Discussion on current topics in redox biology and future directions/year in review

Redox reactions are fundamental processes in all living organisms, playing a critical role in biomacromolecule function, cellular signaling involved in metabolism, aging, disease, and responses to endogenous and exogenous stresses. Despite the importance of redox biology and the vast number of studies published across various aspects and layers, both basic research and clinical translation in this field have not reached their full potential. The redox field appears to have reached a bottleneck, making it an opportune time to reflect on its future directions. Key considerations include refining conceptual frameworks, addressing essential questions and challenges, developing new strategies, and even rethinking research paradigms.

In this context, the "Redox Future Perspective Forum" was inaugurated at the 11th Biennial Meeting of the Society for Free Radical Research-Asia (SFRR-Asia) and the Chinese National Conference of Redox Biology and Medicine held in October, 2024. Twelve distinguished scientists from around the world shared their insights, fostering vibrant discussions. Two key objectives emerged with broad consensus: (1) to outline a roadmap for the future of redox biology and medicine, and (2) to advance the International Redox-Decode Project. To continue this mission, a special session titled *"*Discussion focused on Current Topics in Redox Biology and Future Directions/Year in Review*"* will be held at the 22nd SFRRI Biennial Meeting, inviting open dialogue and collaboration. The outline of this discussion is as follows:

1. To know redox: Exploration of redox networks inside and outside cells and between the host and microbiome and required methodology. What about redox family composition, redox genes, redox species, redox relevant noncoding RNAs, and turn over? What emerging tools can advance redox research (AI, organoids, systems biology, X-omics)? How can we overcome technical barriers in precisely measuring redox states in vivo as well as in vitro with specificity and sensitivity?

2. To decode redox: Elucidation of the biochemical mechanisms underlying redox sensing and relay, redox signaling in physiological processes (organelle function, quality control, cell fate, development, reproduction, regeneration, and adaptive response to environmental challenge) and redox stress in the pathogenesis of various diseases. Decoding redox is the basis of life science and the critical breakthrough point for aging intervention and disease prevention and treatment.

3. To utilize redox: Translating redox knowledge into applications. Precision redox intervention and health management, utilizing traditional medicine, intelligence materials, lifestyle modification, nutritional and pharmacological manipulation, etc. How can we accelerate the translation of redox research into clinical applications? How can we design targeted redox therapies for specific disorders? What strategies can optimize redox-based health management?

4. To promote redox decode project (RDP): This initiative emphasizes organized, government-supported research to address complex challenges closely tied to human health. Future progress will require enhanced collaboration across multidisciplinary fields, deeper integration of basic and clinical research, stronger international cooperation, and fundraising. Just like the Human Genome Project (HGP) that revolutionized our understanding of genetics, RDP holds the potential to unravel the mysteries of redox biology and deliver transformative benefits for human health. What actionable steps can we start for the successful implementation of RDP?