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NIDCD's 5-Year Strategic Plan Describes Scientific Priorities and Commitment to Basic Science

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Abstract
The National Institute on Deafness and Other Communication Disorders (NIDCD) recently issued a new strategic plan that describes the institute's scientific priorities over the next five years. Developed in collaboration with informed stakeholders, the *2023–2027 NIDCD Strategic Plan: Advancing the Science of Communication to Improve Lives* creates a unified vision to stimulate discoveries in basic research, model systems, innovative technologies, individualized treatment approaches, scientific data sharing, and translation of research findings into clinical practice. To further accelerate scientific discoveries, the institute encourages collaborations and information sharing among interdisciplinary teams conducting research in these priority areas, and advocates for the utilization of biomedical databases to share scientific findings. NIDCD also welcomes investigator-driven applications that capitalize on advances in basic research to better understand normal and disordered processes; develop or improve model systems to inform research; or facilitate the use of biomedical data utilizing best practices. Through these efforts, NIDCD will continue to conduct and support research that improves the quality of life for the millions of American impacted by conditions affecting hearing, balance, taste, smell, voice, speech, or language.

Keywords NIDCD · Animal models · CRISPR · Data sharing

Introduction

The National Institute on Deafness and Other Communication Disorders (NIDCD) recently announced the release of its five-year strategic plan, with scientific priorities that include basic research, model systems, innovative technologies, individualized treatment approaches, scientific data sharing, and translation of research into clinical tools [1].

Over the last three decades, NIDCD-supported researchers made critical discoveries that led to increasingly effective, evidence-based treatments for the millions of Americans impacted by conditions affecting hearing, balance, taste, smell, voice, speech, or language. To communicate our priorities over the next five years, the *2023–2027 NIDCD Strategic Plan: Advancing the Science of Communication to Improve Lives* was developed with input from scientific experts, the National Deafness and Other Communication Disorders Advisory Council, NIDCD staff, and the public. The result is a plan that presents a unified vision organized into six main priority themes: (1) basic research to better understand normal function and disordered processes; (2) model systems to inform research and transform findings into more effective treatments; (3) precision medicine approaches to prevention, diagnosis, and treatment; (4) translation of scientific advances into standard clinical care; (5) biomedical data sharing; and (6) advanced technologies to improve prevention, diagnosis, and treatment [1] (see Fig. 1).

NIDCD encourages cooperation and information sharing among interdisciplinary teams conducting research in these six priority areas. Through these collaborations, basic researchers can better understand how their findings help address challenges and opportunities in clinical practice. In turn, clinicians can use biomedical databases, basic science, and model systems to inform personalized therapies and clinical decision-making. This article outlines just a few examples of how basic research, and the broad dissemination of its findings, can lead to discoveries that improve public health within NIDCD's mission areas.

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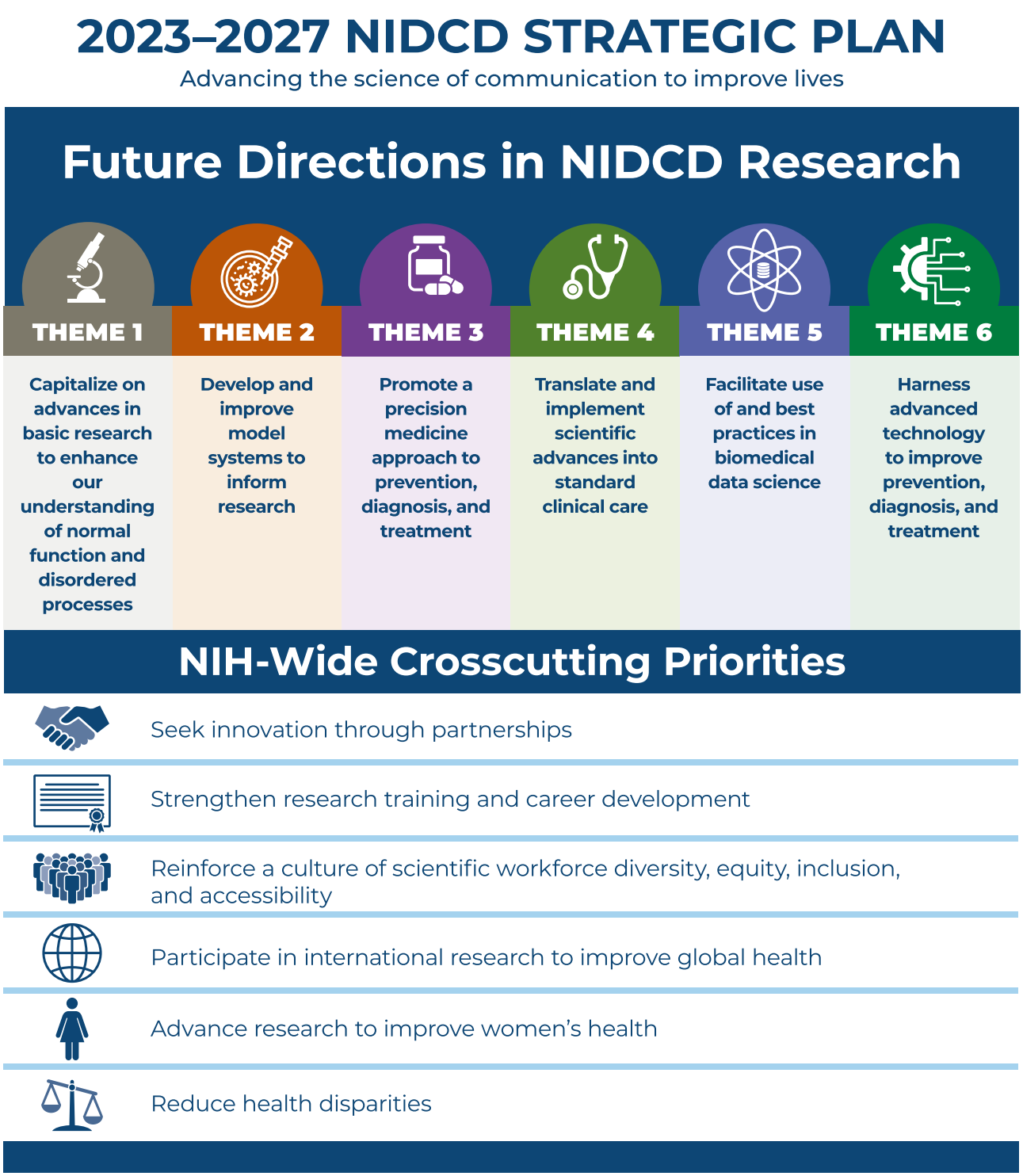

Fig. 1 Scientific priority themes outlined in NIDCD's five-year strategic plan. Investigator-initiated research proposals that address these themes are welcomed

Models of Human Hearing

Rodent and other non-human models have provided valuable insights into normal and disordered conditions that fall within NIDCD's mission areas. For example, the Mongolian gerbil is often used to model the human auditory system because this species demonstrates hearing sensitivity in a range that is important for human communication [2]. The mouse is one of the best models for characterizing the roles of genetic variants responsible for

certain types of hearing loss due to the existence of techniques that allow for extensive and rapid modification of its genome [3]. However, the comparatively shorter lifespan of rodents may limit their utility in exploring some human disease phenotypes such as bilateral progressive hearing loss or adult-onset hearing loss. In addition, some mouse models of deafness genes fail to recapitulate the human hearing loss phenotype due to differences in gene expression between rodents and primates, necessitating the use of non-human primate models such as the common marmoset [4].

Zebrafish are another commonly used model for some aspects of human hearing. Because zebrafish embryos are transparent and develop outside of the mother's body in a compressed time scale, they are ideal for in vivo experimentation [5]. Zebrafish, like all other fish, also have a lateral-line system which contains a series of mechanosensitive structures located along the surface of the animal. These structures include mechanosensitive hair cells which are very similar to the mechanosensitive cells located in the mammalian inner ear. The lateral line's location on the surface of the animal provides significant advantages for study in comparison with the mammalian inner ear, which is encased in the temporal bone of the skull. Researchers can visualize and study the development and function of different cell types in zebrafish embryos in real time using transgenic zebrafish lines in which different cell types or proteins express genetically-linked fluorescent indicators [6–9]. Moreover, through manipulation of the zebrafish genome it is possible to use reverse genetics to observe the phenotype that results from a change to a particular genetic sequence [10].

Cell-based assays, in vitro, and in silico models offer additional ways to accelerate therapeutic development, validation, and clinical translation. Investigators may employ organoids, "organ-on-a-chip," or computer models of biological processes to monitor and interrogate both normal and disordered processes and test potential hearing loss treatments. NIDCD encourages scientists to leverage these in silico and in vitro model systems to study the neurosensory biology of human inner ear cells, understand disorders of the inner ear, screen potential drugs, and possibly develop cell-based therapies.

Genomic Editing: CRISPR-Cas9

The development of CRISPR-Cas9 (clustered regularly interspaced short palindromic repeats associated with Cas9 endonuclease) approaches enable precise editing of a DNA sequence by targeting and cutting both DNA strands at a specific location. Scientists then take advantage of existing DNA repair machinery to introduce changes in the DNA sequence. The CRISPR-Cas9 gene editing tool increased the breadth of useful non-human models by enabling researchers to create even more sophisticated, targeted mutations in zebrafish and other non-mouse models [11, 12]. Researchers have also used the CRISPR-Cas9 technology to edit specific alleles in mouse models of hereditary hearing loss [13, 14]. Because many of these variants have also been described in humans, treatments developed in these basic models could lead to clinical applications for patient populations [13–15].

Biomedical Data Sharing

Improved models and tools produce valuable scientific data that can be uploaded into large, shared biomedical data repositories, thereby accelerating the pace of scientific discoveries. One example is an NIDCD-supported platform for analysis of gene expression data, the gene Expression Analysis Resource (gEAR), a portal that supports upload, visualization, and analysis of multi-omic and single-cell RNA sequencing (scRNA-seq) data. Users may upload public datasets from a range of species, such as humans, rodents, zebrafish, and marmosets, and use private domains to display these results alongside their own to allow for cross-experimental validation and discovery [16]. NIDCD also leverages several NIH-wide data resources that facilitate secure data storage and expanded access to biomedical datasets [17, 18]. Sharing scientific data helps validate research results, enables researchers to combine data types to strengthen analyses, facilitates reuse of hard-to-generate data or data from limited sources, and accelerates ideas for future research inquiries.

Looking Into the Future

NIDCD welcomes investigator-driven applications focused on basic research; improving model systems; or enhancing best practices in biomedical data storage, standardization, and analysis. To support its extramural research community, the NIDCD website offers guidance on how to apply for grants, as well as sample grant applications [19, 20]. The institute uses its talented workforce to aid investigators conducting research in our mission areas. For example, NIDCD program officers interact with grantees to assess research needs and help NIDCD develop notices of funding opportunities to address these needs.

As the pace of scientific discovery quickens, it is increasingly important that NIDCD, and its investigators, stay at the forefront in development and application of new technologies and data sharing platforms. I look forward to working with scientists, health care providers, policymakers, and the public to advance NIDCD's mission to conduct and support

research in the normal and disordered processes of hearing, balance, taste, smell, voice, speech, and language.

Declarations

Conflict of Interest The author declares no competing interests.

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