NHLBI's Crowd-Sourced Strategic Visioning Plan and Its Importance to Pulmonary, Critical Care and Sleep

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Recently, the National Heart, Lung and Blood Institute (NHLBI) announced its strategic visioning plan, created in large part by crowd-sourced input from the cardio-pulmonary community. This document outlines the major interest areas to the pulmonary, critical care and sleep community.

The NHLBI made a different kind of request to the heart, lung and blood community in 2015, asking for input to set its research priorities. In its request for the input, the NHLBI outlined its objectives with what it called its "Strategic Visioning Plan" and said it would provide guidance for its work in heart, lung and blood research for the next decade. What was different is that the institute didn't just ask for public comment, it launched an online forum to gather ideas and support (or non support) of those ideas in real time.

The NHLBI's online Strategic Visioning Forum collected over 1,234 idea submissions, with more than 42,000 votes for those submissions. They even ranked the "popularity" of the ideas by tracking "leaders" within the forum (the forum idea and leader information is still available at http://nhlbistrategicvisioning.ideascale.com/a/leaderboard?pageOffset=0).

The process included scientists, medical professionals, policymakers, patients, patient advocates, professional and professional groups and allowed the creation of a "living" strategic plan, according to the institute. NHLBI promises it will be a dynamic document and will be refreshed periodically by using timely input from the scientific and patient communities.

The NHLBI Strategic Vision lays out six overall strategic goals and eight objectives with which to achieve them and an initial outcome that includes 132 Research Priorities. Many of the identified research priorities are particularly important to the pulmonary, critical care and sleep community and some were consistent with comments and recommendations the ATS and its Research Advocacy Committee submitted through the forum.

According to NHLBI Director, Gary H. Gibbons, M.D. in his introduction of the strategic vision, "The research priorities in this Strategic Vision will enable us to accelerate our journey toward scientific and health advances over the next decade."

NHLBI's Strategic Vision has a focus on four goals which it calls "mission-driven goals":

- Understand Human Biology
- Reduce Human Disease
- Advance Translational Research
- Develop Workforce & Resources

Eight objectives provide a framework for the strategic research priorities and will serve as the NHLBI's guide for decisions related to exploring research opportunities and making investment decisions.

NHLBI's Eight Strategic Vision Objectives:

Objective1: Understanding normal biological function and resilience

Objective 2: Investigate newly discovered pathobiological mechanisms important to the onset and progression of HLBS diseases

Objective 3: Investigate factors that account for differences in health among populations

Objective 4: Identify factors that account for individual differences in pathobiology and in responses to treatments

Objective 5: Develop and optimize novel diagnostic and therapeutic strategies to prevent, treat, and cure HLBS diseases

Objective 6: Optimize clinical and implementation research to improve health and reduce disease

Objective 7: Leverage emerging opportunities in data science to open new frontiers in HLBS research

Objective 8: Further develop, diversify, and sustain a scientific workforce capable of accomplishing the NHLBI's mission

The ATS has identified the areas of the NHLBI Strategic Vision that are of particular interest in the pulmonary, critical care and sleep community and have pulled them into a graph for ease of review.

To review the entire NHLBI strategic visioning plan, go to:
https://www.nhlbi.nih.gov/sites/www.nhlbi.nih.gov/files/NHLBI-Strategic-Vision-2016_FF.pdf

Key:
Compelling Questions: the most pressing scientific questions
Critical Challenges: research barriers

Objective 1: Understanding normal biological function and resilience

Compelling Questions	Critical Challenges
How are normal cell functions regulated by complex gene networks and cell-to-cell interactions?	Reliable and diverse investigational models—from single cells to animals— that reflect individual variation as well as sex/gender-based differences are needed to reproduce normal functioning of HLBS systems and to reflect the activities of molecular targets in those systems and related diseases
What are the key molecular and structural mechanisms that allow single cells and tissues to sense, integrate, and respond to mechanical cues and influences at local and systemic levels?	Development and application of comprehensive single-cell biology analytics are needed to facilitate an integrated understanding of cellular diversity, cell- cell interactions, and cellular phenomena in HLBS health and disease risk
What are the mechanisms and range of normal physiologic responses to environmental, neuropsychiatric, social, and other stimuli that predict homeostatic resilience or transition to disease across the lifespan?	Advances in methods of and models for assessing and characterizing exposures (e g , environmental, dietary, social) are needed to improve research on normal biologic function and resilience

What innate and adaptive immune system mechanisms promote HLBS health and prevent development of HLBS diseases?	New investigative tools and knowledge of structural and matrix biology are needed to better understand injury, regeneration, and repair of the normal (or developing) heart, lung, and blood tissues and to enable regenerative medicine
How do specific lymphatic immune and non-immune circulatory functions interact with and contribute to HLBS health and resilience?	
What is the influence of the microbiome (including biome and fungome) on the immune system and on HLBS health and resilience, including developmental processes, across the lifespan?	
What are the basic pathways underlying the effects of circadian function, synchronization, and harmonization on HLBS health and resilience across the lifespan?	
Does circadian regulation modify the effects of environmental exposures (eg, cigarette smoke, particulates, pathogens, temperature, humidity) on mechanisms of HLBS function?	
What are the mechanisms that underlie adaptation in HLBS systems in extreme conditions, and how can this knowledge be used to develop novel interventions that optimize health or prevent disease?	
What are the normal molecular and cellular variations in specific regions of the lung, and what controls these variations?	
What “omic” signatures describe the normal vasculome (gene expression patterns in the vascular endothelium) of the different vascular beds and different arteries (elastic vs muscular) that supply HLBS tissues and organs?	

Objective 2: Investigate newly discovered pathobiological mechanisms important to the onset and progression of HLBS diseases

Compelling Questions	Critical Challenges
What are the molecular mechanisms underlying dysregulation of homeostasis, and how do these mechanisms vary from individual to individual, leading to development of HLBS diseases in	Understanding the pathobiologic mechanisms that govern the conversion of chronic HLBS conditions into acute disease is critically needed, specifically identifying biomarkers to predict and therapies to prevent these transitions

some but not in others?	
What are the roles of RNAs (e g , microRNAs, long non-coding RNAs) in HLBS systems' growth, adaptation, and injury-repair responses?	
What biomarkers of acute and chronic environmental exposures (e g , smoking) are predictive of disease onset or progression? What biologic effects measured by these biomarkers are irreversible responses and which are opportunities for intervention?	
How do endogenous stem/progenitor cells and defects in these cells contribute to the onset and progression of chronic HLBS diseases?	
What are the mechanisms whereby congestive heart failure causes lung remodeling and leads, in end-stage disease, to right ventricular failure?	
What is the pathobiology of fibrosis that accounts for its organ specificity (often a affecting the lungs, heart, or bone marrow alone), its progression in the absence of apparent stimuli, and its resistance to drug therapy?	

Objective 3: Investigate factors that account for differences in health among populations

Compelling Questions	Critical Challenges
What community-based effectiveness and implementation research strategies can help address HLBS health inequities?	Sex/gender-specific city is needed in basic, translational, and clinical studies; data analyses; and management guidelines for HLBS conditions
What are the environmental, genetic, and epigenetic factors and molecular, cellular, and systemic mechanisms that determine sex- related differences in HLBS health and disease?	Novel experimental strategies and tools are needed to evaluate the effect of sex differences on HLBS health, resilience, and disease
Do the factors that render individuals or populations subjected to the same exposures (e g , diet, smoking, other environmental and social exposures) resilient or susceptible to disease differ across the lifespan and by sex/ gender?	Advances in methods of and models for assessing and characterizing exposures (e g , diet, smoking, other environmental and social exposures) are needed to understand differences in health among populations

Objective 4: Identify factors that account for individual differences in pathobiology and in responses to treatments

Compelling Questions	Critical Challenges
Which phenotypic, biomarker, and molecular characteristics predict outcome and, when applied in clinical studies, predict differential responses to therapy in individuals and in different populations with HLBS diseases?	Predictive modeling and prevention trials are needed in populations at high risk for highly prevalent HLBS diseases
What factors render individuals or populations subjected to the same exposures (e g , diet, smoking, other environmental and social	

exposures) resilient or susceptible to disease?	
What underlies secondary resilience, such that some people are protected from the complications of HLBS diseases?	
What tests would identify individuals who are at high risk of venous thromboembolic events and would bene t from targeted risk factor modification and/or intensive prophylaxis?	
What are biomarkers of pulmonary hypertension that could better identify individuals at high risk, reveal underlying mechanisms, and guide treatment?	
What are the major determinants of individual and sex differences in breathing patterns in sleep, susceptibility to insomnia, and other sleep behaviors?	

Objective 5: Develop and optimize novel diagnostic and therapeutic strategies to prevent, treat, and cure HLBS diseases

Compelling Questions	Critical Challenges
Would interventions in pregnancy or early childhood designed to modulate immune development result in primary prevention of asthma?	An understanding of the immune system from a systems biology perspective is needed to design more efficacious treatment strategies for chronic inflammatory and autoimmune HLBS diseases
How should the management of diseases that typically develop in childhood (including childhood interstitial lung disease, hemoglobinopathies, congenital heart disease, cystic fibrosis, and asthma) be modified as affected individuals mature into adulthood?	Robust tools and algorithms are needed to evaluate objective biomarkers of sleep health and dysfunction
Would using multidisciplinary teams (e g , nutritionists, exercise physiologists, social workers, psychologists, nurses) be an effective approach to developing, testing, and ultimately applying lifestyle interventions as part of routine patient care in a variety of contexts from community to patient care settings?	
Would circadian-based strategies (e g , sleep, timing of medication, meals) improve the efficacy of treatments for HLBS diseases (e g , hypertension, asthma, thrombosis, obesity/diabetes)?	
How can imaging technology be leveraged to identify clinically useful markers of metabolic syndrome and cardiopulmonary disease?	
Do interventions to improve ventilation during sleep decrease morbidity and mortality in	

individuals with either heart failure (or other diseases associated with chronic hypoxemia) and sleep-disordered breathing?	
How can alterations of stem cell cycles and other therapies, as well as endogenous mechanisms, be harnessed to promote repair and regeneration of the heart, lung, and blood systems?	
How can we better integrate palliative care concepts, such as respect for personal values, goals, and treatment preferences, in the management of patients with HLBS diseases?	

Objective 6: Optimize clinical and implementation research to improve health and reduce disease

Compelling Questions	Critical Challenges
What methods and technologies are effective for increasing aware- ness of and participation in clinical research, as well as awareness of and access to evidence-based diagnostics and therapeutics, including emerging approaches to care?	Synergy and collaboration among people at the MD and PhD level for; basic science; translational, patient-oriented researchers; community and population scientists; and individuals from multiple disciplines (e g , engineers, clinicians, subspecialists, generalists, bioinformatics experts, academics, nonprofit organizations, industry) are needed to enhance and expedite advances in HLBS research
How can we engage relevant stakeholders, including patients, private entities, and federal agencies, to improve the clinical research enterprise and address critical needs such as standardized informed consent and cost containment?	Innovative approaches to private sector collaborations and partnerships are needed early in therapeutic and diagnostic product development to bridge the gap between academic discoveries and product commercialization
	Expanded resources for identifying therapeutic targets and agents, establishing proof of concept, and developing data for investigational new drug applications are needed to enable the early translation of research findings to clinical applications
	Creative approaches to clinical trials in rare HLBS diseases are needed to successfully test strategies that will expand preventive and therapeutic options
	Standardized approaches and resources, including data and biospecimen repositories, should be developed to facilitate collaboration between basic, clinical, and population scientists in clinical trials and population studies
	Creative approaches are needed to effectively transcend silos (e g , perinatal, pediatric, and adult divides in clinical and translational research)

	Multidisciplinary, multinational partnerships are needed to develop effective and sustainable strategies for combating chronic HLBS disorders in developing nations, which take into account the highly variable local epidemiology of HLBS disorders, the need for novel approaches to reducing disease burden, and the challenges of implementation in developing countries

Objective 7: Leverage emerging opportunities in data science to open new frontiers in HLBS research

Compelling Questions	Critical Challenges
How do we encourage training in biostatistics, computer science, and bioinformatics to reach the entire biomedical community in this era of very large data sets?	The development, application, and sharing of robust and multidimensional data-analytical and theoretical methods, mathematical modeling, and computational simulation techniques are needed The development, application, and sharing of robust and multidimensional data-analytical and theoretical methods, mathematical modeling, and computational simulation techniques are needed for understanding fundamental mechanisms of HLBS systems, including gene, protein, and metabolic regulatory networks and the impact of environmental exposures on those networks
	Novel integrative systems biology and analytical approaches are needed to exploit the wealth of knowledge coming from genetics, epigenetics, transcriptomics, metabolomics, proteomics, environmental exposures, electronic health records, and imaging to de ne disease subtypes, predict risks, and identify therapeutic targets
	Novel analytical approaches, coordinated access to data, well-planned sample analyses, and creation of a scientific data commons are needed to leverage existing deeply phenotyped cohorts to accelerate translational research and promote the discovery of key druggable targets and the development of novel and precise treatments for HLBS diseases
	Bold new bioinformatic and biostatistical methods and approaches are needed to improve the analysis of big data
	Creative and innovative methods to integrate and analyze data from population and cohort research are needed to generate hypotheses and to expedite bedside-to-basic “reverse translation ”

	Integration of multidimensional data from a variety of sources (e g , molecular, social, behavioral, environmental exposures, wearable sensor, self-reported data) is needed to develop predictive and actionable models of weight gain, weight loss, and weight loss maintenance and to clarify the role of obesity in the risk, prevention, and treatment of cardiopulmonary and sleep disorders

Objective 8: Further develop, diversify, and sustain a scientific workforce capable of accomplishing the NHLBI's mission

Compelling Questions	Critical Challenges
What kinds of exposures, beginning in early education, would stimulate and maintain students' interest in and understanding of science, particularly students from diverse and disadvantaged backgrounds?	Sufficient numbers of clinical scientists are needed, particularly those interested in pursuing translation of breakthroughs from basic science laboratories into clinical settings
How can we foster diversity among trainees and in the HLBS scientific workforce so that our research community reflects the makeup of the population at large and has ample participation of individuals from disadvantaged and medically underserved communities?	Programs of training, professional development, and mentoring are needed to help create a more diverse cadre of senior leaders in science and medicine
How can clinical research training programs increase cultural competency about diseases or conditions that disproportionately affect underserved populations and attract and retain researchers who better understand the populations affected?	Methods for encouraging medical students to choose research career paths are needed
What are the best strategies to develop a highly competent and diverse scientific workforce—across the spectrum from basic to population science—to address domestic and international health inequities?	Training that emphasizes rigorous scientific methods in the biomedical, behavioral, and social sciences is required to increase reliability and reproducibility of research findings
How do we ensure that HLBS trainees across the career continuum are aware of and prepared for a variety of possible scientific career opportunities (e g , careers in teaching, industry, government)?	Better preparation of scientists for transitions between career stages (e g , the graduate/medical education stage, the postdoctoral/fellowship period, the junior investigator stage) is needed
How do we best develop a scientific workforce that is fluent in product development and commercialization issues, including regulatory, intellectual property, and business issues, in order to bring products for HLBS indications to the market?	There is a need to develop and improve skills to communicate science to the public as well as among scientists of different specialties

How do we attract more students/trainees into traditional research fields (e g , physiology, integrative biology) that are as critical to advancing science as emerging fields (e g , “omics,” big data), but do not have the same cache and are thus on the decline?	Curricula and resources for education of health care workers in evidence- based care are needed
How do we add communication skills to our training programs to improve scientists’ communication with the public? How do we also improve the ability of basic and clinical scientists to understand each other’s scientific language and appreciate the importance of the other’s research questions and findings?	Collection and analysis of education and employment data from HLBS scientists over the course of their careers is needed to de ne metrics and predictors of success at both individual and training-program levels
How can we harness virtual learning technologies (e g , immersive learning simulations, serious games) to address the needs of the modern and future biomedical workforce?	
How can we better incorporate interdisciplinary and team science in our training and career development programs to prepare scientists for collaborative research and for using emerging technologies and resources?	
How can senior scientists be encouraged to mentor young investigators and, in the later stages of their career, to entrust greater responsibility to emerging lab leaders (e g , incrementally turning over their projects to more junior lab members)?	

NHLBI says the strategic vision will be updated regularly to include new input.

Questions about Strategic Visioning or ideas for new Compelling Questions or Critical Challenges may be emailed to NHLBI_Vision@mail.nih.gov (link sends e-mail)
or mailed to:
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