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Med-X

EDITORIAL

X for medicine: exploration and innovation in biomedical engineering

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We are thrilled to launch *Med-X*, a new international and high-quality open-access journal that publishes groundbreaking papers across the areas of biomedical engineering for the purpose of transforming modern medicine. Biomedical engineering applies principles of engineering to develop solutions for various health-related issues. It is the fastest-growing engineering discipline with unlimited potential and opportunities. Our journal aims to provide an interdisciplinary platform for communicating the latest important discoveries and innovations in basic and applied biomedical science and technology. We will accomplish this goal by publishing state-of-the-art research articles, rapid communications, case reports, reviews, perspectives, and commentaries.

What would be *X* that may revolutionize the future of medicine? For genetic engineering, *X* can be novel gene editing tools; for tissue engineering, X can be programmable scaffold materials; and for artificial intelligence, *X* can be neural network algorithms. Broadly, *X* represents the uncharted territories and unknowns in the intersection of different disciplines with medical sciences; *X* embodies an engineering-focused interdisciplinary driving force that leads to exciting discoveries, innovations, and inventions for biomedical applications; and *X* represents our ambition and pioneering spirit to push the boundaries of multiple disciplines.

The scope and development of biomedical engineering are profoundly interdisciplinary, diverging significantly from traditional fields such as math, physics, chemistry, and biology. Firstly, novel areas and technologies in biomedical engineering usually arise from the progress of multiple fields and require the integration of knowledge and technologies from diverse, seemingly unrelated disciplines. Secondly, the expansion of biomedical engineering necessitates branching out in various directions and incorporating more and more disciplines, leading to the spiraling evolution of the field. These interdisciplinary aspects establish biomedical engineering as an infinite engine for discovery and innovation, offering limitless possibilities for advancement.

For example, tissue engineering aims to repair and regenerate damaged tissues and organs by engineering two crucial components: cells and extracellular matrix. To achieve this, a comprehensive understanding of human anatomy and physiology is necessary, along with expertise in molecular and cell biology and biomaterials. In the 1990s, leaders in chemical engineering, materials science, and biomechanics created scaffold materials that mimic the native matrix and designed bioreactors that provide a controlled biochemical and biomechanical environment for cells to grow and differentiate into functional tissue. In addition, microfabrication technologies such as photolithography and microfluidics help guide cell functions and tissue formation and have led to organ-on-a-chip systems for disease modeling and drug screening. On the other hand, advances in stem cell biology and cell reprogramming enable the derivation and engineering of all cell types in the body for regenerative medicine applications. Recently, synthetic biology and genetic engineering, exemplified by CRISPR-mediated gene editing, offer precise control of gene activation, inhibition, and corrections. For in vivo applications, immunomodulation, initially aimed at achieving immune acceptance of transplanted cells, tissue, and organs, has now evolved into exciting immunoengineering technologies for tissue regeneration and the therapy of diseases such as cancer. With progress in stem cell engineering, immunoengineering, biomaterials, and drug delivery, in situ tissue engineering has emerged as a promising direction for low-cost, off-the-shelf, and personalized therapy. The development and evolution of tissue engineering reflect the interdisciplinary nature of biomedical engineering, where related areas converge and diverge,

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constantly breaking traditional discipline boundaries. Furthermore, tissue engineering also exemplifies typical multiscale bioengineering approaches that characterize and engineer the complex biological systems across molecular, cellular, tissue, organ, and system levels, for the advancement of new biomedical technologies and clinical therapies.

Biomedical imaging also demonstrates the multidisciplinary evolution of this field. The development of electronic equipment and computers since the 1950s paved the way for medical instruments such as X-ray machines, magnetic resonance imaging (MRI), and computed tomography (CT) scans. Engineers have worked at the forefront of designing and developing the hardware and software components of biomedical imaging devices, including sensors, detectors, electronics, and image processing algorithms. Material science plays a crucial role in creating biocompatible and safe materials for use at the interface of sensors and the body's surface or within the human body. Additionally, chemistry is utilized to create contrast agents that enhance the visibility of certain tissues or organs during MRI. In recent years, advancements in microtechnologies have enabled the fabrication of wearable bioelectronics for imaging, allowing for continuous monitoring of the human body. Moreover, artificial intelligence and machine learning are increasingly utilized for the reconstruction, analysis, and automated interpretation of medical images for diagnosis.

Overall, the emergence and growth of diverse biomedical engineering areas have demonstrated a continuous effort to improve healthcare by integrating engineering principles, physical sciences, and medical sciences to create new technologies, devices, and therapies. *Med-X* aims to cover the latest advances in basic and applied research in the field of biomedical engineering, integrating multidisciplinary approaches to address challenges in medicine and healthcare. This includes topics at the forefront of diagnosis, monitoring, treatment, and prevention of human diseases. Our goal is to provide a platform for researchers, engineers, clinicians, and practitioners to share their knowledge and expertise and facilitate collaborations to advance the field and benefit human health. The examples of topics include but not limited to

1. Molecular and Cellular Engineering
2. Smart Biomaterials and Tissue Engineering
3. Drug, Gene and Cell Delivery Systems
4. Immunoengineering
5. Biomechanics and Mechanobiology
6. Biothermal Science and Engineering
7. Biomedical Devices and Biosensors
8. Medical Robotics, Artificial Intelligence, and Telemedicine
9. Biomedical Imaging
10. Bioinformatics and Computational Biology

This inaugural issue of *Med-X* features reviews and research articles that cover a range of topics at the forefront of biomedical engineering, and we also plan to publish special issues to highlight new frontiers in the field. Our editorial team comprises world-renowned experts and up-and-coming talent across all areas of biomedical engineering, and our ultimate aim is establish *Med-X* as a premier journal in the field. We warmly invite researchers working in the field of biomedical engineering to submit their work to our journal, and join us in advancing this exciting interdisciplinary field and shaping its future.

For biomedical engineering, there is no limit.

Authors' contributions Song Li and Lisa X. Xu wrote the manuscript. The authors read and approved the final manuscript.

Declarations

Competing interests The authors declare that they have no competing interests.

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