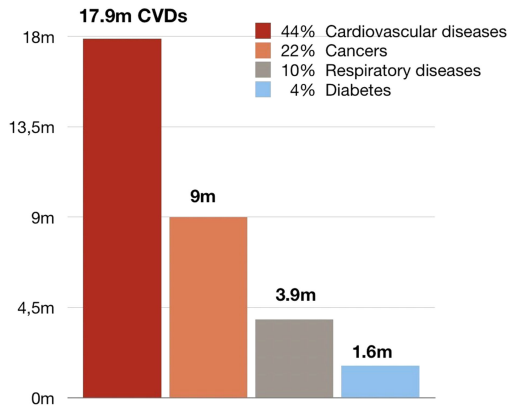

Fig. 1. Annual death of Noncommunicable diseases [item 2) in the Appendix].

The IEEE REVIEWS IN BIOMEDICAL ENGINEERING (R-BME) reviews the state-of-the-art and trends in the emerging field of biomedical engineering. As Editor-in-Chief of this journal for the second term starting in 2020, I continue to welcome reviewing papers on any subject within that broad scope. Our mandate remains the same: to provide the primary forum for advancement and dissemination of scientific knowledge on biomedical and health engineering. I am also very much interested in including, in particular, high-quality manuscripts that give in-depth critical reviewing on methodological and clinical issues of the prevention and control of chronic diseases especially CVDs. If you are uncertain about the suitability of your submission to R-BME or have any suggestions and questions concerning the journal, please do not hesitate to contact me using the email address below.

Finally, I would like to introduce and welcome the new Managing Editor: Wei Chen, from Fudan University, China. Wei obtained her Ph.D. from the University of Melbourne, Australia in 2007. She worked at Bell Laboratories Germany as an intern in 2005, and served as Chair of the Theme Health Care at Eindhoven University of Technology (TU/e), the Netherlands.

Digital Object Identifier 10.1109/RBME.2019.2959113

Wei is currently Professor and Director of Center for Intelligent Medical Electronics at the School of Information Science and Technology, and Director of the Physiological Signal and Sleep Platform at the Human Phenome Institute, Fudan University, Shanghai. For me, Wei has been a close collaborator and a highly valued friend for more than a decade, since 2007 when she was an Assistant Professor at TU/e. Therefore, I am particularly happy to welcome Wei on board. I would also like to take this opportunity to thank all the editorial members, authors, reviewers, and staff for their contributions to the journal. My special thanks go to Deputy Editor, Professor Emma MacPherson for her dedication and commitment to the journal during the past three years. I trust that with the new addition and team efforts, we will do even better for the journal in the next three years than ever before.

Best wishes and thank you in advance for your contribution to R-BME.

Y.-T. ZHANG, *Editor-in-Chief*
City University of Hong Kong
Hong Kong SAR, China
yt.zhang@cityu.edu.hk

APPENDIX
RELATED WORK

1) M. McClellan, N. Brown, R. M. Califf, and J. J. Warner, "Call to action: Urgent challenges in cardiovascular disease: A presidential advisory from the American Heart Association," *Circulation*, vol. 139, pp. e44–e54, Feb. 2019.
2) *Noncommunicable Diseases*, World Health Org., Geneva, Switzerland, 2018.
3) B. Mozaffarian, E. Benjamin, A. Go, D. Arnett, M. Blaha, and M. Cushman, "Heart disease and stroke statistics—At-a-glance," Dec. 2014. Accessed: Jul. 16, 2018. [Online]. Available: http://www.heart.org/idc/groups/ahamah-public/@wcm/@sop/@smd/documents/downloadable/ucm_470704.pdf
4) M. G. George, X. Tong, E. V. Kuklina, and D. R. Labarthe, "Trends in stroke hospitalizations and associated risk factors among children and young adults, 1995–2008," *Ann. Neurol.*, vol. 70, pp. 713–721, 2011, doi: 10.1002/ana.22539.
5) M. G. George, X. Tong, and B. A. Bowman, "Prevalence of cardiovascular risk factors and strokes in younger adults," *JAMA Neurol.*, vol. 74, pp. 695–703, 2017, doi: 10.1001/jamaneurol.2017.0020.
6) Y. Yu *et al.*, "Maternal diabetes during pregnancy and early onset of cardiovascular disease in offspring: Population based cohort study with 40 years of follow-up," *Brit. J. Med.*, vol. 367, 2019, Art. no. l6398. [Online]. Available: https://doi.org/10.1136/bmj.l6398
7) *Cardiovascular Disease: A Costly Burden for America, Projections Through 2035*, Amer. Heart Assoc., Washington, DC, USA, 2017. Accessed: Aug. 23, 2018. [Online]. Available: https://healthmetrics.heart.org/wp-content/uploads/2017/10/Cardiovascular-Disease-A-Costly-Burden.pdf
8) Y. T. Zhang, "Editorial health engineering: Convergence transforming reactive medicine to proactive healthcare," *IEEE Rev. Biomed. Eng.*, vol. 11, p 1, 2018, doi: 10.1109/RBME.2018.2852858.