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New Biofrontiers: Where Biotechnology, National Security, and Geopolitics Intersect

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SYNOPSIS

Biotechnology, driven by technological progress and global challenges, is shaping scientific innovation and economic growth. The US and China have invested substantially in this field, recognising its role in economic and national security. Against the backdrop of the COVID-19 pandemic, the geopolitics of biotechnology have revealed a complex interplay of political, economic, scientific, and humanitarian factors.

COMMENTARY

Spanning across medical, agricultural, industrial, environmental, and food sectors, biotechnology harnesses living organisms to improve human life and the environment. The global biotechnology market valued at US$1.55 trillion in 2023 – with the United States as a major contributor – underscores its economic significance. In 2022, the US biotech industry alone contributed over US$491 billion to the economy. The revenue is projected to increase to US$1.25 trillion by 2030.

Biotechnology significantly impacts national security in several ways, including biosafety, biosecurity, food, and agricultural security. Artificial intelligence amplifies these efforts, revolutionising drug discovery and precision medicine. However, biotechnology also presents ethical, environmental, and regulatory challenges, necessitating collaborative efforts to address barriers and promote responsible development.

Competition and Collaboration between the US and China

The United States is deeply engaged in various facets of the biotechnology landscape, spanning critical areas such as COVID-19 pandemic response and vaccine

development, biodefence, precision medicine, biomedical research, agricultural biotechnology, innovation and entrepreneurship, bioethics and regulation. US federal agencies like the National Institute of Health (NIH), Department of Energy (DOE), and Department of Defense (DOD) allocate significant funding for biotechnology research and manufacturing across numerous institutes and centres.

Parallel to government support, pharmaceutical companies play a pivotal role in advancing biotechnological innovations. These companies invest heavily in research and development for drug discovery and development. There has been a surge of interest and investment in areas such as precision medicine, gene therapy, immunotherapy, and synthetic biology in recent years.

New initiatives such as The Bold Goals for US Biotechnology and Biomanufacturing (White House, March 2023), The National Security Commission on Emerging Biotechnology (created by the US Congress, March 2022), the Bio Industrial Manufacturing Programme (DOD, March 2023), and the Critical and Emerging Technologies List (White House, February 2024) highlight the multifaceted considerations surrounding biotechnology's impact on national security, competitiveness, international cooperation, workforce development, ethical considerations, and data sharing. By proactively addressing these complex issues, the US aims to maintain its leadership position in the global biotechnology landscape while ensuring responsible and secure innovation.

China's biotechnology sector has undergone significant expansion and investment in recent years. Areas such as biomedicine, bioagriculture, biomanufacturing, and biosecurity have been identified as strategic priorities. Through programmes like the National Key Research and Development Programme and the 14th Five-Year Plan (2021-2025), China allocates substantial funding to bolster strategic initiatives in biotechnology. Additionally, Chinese biotechnology companies attract funding from venture capital, private equity, and strategic partnerships, fueling further growth and innovation in the sector.

Many factors contribute to the competition between the US and China. Both countries compete for talent. China's biotechnology institutions and companies use multiple channels to access US intellectual property (IP), including universities, labs, and private companies. Concerns such as espionage and cyber threats, export controls, and geopolitical tensions have changed the dynamic of the competition. In April 2024, US legislators recommended seven Chinese companies – BGI, WuXi AppTec, Innomics, STOmics, BGI Genomics Co, Origincell, and Vazyme Biotech – to be added to the DOD list due to security concerns.

The relationship between the United States and China in biotechnology appears symbiotic. The US relies on China for manufacturing and services, while China depends heavily on access to the US' basic research.

Besides the competition between the two countries in biotechnology, there exist opportunities for collaboration and mutual benefits. Basic scientific research forms the foundation upon which groundbreaking discoveries are made, and collaborative projects in fields like genomics, synthetic biology, and bioinformatics can yield transformative insights and innovations. Moreover, joint efforts in disease surveillance

and epidemiology can strengthen early detection and response to infectious diseases and pandemics, enhancing global health security.

Biopharmaceutical development represents another promising avenue for collaboration, with joint initiatives capable of accelerating the discovery and development of therapeutics and vaccines for a myriad of diseases. Similarly, cooperation in precision medicine, agricultural biotechnology, environmental sustainability, and global health initiatives can yield tangible benefits for both nations and the broader international community.

Geopolitics of Biotechnology – Case of the COVID-19 Vaccine

The geopolitics of biotechnology, particularly evident in the race to develop the COVID-19 vaccine, demonstrated the intricate manoeuvring on the global stage, where political, economic, and strategic interests converge. Countries such as the US, China, and Russia are engaged in the so-called “vaccine diplomacy”, leveraging their vaccine production and distribution capabilities to strengthen their influence in international relations.

The geopolitics of COVID-19 vaccines revolve around vaccine access, distribution, and equity issues. There have been disparities in vaccine access between wealthy countries with advanced healthcare systems and resources and low- and middle-income countries with limited access to vaccines.

The geopolitics of COVID-19 vaccines intersect with intellectual property rights and technology transfer issues. Developing countries, particularly those in the Global South, have called for the waiving of intellectual property rights related to COVID-19 vaccines to facilitate technology transfer and increase global vaccine production capacity. However, vaccine-producing countries and pharmaceutical companies have raised concerns about the implications of waiving intellectual property rights on innovation and investment in biotechnology.

Meanwhile, vulnerabilities in global supply chains have exposed the risks of overreliance on specific regions or countries for critical vaccine components. As the scramble for vaccines intensifies, major powers engage in a high-stake competition, each seeking to showcase their vaccines as symbols of scientific prowess and global leadership.

While international organisations strive to coordinate vaccine distribution efforts, geopolitical tensions often complicate matters, slowing the process and hindering equitable access to vaccines.

Through the lens of COVID-19 vaccine issues, valuable lessons emerge. The breakneck speed of vaccine development underscores the power of collaboration and streamlined processes. Yet, the imperative of ensuring equitable access worldwide remains a pressing challenge, demanding effective communication strategies to combat misinformation and hesitancy.

As the world grapples with evolving virus variants and potential future pandemics, the

need for robust pandemic preparedness and international cooperation becomes ever more apparent.

Looking Ahead

Biotechnology is poised to become a crucial driver of economic and national security activities. The concerns about dependence on outsourced manufacturing and poorly documented supply chains underscore the need for strategic planning and risk mitigation.

The geopolitics of biotechnology, particularly in the context of COVID-19 vaccines, reflect complex interactions between political, economic, scientific, and humanitarian factors. Addressing these geopolitical challenges requires international cooperation and commitment to equitable access to vaccines and healthcare resources.

Conclusion

Biotechnology offers immense potential for scientific advancement, economic growth, and global health. Collaborative efforts between the US and China are essential for realising this potential, emphasising the importance of international cooperation, equitable healthcare access, and responsible innovation. Trust, dialogue, and transparency are pivotal in shaping the trajectory of biotechnology in the twenty-first century.

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