2022-2027 NIDCD Strategic Plan
Draft Themes and Goals for Public Comment

NIDCD Mission and Vision

NIDCD’s mission is to support research and research training on the normal and disordered processes of hearing, balance, taste, smell, voice, speech, and language. The Institute’s vision is to advance the science of communication to improve lives.

The NIDCD strategic plan’s themes and goals refer to “communication” and “sensory” in relation to all of NIDCD’s seven mission areas: hearing, balance, taste, smell, voice, speech, and language.

Themes and Goals

Theme 1: Capitalize on advances in basic research to enhance our understanding of normal function and disordered processes

Basic research is encompassed in all of NIDCD’s mission areas, and scientific progress requires interdisciplinary approaches to develop new technologies, improve methods of data analysis, and provide insight on fundamental disease pathways. NIDCD encourages basic research collaborations that span the traditional and emerging disciplines of life, physical, engineering, computer, behavioral, and social sciences.

NIDCD seeks to leverage new technologies and recent discoveries to better understand development, normal and disordered function of cells, circuits, tissues, and systems that play important roles in human communication. By defining what is normal in both animal models and humans, we can better understand mechanisms of disease. Increasing our knowledge of the mechanisms of diseases, disorders, and dysfunctions that impair human communication and health can lead to fundamental advances and technological developments for translational and clinical advances to occur.

Goal 1: Identify and characterize different cell populations in both peripheral and central regions

Hearing, balance, taste, and smell depend upon highly specialized cells to detect and process sensory information. Understanding the cell types in sensory organs and the peripheral and central nervous systems is important to gain fundamental knowledge that will allow scientists to develop future treatments. NIDCD encourages investigators to identify and characterize the molecular, cellular, anatomical, and functional properties of cells important for communication, and how normal function can be perturbed in disease.

Goal 2: Identify and characterize neural circuits involved in sensory processing

Cutting-edge technological methods advanced by the NIH Brain Research Through Advancing Innovative Neurotechnologies (BRAIN) Initiative has allowed for the development of high-speed
functional microscopy that enables scientists to image extremely rapid, physiological changes at the single-cell level and across the brain in awake, small animal model systems. NIDCD encourages multidisciplinary and innovative projects to identify and characterize the neural circuits that play a role in sensory processing for communication. Researchers might propose to develop a map of brain circuits involved in specific sensory pathways, examine the neural circuits that underlie multisensory interactions in communication processing, determine the conservation of circuits in a sensory system across species, or identify the changes to circuits when compromised by sensory and communication deficits.

Goal 3: Facilitate the utilization of human postmortem tissue to advance research
On a path towards translating basic research to clinical research, studies using animal models may require validation in human tissue. To provide a critical link from animal studies to the human tissue and eventually to the clinic, NIDCD encourages research to improve current techniques for the processing and use of donated postmortem human temporal bones, brains, and other sensory tissues. Studies of human tissues are limited by the uneven quality of preservation and preparation of postmortem specimens and incomplete patient records or patient disease histories. NIDCD encourages the incorporation of human postmortem tissue studies to complement current work using animal models for normal and disordered communication. In addition, new and/or improved methods are needed for analysis of human postmortem tissue, such as immunohistochemistry and multi-omic analyses, and other emerging techniques. NIDCD also encourages researchers to consider how to best use new imaging techniques and tissue preservation methods to study human postmortem temporal bones, brains, or other sensory tissues with a goal towards improved understanding of human communication disorders.

Goal 4: Define interactions between immune-mediated networks and the influence of inflammation on normal and disordered function
The immune system wards off infection and disease and also responds to injury and repair of damaged tissue. The role of the immune system in communication disorders is not well understood. Filling this knowledge gap is critical for the prevention and treatment of communication dysfunction. It is important to define the immune cell types and signaling mechanisms that contribute to communication function and dysfunction. Immune cells can contribute to both tissue injury and tissue repair, and the signals that mediate these responses are poorly defined in sensory systems. Defining these signals will advance our understanding of normal processes as well as inform the development of therapeutic interventions for communication disorders. NIDCD recognizes the need to better understand the immune system’s roles in these processes to improve our ability to prevent and treat these disorders.

NIDCD encourages new approaches to modulating immune responses to viruses and bacteria that impact sensory and communication function with the goal of promoting tissue repair and regeneration while reducing immune responses that damage sensitive cells, tissues, and organs needed for effective human communication.

Theme 2: Develop and improve model systems to inform research
There continues to be a critical need for the development of relevant model systems to study normal and pathologic conditions in human communications. Thus, the development of new
pre-clinical, *in vivo*, *in vitro*, and *in silico* model systems and the improvement of current models are critical to informing research and developing future clinical translation and treatments.

**Goal 1: Develop robust *in vivo* and pre-clinical models to study normal and disordered function**

NIDCD seeks to support research on *in vivo* models to deepen our understanding of the mechanisms underlying normal and disordered function of the systems involved in human communication. By defining what is normal in animal models and humans, researchers can better understand underlying causes of communication disorders. In addition, optimization of novel therapeutics is usually dependent upon pre-clinical evaluation in animal models or *ex vivo* model systems. Such models can help to inform the decision to advance a therapeutic candidate to clinical testing and can provide valuable data for clinical study design. The development of new pre-clinical models should provide an improved translational toolkit that will better predict the efficacy and safety of new therapeutic strategies for treating communication disorders.

**Goal 2: Develop *in vitro* models to accelerate basic studies and high throughput screening**

*In vitro* models can expedite translation of basic research discoveries into more specific disease models. Cell-based assays and other *in vitro* models allow the characterization of the effects of candidate therapeutics on targeted tissues. NIDCD encourages the continued development of cell-based assays and other *in vitro* models for high-throughput or high-content studies, as well as disease-specific research.

Such models may include new organ system platforms (i.e., “organs on chips”), or bioengineered platforms that can generate 3-dimensional models of the organ systems (i.e., organoids) from human cell sources. These models reproduce critical molecular, anatomical, and physiological features that mediate tissue and organ function allowing efficient monitoring and interrogation of normal and disordered processes. This type of *in vitro* model system can bridge the gap between pre-clinical testing in animals and human clinical trials, thus improving safety and efficacy of new treatments in humans while also potentially reducing the cost and time needed for development of therapies.

**Goal 3: Develop *in silico* (computer) models to enable insights into normal and disordered function**

*In silico* modeling is the use of computers to develop models of biological processes. It combines the advantages of both *in vivo* and *in vitro* experimentation, but without being subject to the ethical considerations and lack of control associated with *in vivo* experiments and without the restrictive parameters associated with *in vitro* experiments. *In silico* models allow the researcher to run multiple, repeated simulations of biological processes while tightly controlling for a number of variables to predict how systems perform and to test the effects of each of the input variables, while still remaining applicable to the whole organism.

The establishment, maintenance, manipulation, and/or characterization of *in silico* models provides the resources and components for future development of new platforms to model pathways and outcomes, including the selection of appropriate *in vivo* and *in vitro* models for an organ system. NIDCD encourages the development and integration of *in silico* models in research project design. In addition, NIDCD encourages research in experimental neuroscience
and in physical, computer, mathematical, and engineering sciences to develop in silico models that are useful for studying normal or disordered functions of communication.

**Theme 3: Promote a precision medicine approach to prevention, diagnosis, and treatment**

Precision medicine is an approach that considers individual differences in genes, environments, and lifestyles in the clinical decision-making process. Historically, clinicians have had to make most recommendations about disease prevention and treatment based on the expected response of an “average” person. This one-size-fits-all approach works well for some individuals and some conditions, but not for many others. A significant goal of precision medicine is to deliver the right drug at the right dose at the right time for each individual patient and to integrate this strategy broadly when developing novel therapies and interventions for clinical care.

A precision medicine approach begins with identification of genes involved in normal and disordered conditions and the description of the phenotypic (observable) effects of these genes. Environmental or lifestyle factors (e.g., carcinogens, excessive noise, acid reflux, or stress) are also considered here since they can contribute to genetic, epigenetic, and phenotypic changes. Advances in precision medicine promote identification of risk factors and biomarkers that would improve diagnostic accuracy and facilitate development of targeted therapies.

NIDCD is committed to partnering with other NIH institutes and other Federal agencies to leverage ongoing initiatives and existing resources to advance precision medicine approaches in sensory and communication science.

**Goal 1: Accelerate the acquisition, accessibility, and ethical use of genetic and phenotypic data**

NIDCD seeks to support research to determine the impact of and interactions between genetic, clinical, environmental and lifestyle factors associated with deafness and communication disorders. Comprehensive datasets generated through efforts such as whole-exome and genomic sequencing, linkage analyses, epigenetic and gene expression profiles, medical records, and lifestyle questionnaires need to be widely accessible to the scientific community while protecting an individual’s privacy and confidentiality. Data holders should consider stewardship, intellectual property, reciprocity, and ethical use of the information.

**Goal 2: Develop genetic and cellular therapies**

NIDCD encourages research that leads to the development of targeted gene delivery vehicles for gene therapy, including viral vectors, nanoparticles, antisense oligonucleotides, and other approaches. In addition, gene repair/correction and site-specific, controlled, sustained molecular therapies for communication disorders are encouraged. This includes development of therapies to prevent loss of sensory function and/or to restore function after loss has occurred. Further, targeted molecular and cellular therapies are needed to improve neuronal function, resist cell damage from internal and external stressors, and enhance cell repair. This goal also encompasses studies designed to elucidate the properties that enable stem cells in the sensory organs and the central and peripheral nervous systems to proliferate and differentiate, advancing not only the treatment of sensory and communication disorders but also other neurological diseases.
Goal 3: Integrate a precision medicine framework into clinical care

Precision medicine approaches for prevention, detection, and treatment of diseases and conditions have immense potential to improve health outcomes for individuals with deafness and communication disorders. Understanding the biological and environmental mechanisms underlying an individual’s health or health outcomes allow clinicians to better predict which treatments will be most effective. NIDCD encourages research that aims to integrate genetic, environmental, and lifestyle data into interventions to improve individual clinical care.

Theme 4: Translate and implement scientific advances into standard clinical care

NIDCD encourages the translation of basic biomedical or behavioral research discoveries into new clinical tools, prostheses, assistive devices, behavioral therapies or interventions, and medications to ameliorate communication disorders. Translational research is facilitated by collaborations and interactions between basic scientists and clinical scientists. These interactions provide the platform for the bidirectional exchange of ideas, stimulate new avenues of research, and accelerate the advancement of basic research findings into the clinic.

NIDCD recognizes that increased dissemination and implementation research are needed to bridge the gap between basic research, the clinic, and policy by building a knowledge base about how health information, effective interventions, and new clinical practices, guidelines and policies are communicated and integrated into public health and health care service use in specific settings. Despite scientific and technological discoveries that have improved the health of the United States population overall, racial and ethnic minorities, persons with disabilities, socioeconomically disadvantaged populations, underserved rural populations, and sexual and gender minorities experience health disparities and continue to bear disproportionate burdens of disease and illness. Improving public health for individuals impacted by conditions and disorders in our mission areas is a priority for NIDCD, and it is critically important that these advances also reduce health disparities.

Goal 1: Accelerate the development of treatments

Significant scientific advances have improved our understanding of the pathophysiology of many communication disorders. In contrast, clinicians struggle to treat patients who have disorders for which the underlying mechanisms are unknown. The NIDCD scientific community is poised to develop better treatment and prevention strategies for many disorders in our mission areas using innovative approaches and leveraging knowledge and new technologies from related fields of research. NIDCD sees great opportunities in the area of vaccine development, repurposing of FDA-approved drugs, bench-to-bedside research, and bedside-to-bench research to prevent and treat communication disorders. NIDCD also encourages research that utilizes the Small Business Innovation Research/Small Business Technology Transfer Program to commercialize novel therapies and devices to treat or prevent communication disorders.

Goal 2: Develop, disseminate, and implement evidence-based practices to improve health-related outcomes

NIDCD aims to support research that will close the gap between basic biomedical and behavioral discovery and population health and health care delivery for deafness and communication
disorders. When developing evidence-based practices, researchers should consider racial, ethnic, and cultural diversity, as well as, gender, socioeconomic, and educational status. Further, NIDCD is interested in dissemination and implementation research to identify and understand barriers to the adoption, adaptation, and integration of evidence-based interventions, tools, and policies.

**Goal 3: Promote health equity and improve access to clinical care**
NIDCD encourages research that advances the understanding or reduces the impact of health disparities and inequities in communication disorders among racial/ethnic minorities and other underrepresented populations. Tackling the complex drivers of health disparities requires strong partnerships among researchers, community representatives, community organizations, health service providers, public health agencies, policymakers, and other stakeholders to ensure that relevant and culturally and contextually appropriate research is conducted and that findings can be translated into sustainable community- and system-level changes that promote health equity. NIDCD encourages innovative clinical and translational research that provides the foundation for improving accessible and affordable health care for individuals with deafness and communication disorders, such as identifying barriers to health care, assessing novel service delivery, screening models for diverse and vulnerable populations, and finding other approaches to improve access to and affordability of health care.

**Theme 5: Facilitate use of best practices in biomedical data science**
In alignment with NIH-wide priorities outlined in the [NIH Strategic Plan for Data Science](https://nihroadmap.nih.gov/roadmapdata/) NIDCD seeks to maximize the value of data generated through NIDCD-funded research by prioritizing efforts to share biomedical and biobehavioral data in ways that encourage ongoing use by the entire scientific community. Since its establishment in 1988, NIDCD-supported research has resulted in vast amounts of data that contribute to biomedical and behavioral research. Widespread access to shared data, along with other advancements in data science, create a unique opportunity to accelerate the discovery of insights that will improve the lives of millions of people with communication disorders.

Shared scientific data accelerate biomedical research discovery and enable validation of research results by independent groups, improve accessibility to large datasets that allow researchers to address high impact questions through secondary analyses, and promote data reuse across research studies. NIDCD encourages the management and sharing of scientific data generated from research between scientists. These data include, but are not limited to, datasets emanating from fundamental research using model organisms, clinical studies, and observational, longitudinal, and population-based epidemiological and statistical studies. The data in the repositories should be standardized and structured in a way that they are usable and interoperable with other repositories, thus allowing for new research that builds upon additional data collected in other significant studies.

**Goal 1: Inform the development and use of standardized outcome measures for basic and clinical research**
The use of standardized outcome measures in basic and clinical research allows for unbiased analysis, interpretation, and reporting of results. Such standardized measures of behavioral and
health outcomes, once developed, will enable basic and clinical researchers to compare results across studies and study populations. These efforts will allow the scientific community to facilitate the translation of research findings into evidence-based practice in health care.

**Goal 2: Encourage the use of data repositories to share findable, accessible, interoperable, and reusable (FAIR) data**

NIDCD encourages researchers to ensure that biomedical data is shared and adheres to FAIR principles - Findability, Accessibility, Interoperability, and Reusability. FAIR data allows reposed datasets to be maintained, queried, and reconfigured to facilitate new analyses, which contributes to a cost-effective and efficient resource for advancing research. NIDCD will continue to partner with the NIH Office of Data Science Strategy to facilitate use of best practices and coordinate activity in this area.

**Goal 3: Develop artificial intelligence and machine learning algorithms that provide novel insights and applications for prevention, diagnosis, and treatment**

There is a tremendous opportunity for data-driven discovery across NIDCD’s mission, including artificial intelligence and machine learning (AI/ML) technologies. AI/ML, which includes deep learning and neural networks, are quickly becoming integrated into many areas of biomedical and clinical research. AI excels at recognizing patterns in large volumes of data, extracting relationships between complex features in the data, and identifying characteristics in data (including images) that were not previously discerned by conventional analytic processes. In ML, computer systems generate new insights and applications from large quantities of data for improved prevention, diagnosis, and treatment of communication disorders.

Using AI/ML to improve the diagnosis, treatment, and management of communication disorders holds immense potential. As new sources of biomedical and health data emerge, the amount of information will continue growing faster than it can be interrogated. AI/ML will be an essential tool for processing, aggregating, and analyzing the vast amounts of information the data hold to drive discovery and improve patient care. Therefore, NIDCD encourages multidisciplinary collaborations among computer or information scientists, engineering, social, behavioral, biomedical, cognitive and/or economic scientists to improve the fundamental understanding of biomedical and health-related processes related to the Institute’s mission.

**Theme 6: Harness advanced technology to improve prevention, diagnosis, and treatment**

Technology has become integral to our lives, and its use is exploding in biomedical research and health care, including across all aspects of communication research. Emerging technology has created critical tools, including instrumentation, methods and software that can be applied to a wide variety of problems in sensory and communication sciences. NIDCD recognizes the immense potential for new technology to lead to more accurate and rapid diagnoses, improved clinical decision-making, and, ultimately, better health outcomes for people with communication disorders.

**Goal 1: Employ rational design principles to engineer novel solutions**

NIDCD encourages projects that use “rational design principles” to engineer therapies that are based on the knowledge of health and disease that continues to emerge from basic research. Our
ever-increasing understanding of complex biological systems, chemistry, and biomedical engineering can be used to conceptualize novel approaches that restore function. New clinical tools, prostheses, assistive devices, medications, or behavioral therapies should be developed as the technology needed to meet these requirements is identified. For example, rational design principles can lead to devices specialized for safe and prolonged drug delivery to the human inner ear, neural prostheses based on optical stimulation, and smart biomaterials that serve as a scaffold to encourage regeneration and repair of tissue.

**Goal 2: Enhance augmentative and alternative communication capabilities**
Advancements in technology have the potential to play an ever-increasing role in augmentative and alternative communication (AAC) devices that assist people who have complex communication needs. Innovations such as brain computer interfaces, which are based on computer translation of changes in brain activity derived from a user’s intent, are examples of the potential these technologies hold for improving communication. Similarly, NIDCD seeks to support novel approaches to AAC integration. NIDCD recognizes AI/ML as tools that can facilitate normal communication and improve accessibility for those with communication disorders. Leveraging existing AI for AAC devices expands the ease with which treatment strategies may be adopted by individuals with communication disorders, families, and caregivers. For children who have hearing loss or speech and language disorders, AAC devices can provide tailored interventions to match the context of the child’s environment and integration into the child’s acquisition of language. In multidisciplinary teams, NIDCD support can leverage expertise in fields, such as neuroscience, engineering, social, and behavioral science to help millions worldwide who cannot rely on their hearing or speech to communicate.

**Goal 3: Develop specialized in vivo imaging capabilities to improve better diagnosis and treatment**
NIDCD has been at the forefront of developing and applying advanced imaging and computational approaches to disorders of human communication. *In vivo* imaging is an essential component in the development of advances in the biology and clinical application of treatments of communication disorders. Systems-wide studies of the molecular and cellular pathways associated with NIDCD-related research areas will require that innovative imaging solutions be developed in a highly multidisciplinary environment. NIDCD encourages research technologies that enable imaging of living human tissue relevant to communication and communication disorders to enable precise diagnosis and the development of new and targeted treatments.

**Workforce Diversity, Equity, and Inclusion**

*(NIDCD is also seeking public comment on our Workforce Diversity, Equity, and Inclusion efforts, which are of significant strategic importance to fulfilling our mission. A section on Workforce Diversity, Equity, and Inclusion will be included in the final version of the 2022-2027 NIDCD Strategic Plan).*

Research studies indicate that diverse teams working together and capitalizing on innovative ideas and distinct perspectives outperform homogeneous teams. NIDCD recognizes the critical need to address barriers that interfere with scientific aspirations of individuals from diverse backgrounds, including women and minorities, and individuals from rural areas and low
socioeconomic status. NIDCD is working to increase the number of individuals from diverse backgrounds in the research pipeline in our scientific mission areas, for both the extramural and intramural programs.

A National Deafness and Other Communication Disorders (NDCD) Advisory Council Working Group on Diversity and Inclusiveness identified challenges faced in the scientific workforce by individuals from sexual and gender minority, minority, and underrepresented groups. In response to the report prepared by the Working Group, NIDCD is focused on assisting potential grantees, mentoring and enhancing the scientific training pipeline, sharing more information, obtaining diverse perspectives, and building a more diverse landscape with regard to both research and research training.

To assist grantees and improve grant-writing skills, the NIDCD website now shares examples of successful grant applications. NIDCD has developed extramural funding opportunities to diversify our training and mentoring pipelines and promote workforce diversity among new investigators. The Institute will continue to explore other mechanisms to encourage growth in workforce diversity. NIDCD is disseminating information by hosting virtual webinars and providing website information focused on special programs to improve the diversity of the extramural research workforce by recruiting and supporting students, post-doctoral trainees, and eligible investigators from diverse backgrounds, including those from groups that have been shown to be underrepresented in health-related research. NIDCD generates a Grantee Newsletter and has ensured the distribution includes Historically Black Colleges and Universities (HBCUs), Minority-Serving Institutions (MSIs), and recent unsuccessful grant applicants. NIDCD staff plan to increase participation at conferences that reach a broader audience of professionals and trainees to share information about application processes and funding opportunities.

To increase dissemination of information about position openings in the NIDCD Division of Intramural Research, an internal Recruitment Strategist, trained by the NIDCD Office of Scientific Workforce Diversity, will participate in all search committees for Tenure-Track or Senior Investigators in NIDCD. An NIDCD intramural recruitment guide, designed to combat bias during the process of advertising, interviewing, and selecting candidates, will continue to be used, and can be used for any position opening in the Institute. Two new programs seek to increase the impact of summer internship opportunities for underrepresented post-baccalaureate and summer interns. The first initiative is an internal recruiting committee that identifies a diverse list of highly-qualified applicants to the central NIH Postbaccalaureate Program for consideration by NIDCD Principal Investigators seeking interns. The second initiative is central funding of all summer internships at the Institute.

NIDCD will continue to explore and implement new and renewed efforts to diversify the scientific workforce. The Institute will recruit a Scientific Diversity Officer who will provide scientific leadership and direction for all diversity requirements and initiatives at NIDCD. NIDCD leadership will identify ways to engage more effectively with underrepresented populations in clinical research in our mission areas and ensure that our own workplace is diverse, respectful, and inclusive. NIDCD recognizes that for the United States to remain a global leader in scientific discovery and innovation, it is dependent upon a pool of highly talented scientists from diverse backgrounds.