Repurposing the Blueprint of Life through Spherical Nucleic Acids (SNAs): Opening the Field of Structural Nanomedicine

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Spherical nucleic acids (SNAs) are nanostructures defined by a densely packed, radially oriented arrangement of nucleic acids on the surface of a nanoparticle core. These structures have transformed large swaths of the field of molecular diagnostics and are now the basis for commercial tools that allow one to detect a wide range of bacteria, viruses, and other infectious disease markers in clinical samples. SNAs are distinct from other forms of nucleic acids, have no natural counterparts, and exhibit unique interactions with biological systems. These structural properties facilitate efficient cellular uptake, positioning them as potent tools for gene regulation, vaccine development, and gene editing. Indeed, they are now the basis for lead compounds that are being explored in the clinic for the treatment of diseases like glioblastoma, Merkel cell carcinoma, squamous cell carcinoma, psoriasis, and several neurological disorders. The modularity of the SNA architecture has opened the field of structural nanomedicine, where nanomedicines are defined not just by the identity of the active components but also by their structural arrangement and chemical connectivity. The power of this approach has been demonstrated in the design and synthesis of very potent SNA vaccines for multiple forms of cancer and infectious disease. Collectively, these advances represent over three decades of progress in nanomedicine and underscore the transformative effect SNAs have had in how diseases are understood, tracked, and treated and highlight the impact of SNAs on science and society.