Life Sciences

SUPERMIND

Disruptive Technologies

Big Data and Artificial Intelligence

As digitization and aggregation of health data continues to accelerate, our ability to manage large data sets and apply cutting-edge artificial intelligence and machine learning technologies shows tremendous promise for both individual care and dramatically increasing the pace of drug discovery. Artificial intelligence is already being used by scientists across numerous research institutions for applications like predicting chemical structures that could lead to better anti-infectious agents and protein-based therapies.

Blockchain technologies could be utilized to protect privacy and transparency of patient health data, though standards must be developed to ensure ethical collection and dissemination of patient-related data and information. Registries should be created to catalog the world of bio-engineered viruses and nanoparticles. With robust ethical guidelines, we should increase sharing of data within and across nations, and with public health agendas and university researchers as applicable to further a globalized understanding of public health. Finally, repositories of data on the results of scientific experiments, including both positive and negative results, should be established.

RNA-based Therapies and Related Technologies

As prominently demonstrated during the COVID-19 pandemic, RNA-based therapies have revolutionized not only vaccine technologies, but also approaches for other therapeutics. Lipid nanoparticles show great promise in the treatment of cancer, inflammatory diseases, or other rare diseases. Nanoparticles containing anti-infectious agents coupled with appropriate imaging guidance could be used to combat infections in hard-to-reach places like the spine. Improved delivery systems enabling the delivery of unpackaged, 'naked' nucleic acid, like novel voltage-based electroporation systems or ballistic gene guns, could enable delivery of RNA therapeutics without bottlenecks in manufacturing or reagent cold chains.

Bioengineered Therapies

Advanced bioengineering approaches can enable a broad range of potential future therapies, from gene and tissue repair and in-vitro prosthetics to the creation of novel viruses for therapeutic delivery. Gene replacement therapies like "Homolog-Directed Repair" (HDR) offer advantages like permanent genomic integration and physiologically relevant gene expression levels. Designer implants with embedded cell-free systems could enable the on-demand synthesis of simple proteins. Engineered microbiomes in both the built and living environment could improve both human and ecological health. Living replacement tissues could render joint replacements obsolete, helping to address organ shortages and helping those who have suffered amputation. Molecular tools like DNA-encoded libraries, DNA-templated organic synthesis, CRISPR and Retron Library Recombineering (RLR) are rapidly being developed to impact the world of drug discovery. "Biomicrobots" delivered via pills in the GI tract could be activated at sites in the human body to ID and kill infected cells. In parallel with scientific work in this area, registries should be established to allow for knowledge sharing and to keep track of natural versus engineered biological components.

Streamline Development of Novel Therapies

Novel regulatory frameworks and funding mechanisms are critical to enabling the rapid development of new therapies, as proven through the rapid development of vaccines and therapies in response to the Covid-19 pandemic. Novel approaches for addressing rare disease, administering appropriate permissions for human subject research, exploring alternatives to traditional clinical trial protocols, and using real-time data are seen as having great potential to accelerate approvals of new therapies. New funding sources are also seen as important when unanticipated infectious diseases strike.

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