The 12th Annual NIH Pain Consortium Symposium on Advances in Pain Research: Multidisciplinary Strategies for the Management of Pain

WORKSHOP SUMMARY

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The 12th annual NIH Pain Consortium Symposium focused on multidisciplinary strategies for the management of pain. Multimodal treatment using mixed-expertise teams is the next logical step in advancing effective and lasting pain management for individuals. Yet, any steps taken must recognize a societal landscape complicated by two competing demands: i) improving patient outcomes by easing pain and suffering and ii) reducing reliance on opioids. Moving pain science forward through pursuit of medical and non-medical options is paramount to serving the needs of people affected by pain. The overall theme of this year's symposium is recognition and action toward understanding and controlling the many dimensions of pain that form a complex, interactive triad of physical, psychosocial, and environmental (including access) factors.

Recent Progress

Keynote Address: Models of Integrated Pain Care

A prevalent struggle for individuals with pain and their caregivers is that access to quality pain care is elusive. More often than not, pain care across America is not based on the most reliable evidence, it is not team-based, and it is limited to pharmacological treatment offered by a single primary-care practitioner or to procedure-oriented and incentivized specialty care providers. Lack of reimbursement for services, especially those that are non-pharmacological, remains a barrier to providing integrative care. Effective integrated care models should include systematic coordination of medical, psychological, and social aspects of health care. They should incorporate contributions from primary care, mental health care, and specialist services as appropriate. The patient is arguably the most important member of an integrated pain care team. Importantly, integration and coordination of care can occur virtually via care-management strategies and electronic health records. Multimodal pain care invokes comprehensive assessment of physical and psychosocial needs, patient preferences, co-morbidities, and well-designed self-management plans.

Panel Session: Pain Management and Opioids (key messages)

- Chronic pain and substance use disorders (SUDs), both chronic conditions, share many features and desired treatment outcomes. Although people with active SUDs cannot be considered candidates for opioid therapy, those with addictive disease in remission can use opioids appropriately and effectively to treat chronic pain.
- The multiple effects of opioids provide physiological/molecular targets for selectivity in the development of more specific opioid medications. Selectivity can be achieved through various approaches: altering route of administration, restricting access to the periphery, tweaking signaling capabilities of active agents (to distinct pathways), adding agents that potentiate the effects of endogenous opioids, and targeting specific opioid receptor sub-types.
- Barriers to buprenorphine/medication-assisted therapy (MAT) use are diverse and dynamic over time, and include funding, anti-pharmacotherapy attitudes, and buprenorphine-prescribing capacity. Intervention studies are investigating payer and provider roles involving financing, regulation, policy, partnerships, and organizational change.

Panel Session: Moving Toward Multidisciplinary Care (key messages)

- Although many different pain treatments are available – ranging from medications to surgery to physical activity to psychological interventions – on the whole, options have not changed much in centuries. Single- or monotherapies are typically only marginally effective, with a wide range of efficacy between individuals.
- Ideal therapies are multidisciplinary, focus on rehabilitation instead of cure, aim to eliminate or reduce opioid use, emphasize self-management and functional improvements, and incorporate behavioral treatments.
- Comprehensive pain assessments must include multiple domains, including cognitive impairment and dementia.
- People with chronic pain typically experience many co-morbidities that call for complex clinical management. Among these co-conditions are mood disorders, anxiety disorders, post-traumatic stress disorder (PTSD), sleep disorders, personality disorders, and various secondary medical conditions.

Stakeholder Involvement

Pain research and policy progresses most effectively with robust and diverse input and involvement from stakeholders, including societies with multidisciplinary membership and patients. The American Pain Society aims to increase the understanding of pain and transform public policy and clinical practice to reduce pain-related suffering. Its primary goal is to promote pain science in the United States thro/ugh research, advocacy, treatment, and education. People living with pain face many hurdles in finding adequate and lasting relief. Some of these obstacles include research funding, an inadequately trained clinical workforce, stigma, and a health system model that promotes single-treatment, fee-for-service care over multimodal approaches delivered over time. Patients can advance pain research and policy through advocacy work in local and regional government settings.

Panel Session: Preventing Chronic Pain Through Multidisciplinary Approaches (key messages)

- The progression of pain from acute to chronic and then to disability provides multiple opportunities for intervention and prevention; although to date, most focus has been on tertiary prevention of disability in people with chronic pain.
- A new transdisciplinary model of psychologically informed physical therapy adds motivational interviewing, cognitive behavioral and mindfulness approaches, and relaxation strategies to physical and postural approaches. Results have been promising but require clinical validation.

- Endogenous pain modulation is a promising target for multimodal prevention of chronic pain; however, evidence-based tools are not yet available for widespread clinical use.
- Future multidisciplinary approaches should also consider modifiable interactions between susceptibility and exposure, including modification of pain-catastrophizing behavior that can lead to poor outcomes.
- Clinical trials of pediatric headache, and other studies, reveal a high placebo-response rate, suggesting that mimicking the placebo effect will have therapeutic benefit.
- Effective self-management is always a goal of pain care but it is frustrated by several factors, including dissonance with the U.S. biomedical model, inadequate provider time to "train" patients, lack of reimbursement, healthcare reform and regulation by health plans, tedious electronic health record charting, and inadequate training of health professionals.

Workshop Summary

Introduction

Walter Koroshetz, M.D., Director, National Institute of Neurological Disorders and Stroke (NINDS)

Dr. Koroshetz thanked the Pain Consortium Executive Committee, the NINDS Office of Pain Policy, speakers, and attendees, and welcomed all to the 12th annual symposium of the Pain Consortium, whose mission is "To enhance pain research and promote collaboration among researchers across the NIH Institutes and Centers that have programs and activities addressing pain." The Federal Pain Research Strategy (FPRS) works to identify and prioritize research recommendations as a basis for a long-term strategic plan to coordinate and advance the federal research agenda for pain. Directly following the Pain Consortium meeting on June 1, 2017, the FPRS hosted a public forum for presentation and discussion of the Draft Federal Pain Research Strategy.

This year's symposium focus is on multidisciplinary strategies for the management of pain, confronted by a societal landscape of related demands: i) improving patient outcomes by easing pain and suffering and ii) reducing reliance on opioids. Moving pain science forward through pursuit of medical and non-medical options is paramount to serving the needs of people affected by pain. Countering the companion public health epidemic that has surged through prescription opioids, heroin, and fentanyl, HHS has developed a 5-pillar opioid strategy, addressing public health surveillance, research, availability and distribution of overdose-reversing drugs, the practice of pain management, and access to treatment and recovery services.

Selected 2016 science advances

1. Non-opioid pain mechanisms

- PD-L1 inhibits acute and chronic pain by suppressing nociceptive neuron activity via PD-1. This report demonstrates that both melanoma and normal neural tissues (including the dorsal root ganglion, DRG) produce the cancer target PD-L1 and that PD-L1 potently inhibits acute and chronic pain.
- The indirect pathway of the nucleus accumbens (NAc) shell amplifies neuropathic pain. This study reveals a new role for NAc medial shell indirect pathway spiny projection neurons (iSPNs) in a rodent neuropathic pain model. Injury-induced excitement of these cells showed that they modulated central pain but also contributed to gated activity in ascending nociceptive pathways.
- Injured sensory neuron-derived CSF1 induces microglial proliferation and DAP12-dependent pain. This study shows that peripheral nerve injury increased levels of colony-stimulating factor 1 (CSF1) in affected sensory neurons and activated microglia through the microglial membrane adapter protein DAP12.
- Selective spider toxins reveal a role for the Nav1 channel in mechanical pain. This study implicates spider-toxin activated $Na_v1.1$ channels in regulating the excitability of sensory neurons in mechanical pain.

2. Risk factors and causes

- Early life stress elicits visceral hyperalgesia and functional reorganization of pain circuits in adult rats. This study evaluated the impact of early-life stress (in rats), identifying increased abdominal

(visceral) pain sensitivity via alteration of the thalamo-cortico-amygdala pathway and emotional-arousal network. Some brain changes were different in males and females.

- Identification of clusters of individuals relevant to temporomandibular disorders and other chronic pain conditions: the OPPERA study. This study grouped clusters of individuals according to a comprehensive array of biopsychosocial measures. The results extend classification of temporomandibular pain disorders beyond anatomy to include etiological information.

3. Tools and instruments

- Coupled Activation of Primary Sensory Neurons Contributes to Chronic Pain. This study describes a novel imaging technique that monitors populations of DRG neurons in vivo. The results demonstrate injury-induced upregulation of glial gap junctions surrounding DRG neurons, unveiling a new form of neuronal plasticity in the DRG that leads to pain hypersensitivity.

4. Basic-to-clinical discoveries

- Structure-based discovery of opioid analgesics with reduced side effects. This computational structural-biological study identified a novel opioid protein, PZM21, that is selective for opioid analgesia without affecting respiratory depression and dependence.

5. Surveillance and human trials

- Two-Year Follow-up of a Randomized Clinical Trial of Mindfulness-Based Stress Reduction vs Cognitive Behavioral Therapy or Usual Care for Chronic Low Back Pain. This study reports a modest benefit from cognitive behavioral therapy for chronic low back pain, but no statistically significant effects from mindfulness stress reduction treatment over the same time period.

6. Disparities

- Sociodemographic disparities in chronic pain, based on 12-year longitudinal data. This study used national data from the Health and Retirement Study to describe long-term pain disparities among older (age 51+) American adults. The findings reveal a high prevalence of chronic pain and significant pain disparities by sex, education, and wealth.
- Racial bias in pain assessment and treatment recommendations, and false beliefs about biological differences between blacks and whites. This study provides evidence for bias among white laypeople and medical students/residents about biological differences between blacks and whites. Such racial bias in pain perception is associated with racial bias in pain treatment recommendations.

Panel Session: Pain Management and Opioids

Moderator: David Thomas, Ph.D., National Institute on Drug Abuse (NIDA)

Overview: Complex pain management with addiction

Peggy Compton, R.N., Ph.D., University of Pennsylvania School of Nursing

According to nationwide data from the Centers for Disease Control and Prevention (CDC), 40 people die daily from prescription-opioid overdoses, and half of all opioid overdose deaths involve a prescribed opioid. Nonetheless, substance use disorder (SUD) is very prevalent; 8% of Americans meet SUD diagnostic criteria, creating enormous economic burdens – nearly $80 billion in 2013. On the whole, demographic data show that prescribed-opioid abusers are unlikely to be people with complex chronic pain, and incidence data is highly variable, ranging from 2% to 26% in primary-care settings or pain

clinics. Yet, chronic pain and SUD, both chronic conditions, share many features and desired treatment outcomes. Each has known risk factors, a predictable course, and treatments of known efficacy; and each feature remissions and exacerbations. In people with chronic pain, SUD risk factors include personal history of drug misuse or addiction, family history of addiction, younger age, psychiatric illness, early drug or alcohol misuse (<13 years), and childhood trauma (physical, sexual, emotional). Roughly half of people with opioid-use disorder are on medication-assisted treatment (MAT), and have high rates of mental illness. Screening tools for elevated pain sensitivity in chronic pain patients at risk for opioid misuse include the Screener and Opioid Assessment for Patients in Pain (SOAPP) and pain ratings for punctuate mechanical stimuli; as well, some genetic risk components have been identified in mouse studies. Information is beginning to accumulate on the effectiveness of prescription-drug monitoring plans (PDMPs); to date, however, efficacy appears limited.

Although people with active SUD cannot be considered candidates for opioid therapy, those with addictive disease in remission can use opioids appropriately and effectively to treat chronic pain. However, in such cases, treatment plans should be opioid-sparing and include risk-mitigation strategies and relapse-prevention components. Detailed opioid-treatment plans are also useful; such plans include provider information, safe usage and storage instructions, and contingency plans for relapse. Violation of such treatment agreements can be tracked through various means: COMM™ (Current Opioid Misuse Measure), PDUQ (Prescription Drug Use Questionnaire) and self-report version PDUQ-p, ABC (Addiction Behaviors Checklist), PMQ (Pain Medicine Questionnaire), and the POAC (Prescription Opioid Abuse Checklist). Medication misuse does not often imply addiction; studies show that only one-third of those discharged from pain treatment had misused/abused opioids, but more research is needed to assess the role of opioids in chronic pain management. A primary goal in opioid treatment of complex pain with addiction is determination of relapse risk. Contributing factors include absence of family support, lack of 12-step involvement, recent history of polysubstance abuse, previous history of chronic opioid therapy, and failure in improvement of pain symptoms. The unfortunate consequence of relapse nonetheless offers opportunities for intervention to support recovery efforts – including monitoring substance use and mental health. Issues for future research include understanding the role of opioid antagonists in managing chronic pain, acute pain treatment in drug-free environments, and further exploration of multimodal therapy.

Opioid Pharmacology and Safer Drug Development

Gavril Pasternak, M.D., Ph.D., Memorial Sloan-Kettering Cancer Center

Opioids can be very helpful in managing pain, but they are not ubiquitously useful and present complications in certain individuals and treatment settings. Opioids exert multiple effects through a number of physiological and molecular targets which can be utilized for selectivity in the development of more specific opioid medications. Selectivity can be achieved through various approaches: altering route of administration, restricting access to the periphery, tweaking signaling capabilities of active agents (to distinct pathways), adding agents that potentiate the effects of endogenous opioids, and targeting specific opioid receptor subtypes.

In particular, μ-opioid receptor-targeted medications would be ideal analgesics if their analgesic effects could be separated from other side effects. Recent studies of the μ-opioid receptor provide information about its three-dimensional structure, as well as pharmacological and signaling effects of splicing variants of the μ-opioid receptor gene *Oprm1*: full-length 7-transmembrane (7TM) variants, truncated 6TM variants, and truncated 1TM variants. Knockout-mouse studies demonstrate that variants have

distinct responses to opioid agonists and antagonists. Research has also shown that truncated G protein-coupled μ-opioid receptor MOR-1 splice variants are targets for highly potent opioid analgesics that do not have significant side effects. Other research has demonstrated that a synthetic compound, iodobenzoylnaltrexamide (IBNtxA), which targets 6-TM splice variants of the μ-opioid receptor gene, is a strong analgesic for acute, thermal pain without exerting side effects. The results suggest value in developing other 6-TM-acting analogs as novel treatments for pain.

Implementation of Addiction Programs: Challenges for Pain Management

Todd Molfenter, Ph.D., University of Wisconsin, Madison

The Center for Health Enhancement System Studies (CHESS), in concert with the University of Wisconsin, Madison, Department of Engineering is conducting implementation science at eight sites on the role of buprenorphine/MAT in pain management. The studies are evaluating the relative roles of clinician training, payer policy, and organizational changes on implementation and dissemination of an evidence-based practice: buprenorphine/MAT use.

Barriers to buprenorphine/MAT use are diverse and dynamic over time, and include adequate funds, anti-pharmacotherapy attitudes and buprenorphine-prescribing capacity. Intervention studies are investigating payer roles (financing, purchasing; regulatory and policy; operations management) and provider roles (partnering with payer, the NIATx organizational change model) over time for efficacy and sustainability. The NIATx model incorporates several features: executive leadership, a "change leader," customer focus, obtaining ideas from outside the organization, and pilot tests. Results have been promising, with significant increases in buprenorphine/MAT use with the NIATx treatment paradigm.

Another study under way is testing the influence on buprenorphine-prescribing capacity using a physician-recruiting bundle, which includes candidate-identification strategies, physician-educational forums, establishing connections with medical schools, flexible physician work scheduling, physician decision-making tools, and telemedicine. Test sites include federally-qualified health centers (FQHCs) and community-based SUD providers in Florida, Ohio, and Wisconsin.

Mitchell Max Junior Investigator Presentations

The NIH Pain Consortium Mitchell Max Award for Research Excellence honors Mitchell Max, M.D. (1949-2008) for his lifetime contribution to pain research and is awarded annually to the best poster presentation at the NIH Pain Consortium Symposium. 2017 Pain Consortium organizers reviewed and scored poster abstracts submitted for the PC Symposium poster session and three finalists were chosen. Each finalist presented their research at the May 31-June 1, 2017 Pain Consortium meeting.

CCR2 Mediates Mechanical and Cold Sensitivity in Chronic Sickle Cell Disease Pain

Katelyn Sadler, Ph.D., Medical College of Wisconsin, Milwaukee

Sickle cell disease (SCD) is a genetic blood disorder affecting approximately 100,000 Americans of African and Hispanic heritage. SCD developed evolutionarily as a protective mechanism against malaria transmission. To counter dehydration, stress, or low-oxygen saturation, SCD red blood cells form a sickle-like shape; these sickled cells adhere to endothelial cells and block blood flow in the microcirculation. Resultant vasoocclusive crises are very painful and often result in hospitalization, where opioid regimens are a mainstay treatment. More than 40% of SCD patients also develop chronic pain that persists with age. The specific mechanisms underlying the chronic phase of SCD are unknown

but likely involve dysregulation in the peripheral nervous system, altered synaptic circuitry and activity in the central nervous system, opioid-induced hyperalgesia from long-term opioid use, persistent, sub-crises level vasoocclusive events, and increased inflammatory tone.

One target for investigating inflammation in chronic SCD is the pro-inflammatory chemokine CCL2, which has been reported to be elevated in SCD patient serum during a vasoocclusive crisis and during inter-crisis periods. The Berkeley (Berk) mouse, which does not express hemoglobin, models this situation and has constitutively elevated CCL2 levels. CCR2 and CCR4 are receptors for the CCL2 ligand. Using the cold plantar assay, this study determined that CCR2 could block cold-behavioral sensitivity, but not sensory-neuron cold sensitivity, in mice. Previous reports showed that the TRPV1 receptor (capsaicin is the ligand) contributes to behavioral mechanical hypersensitivity in SCD mice. This study also revealed that CCR2 mediated TRPV1 neuronal sensitization, implying that TRPV1's signaling effects are upstream of the CCL2-CCR2 interaction. Collectively, these results suggest that peripheral inflammatory mediators contribute to chronic SCD sensitivity.

MRGB2 Contributes to Mechanical and Thermal Allodynia in Animal Models of Inflammatory and Neuropathic Pain

Dustin Green, Ph.D., Johns Hopkins University

Mast cells are immune cells activated by immunoglobulin (Ig)E antibodies. Located at tissue-environment interfaces, they provoke withdrawal from intense, noxious environmental stimuli. In chronic pain disorders, the proximity of mast cells to nerves enables immune-neuronal cross-talk that includes the mas-related G-protein-coupled receptor B2 (Mrgprb2), which mediates non-allergenic activation of mast cells. Mast cells appear to be involved in the pain response, exuding molecules such as substance P and nerve growth factor (NGF).

This study, employing a Mrgprb2 knockout mouse and the CCI neuropathic pain model, shows that mast cells contribute to mechanical and thermal hypersensitivity. Ongoing analysis is investigating the role of Protease-activated receptor 2 (PAR-2) as a downstream mediator of Mrgb2 in the pain response.

Variation in MC1R Gene Predicts Dental Pain Sensitivity*

Cameron Randall, West Virginia University/University of Washington

Consequences of orofacial pain include generalized distress, poor sleep, disability, lost productivity, and/or poor quality of life. Such pain tends to be chronic and can affect both oral health behavior and dental treatment-seeking behavior. Fear can drive delay in treatment-seeking behavior, which can have deleterious consequences since oral health problems worsen over time. Previous reports have suggested a mechanistic underpinning for dental-care related fear. Melanocortinergic signaling, involving the protein MC1R, is known to be important in pain and anxiety. MC1R is one of the key proteins involved in regulating mammalian pigmentation, and MC1R genetic variation is common in people with red hair. MCR1 variation has also been linked to acute pain perception; reduced efficacy of general and local anesthesia; and fear of pain, dental care-related fear, and dental treatment avoidance. This study (N = 96) concluded that MC1R variation predicted dental-pain sensitivity. Methods included psychosocial assessment, genotyping, and an electric-pulp tester (a novel dental-pain sensitivity assessment), which measured pain tolerance and threshold for six teeth and assessed subjective pain and fear.

*Cameron Randall was selected as recipient of the 2017 Mitchell Max Award for Research Excellence. He is a doctoral candidate at West Virginia University, currently completing his final year of training in clinical psychology as a resident in behavioral medicine and neuropsychology at the University of Washington School of Medicine. His research interests include psychological processes involved in pain perception, treatment-seeking behavior, health behavior, and health outcomes; the etiology and treatment of health care –related fear and anxiety; and dissemination of knowledge on these topics to health care professionals. His research program has applied these interests to dentistry: in particular, the role of genetics in dental pain perception, dental-care-related fear and treatment avoidance, and methodologies for experimental assessment of dental pain.

NCCIH Pain Initiatives

Josephine Briggs, M.D., Director, National Center for Complementary and Integrative Health (NCCIH)

Although pharmacological interventions are likely to remain a mainstay of pain treatment, many alternative mechanisms exist and have been shown to provide relief: one example is the use of tai chi for fibromyalgia. Dr. Briggs stated that 40% of the NCCIH budget funds pain research, much of it related to non-pharmacological approaches to treatment.

Recommendation 2 of the recently issued guidelines for the treatment of chronic low back pain states that: " …Clinicians and patients should initially select non-pharmacologic treatment with exercise, multidisciplinary rehabilitation, acupuncture, mindfulness-based stress reduction, tai chi, yoga, motor control exercise, progressive relaxation, electromyography biofeedback, low-level laser therapy, operant therapy, cognitive behavioral therapy, or spinal manipulation." However, despite this recommendation being labeled as "strong," its supporting evidence has been labeled "low-quality." Thus, a challenge exists to build a strong evidence base for all pain treatments, both pharmacological and not.

NCCIH also supports an intramural research program led by Dr. Catherine Bushnell. To address pain management in military and veteran populations, NCCIH is co-leading the NIH-DoD-VA Pain Management Collaboratory, with involvement of several NIH Institutes and Centers, the Department of Defense, and the Veteran's Administration (VA). This effort, modeled after the NIH Collaboratory, aims to develop the capacity to implement cost-effective large-scale clinical research in military and veteran health care delivery organizations focusing on non-pharmacological approaches to pain management and other co-morbid conditions.

Keynote Address: Models of Integrated Pain Care

Robert Kerns, Ph.D., Yale University

As defined by the Institute of Medicine's (IOM's) landmark 2011 report "Relieving Pain in America," pain is a biopsychosocial condition that often requires integrated, patient-centered, evidence-based, multimodal, and interdisciplinary care. Addressing the issue of pain thus requires assessment methods, self-management approaches, patient-centered care, and collaboration between many providers involved with an individual's pain care. Challenges are many, including barriers to care access, persistent health disparities, and stigma. The National Pain Strategy, released by the Office of the Assistant Secretary for Health in 2016, offers a roadmap for implementing principles outlined in the IOM report.

However, a key struggle for individuals with pain and their caregivers is that access to quality pain care remains elusive. More often than not, pain care across America is not based on the best evidence, it is not team-based, and it is limited to pharmacological treatment offered by one primary-care practitioner or to procedure-oriented and incentivized specialty care practitioners. Lack of reimbursement for services, especially those that are non-pharmacological, remains a barrier to progress in providing integrative care. Integrated care models should include systematic coordination of medical, psychological, and social aspects of health care. They should incorporate contributions from primary care, mental health care, and specialist services as appropriate; yet, the patient is arguably the most important member of the integrated pain care team. Importantly, integration and coordination of care can occur virtually via care-management strategies and use of electronic health records. Multimodal pain care invokes comprehensive assessment of physical and psychosocial needs, patient preferences, co-morbidities, and well-designed self-management plans.

Estimates suggest that 50-75% of U.S. military veterans experience persistent pain, and that pain is reported to be more severe in veterans than that reported by non-veterans. Moreover, a majority of veterans simultaneously experience chronic pain, post-traumatic stress disorder, and traumatic brain injury. Absent any systematic reviews on pain-care delivery, the VA recently produced an interim summary of an evidence brief on the effectiveness of models used to deliver multi-modal care for chronic musculoskeletal pain. The evidence review is evaluating models using system-based mechanisms to increase uptake and organization of multimodal pain care, focusing on adults with chronic musculoskeletal pain, and analyzing interventions integrated with primary care. Four existing models provided the highest quality of evidence for care that combined decision support with case management. Two of these models include SEACAP (a collaborative intervention to improve chronic pain-related outcomes, including comorbid depression severity, in a VA primary-care setting) and SCAMP (a combined pharmacological and behavioral intervention to improve both depression and pain in patients with musculoskeletal pain and co-morbid depression in VA clinics).

The VA's approach to stepped care involves i) pain self-management; ii) a patient-aligned care team in primary care; iii) secondary consultation; and iv) tertiary, interdisciplinary pain centers. A 2014 survey that assessed implementation of the Stepped Care Model of Pain Management reported 100% compliance agency-wide with approximately 70% of sites having at least partially implemented plan components. The 4-year Project STEP conducted a mixed-methods formative evaluation of the VA stepped-care program, examining changes in group and organizational processes, pain management, and organizational outcomes. Identified barriers included inadequate training, organizational impediments, clinical frustration, skepticism among primary-care providers, care-sharing, antagonistic aspects of provider-patient interactions, and time. On the contrary, several positive features were noted. These included intellectual satisfaction of solving difficult diagnostic and management problems, an ability to develop keener communication skills, rewards of healing and building therapeutic alliances with patients, and practicing multidisciplinary care. Of note, participating nurses expressed an interest in working at the higher end of their competencies and appreciated more involvement than typical for this provider population. Following up with past VA studies is the Triple Aim QUERI study to optimize health outcomes across the VA system. Its objective is to develop measures of multimodal chronic pain care quality by learning from high-performing sites. Expected deliverables include a summary of multimodal pain-care metrics, maps of variation in multimodal chronic pain care, and site-level summaries of multimodal chronic pain care.

Panel Session: Moving Toward Multidisciplinary Care

Moderator: Wen Chen, Ph.D., NCCIH

Interdisciplinary Pain Rehabilitation – When Pills, Potions, and Procedures are Inadequate

Dennis Turk, Ph.D., University of Washington

Although many different pain treatments are available – ranging from medications to surgery to physical activity to psychological interventions – on the whole, options have not changed much in centuries. Single- or monotherapies are typically only marginally effective, with a wide range of efficacy between individuals. Generally speaking, evidence is sorely lacking for pain therapy: an assessment of 1,016 Cochrane review articles revealed that 44% of pain treatment interventions are beneficial, 7% are harmful, and 49% are inconclusive as to benefit or harm. It is likely that pain treatment failures stem from an outdated biomedical perspective of chronic pain, with overreliance on injury-based pathology, structural causes and mechanical solutions, provider-only decision-making, and symptom-driven therapy. Emblematic of lack of a thorough understanding of cause and effect in pain management, technical successes (e.g. surgical precision) may nonetheless coincide with clinical failure, with unacceptable, persistent levels of ongoing pain and disability. Another concept that may be missed when considering efficacy of individual people and monotherapies is that treatments may have distinct effects: thus, looking at average measures may obscure bi- (or more) modal responses.

Multi/interdisciplinary pain rehabilitation programs (IPRPs) present one possibility, although the research literature demonstrates mixed results for the effectiveness of IPRPs. These programs share several features: They are multidisciplinary, focus on rehabilitation instead of cure, aim to eliminate or reduce opioid use, emphasize self-management and functional improvements, and incorporate behavioral treatments. A main focus is on functionality: a person's disability does not need to prevent him or her from living a full life. Maintenance enhancement of benefits requires commitment, a focus on the positive, and a general strategy to convert demanding controlled-processing behaviors (e.g., cooking) to routine automatic-processing behaviors (e.g., putting on a seatbelt in the car). Psychological features such as resilience are critical, and these can be learned.

Multidisciplinary Pain Management in Complex Older Adults

Barbara Rakel, R.N., Ph.D., F.A.A.N., University of Iowa College of Nursing

Many challenges frustrate pain management in older adults. These include physiological issues (pharmacokinetic changes/polypharmacy, co-morbidities, physical frailty/inactivity, cognitive deficits/dementia), psychological issues (attitudes to pain/fear, catastrophizing behavior, anxiety, depression/hopelessness/pessimism), and health care issues such as access to care. Due to co-morbidities, older adults may have several different types of pain. Such realities point to the need for comprehensive pain assessments that address multiple domains, including cognitive impairment and dementia. To achieve the goal of optimal pain relief, patients and providers must balance safety, efficacy, and quality of life with risk, tolerability, and patient characteristics/preferences. Non-pharmacologic therapies remain underused.

What works? Regression analyses have identified predictors of poor post-operative outcomes after joint (knee) replacement. These include depression, anxiety, and pre-surgery resting pain. A 1-day behavioral intervention called Acceptance and Commitment Therapy (ACT) aims to enhance psychological flexibility

and is showing promise in individuals with migraines and total-knee arthroplasty. In a study of older adults with chronic neck pain, a group-based multidisciplinary rehabilitation program had beneficial outcomes on disability, pain, and quality of life, and the effects persisted for one year. Transcutaneous electrical nerve stimulation (TENS), a nonpharmacological intervention that activates a complex neuronal network to reduce pain by activating central descending inhibitory systems, has seen mixed results in older populations. However, variability may be due to a range of factors that include timing, patient criteria, opioid use, frequency, and others.

Managing Pain and Co-occurring Conditions

Martin Cheatle, Ph.D., University of Pennsylvania

People with chronic pain typically experience many co-morbidities. Among these are mood disorders, anxiety disorders, PTSD, sleep disorders, personality disorders, and various secondary medical conditions. Abundant data also shows a high prevalence of suicidal intention (and suicide success) in people with chronic pain: SUD is often intertwined. Endogenous mechanisms may also interfere with pain control. Fibromyalgia has been associated with dysfunction of the descending pain modulatory network, elevated opioid activity, an underactive serotonergic/noradrenergic system, and individual pharmacogenetic variation. Thus, selection of an appropriate anti-depressant for people with pain is especially important and may require substantial trial-and-error.

Research shows that up to 70-80% of people with chronic pain conditions complain of sleep disturbances, with companion effects on mood and disability. It is not clear which comes first, since insomnia can lead to poor health outcomes and pain impedes sleep. Pharmacological treatment approaches include medications (benzodiazepines, non-benzodiazepine receptor agonists, melatonin receptor agonists, sedating antidepressants, atypical antipsychotics, and antiepileptic medications). All of these have side effects and most can exert adverse consequences if mixed with alcohol and/or opioids. Several non-pharmacological treatments, though less thoroughly studied, may be used. These include acupuncture, neurofeedback/biofeedback, physical therapy, massage, 12-step programs, dietary supplements, manipulation, mindfulness, and yoga. Cognitive behavioral therapy has been fairly well-studied with documented effects on arthritis, SCD, chronic low back pain, temporomandibular disorder, lupus, and pain in breast cancer patients. Research has also shown that cognitive behavioral therapy used to reduce catastrophizing thoughts helped to normalize pain-related brain responses. Cognitive behavioral therapy specialized for insomnia (CBT-I) includes education about sleep and insomnia, stimulus control, sleep restriction, sleep hygiene, relaxation training, and cognitive restructuring. In one study, patients who received CBT-I had significantly improved sleep, and the benefits persisted even 6 months after treatment ended, despite the persistence of moderate to severe pain.

Update from the American Pain Society

David Williams, Ph.D., University of Michigan, President of the American Pain Society (APS)

The APS is a multidisciplinary community of scientists, clinicians, and other professionals (journalists, attorneys, others) that aims to increase the knowledge of pain and transform public policy and clinical practice to reduce pain-related suffering. Its primary goal is to promote pain science in the United States through research, advocacy, treatment, and education.

APS hosts several meetings to achieve its goals. The annual scientific meeting is unusual in its focus on investigators presenting original, unpublished work. The APS Conference on Analgesic Trials assembles expert panelists from regulatory bodies, industry, and academia to discuss the reliability and accuracy of analgesic clinical trials. In its 16th consecutive year, the "Fundamentals of Translational Pain Medicine: Integrating Science into Clinical Care" conference provides a foundation for early-career pain scientists and clinicians with a translational focus. As such, it aims to foster new levels of multidisciplinary integration in pain care and treatment. The "A Balanced Approach to Pain Management" conference held May 20, 2017 invited a wide swath of stakeholders to gather and interact: attendees included people with pain, providers, medical students, and others. "Pain Primary Care," to be held in November 2017, aims to connect primary-care physicians with evidence-based findings and to learn about practice challenges in the field. Finally, APS early-career scientist forums aim to help young pain researchers navigate research, funding, and policy with a faculty-mentoring event, mock study sections, an NIH grant workshop, and a scientific "sounding board" for the free exchange of ideas on research. Save the date for the upcoming "Scientific Summit: Understanding Pain Mechanisms" to be held in March 2018 in Anaheim, CA.

APS publishes in the *Journal of Pain* periodic clinical guidelines for pain treatment and co-sponsors efforts of the National Pain Strategy. APS grant programs support research and scientific travel for early-stage investigators: The Future Leaders in Pain Research program (in collaboration with the Mayday Fund) has awarded 82 NIH grants totaling $58.5 million since 2005. In addition to also co-supporting the Future Research Leaders grant program, since 2009 the Rita Allen Foundation has funded two $50,000 grants annually for a period of up to 3 years. In April 2016, to facilitate implementation of the National Pain Strategy, APS and Pfizer teamed up to announce the Independent Grants for Learning & Change: three awards were funded in May 2017 (Weill Cornell Medicine, the University of Iowa, and Seattle Children's Hospital).

Finally, through advocacy APS aims to influence the evolution of public and private regulations, policies, and practices to support the development of optimal research, education, and interdisciplinary treatment of pain for all people.

A Patient's Perspective

Cindy Steinberg, National Director of Policy and Advocacy for the U.S. Pain Foundation and Policy Council Chair for the Massachusetts Pain Initiative

Ms. Steinberg is a person living with chronic pain, which began several years ago when she sustained a severe crush injury at work that disabled her thoracic spine permanently. Since that time, she experiences daily pain, and it took 5 years to find a provider who was willing and able to work collaboratively with her on easing her pain. Surgery was not an option, so she has navigated the world of pain care for years as she also acts as a patient advocate for others in similar situations. A first step was assembling an informal support group in her local library near Boston: 17 years later, this group has welcomed more than 350 members who have experienced a wide range of pain conditions and come from all walks and stages of life. The group provides support, education, and social connection; teaches self-management and coping skills; helps members find treatment, offers practical tips for living with pain; and visits psychosocial issues such as intersections between pain and grief, family, relationships, and self-esteem. People living with chronic pain often come to terms with the fact that chronic pain itself is their disease. Steinberg describes chronic pain as "being imprisoned in your own body with no means of escape."

Several issues may contribute to inadequate pain care in the United States: underinvestment in research (including epidemiology and interactions between patients and researchers), undertrained physicians, limitations in the number of effective treatments, lack of public awareness, stigma, and access to care. Through her advocacy work, Steinberg has helped promote several state policies and legislative actions. She concludes that multimodal treatment is essential for adequate pain care, as is the vitality of long-term support and acceptance of personal limitations. Patients can contribute substantially to progress in pain research and care. Looking more closely at "survivors" may point to resiliency factors, and data-sharing (e.g., via the website "Patients Like Me") may offer researchers real-world data on the complexities faced by people living with chronic pain.

Panel Session: Preventing Chronic Pain Through Multidisciplinary Approaches

Moderator: Mark Pitcher, M.Sc., Ph.D., NCCIH

Preventing Chronic Pain through Multidisciplinary Approaches: An Overview

Katrina Maluf, P.T., Ph.D., San Diego State University

The notion of a multidimensional model of pain has evolved over time from René Descartes' specificity model asserting the presence of dedicated pathways for each somatosensory modality and a purely anatomical basis. Millennia earlier, however, the philosopher Aristotle conjectured a psychological component, which he noted that along with pleasure, is a "passion of the soul," and thus more of an emotion. Introduction of the gate theory in 1965 offered a physiological explanation for psychological effects on pain perception and gave rise to the neuromatrix theory, in which brain networks (particularly the reward-motivation network and the descending pain modulatory system, DPMS) likely confer vulnerability to painful conditions. The current biopsychosocial model of pain invokes a triad of psychological, physiological, and environmental influences and support the notion that factors from each domain can be either pathological or protective. This framework supports multidisciplinary models of care for the prevention of chronic pain, and internationally several initiatives have employed this logic to construct collaborative models based on risk stratification. The United States has not yet embraced this system.

The progression of pain from acute to chronic to disability offers multiple opportunities for intervention and prevention; although to date, most focus has been on tertiary prevention of disability in people with chronic pain. What are strategies for intervening earlier? Can effective approaches be borrowed from other disciplines, like infectious disease? Secondary prevention efforts (focused on the transition from acute to chronic pain) require knowledge of risk factors for screening and stratified care. Some advances have been made with low back pain screening, such as using the STarT Back screening tool. Another mode of secondary prevention involves the transdisciplinary model of psychologically informed physical therapy practice. This strategy adds motivational interviewing, cognitive behavioral and mindfulness approaches, and relaxation strategies to contemporary physical and postural approaches.

Because conducting prevention trials with a low number of events requires a very large sample size, the least amount of work has been done on multidisciplinary primary prevention, despite the fact that early intervention is likely to have the most significant impact. It has been argued that risk factors are too variable across individuals to be of general preventive use. However, primary prevention efforts have centered largely on biomechanical exposures and not on susceptibility, such as reduced endogenous pain inhibition, depressed mood, and female sex. Endogenous pain modulation represents a promising

target for multimodal prevention of chronic pain; however, evidence-based tools are not yet available for widespread clinical use. Future multidisciplinary approaches should consider modifiable interactions between susceptibility and exposure.

Prevention Strategies for Pediatric Headache

Andrew Hershey, M.D., Ph.D., F.A.H.S., Cincinnati Children's Hospital Medical Center

Of the many types of headaches, migraine has been particularly amenable to research based on its prevalence (in adults and children); social, productivity, and economic impacts; and pathophysiology (primarily, genetic influences). Motor effects that accompany headache may inhibit learning and long-term development, and it remains a top contributor to global burden of disease across the lifespan. The condition of migraine changes with age; investigation of temporal contributors may offer prevention or early treatment opportunities. Cyclic hormonal effects vary by age, with prominent influence of estrogen in adult women and progesterone in girls. The role of genetics in migraine has been studied extensively through twin studies, showing a 70% influence from genetics and a 30% influence from an independent environment, but an insignificant influence from a shared environment. Other approaches have included genome-wide association studies, pointing to a wide range of candidate neurological (dopamine, serotonin), vascular, hormonal, and inflammatory factors.

How can knowledge of pathophysiology yield prevention strategies? Pharmacological therapies are widely used in treating children with migraines and can be enhanced with education on coping strategies that modulate response expectations. Drug treatments include anticonvulsants, antiserotonergics, antidepressants, NSAIDs, beta-blockers, and calcium-channel blockers. Also used are riboflavin, Coenzyme Q(10), Vitamin D, and biofeedback. A shallow evidence base makes it difficult to treat children based solely upon translating adult data. One randomized trial, the CHAMP study, found no significant differences in reduction in headache frequency or headache-related disability in childhood and adolescent migraines with amitriptyline, topiramate, or placebo over a period of 24 weeks, and active drugs were associated with higher rates of adverse events. However, and echoing results of other studies, the CHAMP trial identified a high placebo response rate, suggesting that mimicking the placebo effect will have therapeutic benefit.

An Integrated Approach to Post-Operative Pain Management for Prevention of Chronic Pain

Daniel Riddle, P.T., Ph.D., Virginia Commonwealth University

The Knee Arthroplasity Pain Coping Training (KAST Pain) is a multi-center randomized trial funded by the National Institute of Arthritis and Musculoskeletal and Skin Diseases, which is assessing the efficacy of pain-coping skills training in reducing knee pain and improving function. The study design employs a specific phenotypic subgroup: patients scheduled for total knee arthroplasty (TKA) with moderate to high pain catastrophizing (rumination, helplessness, magnification). The pain catastrophizing phenotype reports more severe pain and worse function, demonstrates more pain behavior, reports higher rates of mental health and coping challenges, uses more analgesics, and is a known risk factor for poor outcome in TKA – even in technically sound surgeries. This trial employed a multidisciplinary team with both pragmatic and explanatory biases; thus, the group consulted the PRECIS pragmatic–explanatory continuum indicator summary to assist in trial design that assessed: i) effectiveness of pain-coping skills training in reducing knee pain and improving function; ii) cost-effectiveness; and iii) identification of treatment-based mechanisms.

The three comparison groups (total N= 402) include: arthritis-education control, usual care, and a relatively pragmatic approach to estimate real-life effects of surgery relative to interventions. The pain-coping intervention was telephone-based delivery pre- and post-surgery, delivered by physical therapists and supervised by clinical psychologists. Although the trial is ongoing, preliminary baseline findings report wide variation in opioid use across sites, ranging from 15.9% to 51.2%. The study team also found that physical therapists are capable and willing to deliver pain-coping skills training to this challenging population of patients.

Self-Management Strategies as Part of an Integrated Approach for Pain Management

James Fricton, D.D.S, M.S., University of Minnesota

In addition to being the most common chronic condition, pain is the leading cause of disability in the United States, according to the CDC. Despite a wide variety of pharmacological and non-pharmacological therapies, most are only 10-20% more effective than placebo and offer only short-term relief. Failed treatment and delayed recovery is often due to many physical, behavioral, and psychosocial risk factors that go unaddressed. However, akin to risk factors ("causes") are protective factors ("cures"), and recovery might be considered a balance of the two. Collectively, these factors include influences from the body, lifestyle, emotions, spirit, society, the mind, and the environment. Effective self-management is always a goal of pain care but it is frustrated by several elements, including dissonance with the U.S. biomedical model, inadequate provider time to "train" patients, lack of reimbursement, health care reform and regulation by health plans, tedious electronic health record charting, and inadequate training of health professionals. Such obstacles may be overcome through use of the chronic care model.

Patient and provider education may be greatly facilitated through virtual learning in the online course "Preventing Chronic Pain: A Human Systems Approach" developed by the University of Minnesota. Although initially developed for providers, thousands of patients have taken the course and reported high satisfaction. It employs the Personalized Activated Care and Training (PACT®) approach. Online training tools address a range of physical and psychosocial issues; each contains information on pain and risk assessment, personalized cognitive behavioral training to reduce risk factors and strengthen protective actions, personal stories of real people, daily action plans (habits, pauses, calming), resources for documenting outcomes, and strategies for overcoming barriers.

Closing Remarks

Nora Volkow, M.D., Director, NIDA

Dr. Volkow stated that NIH is firmly committed to addressing the opioid crisis through research, pointing to a recent publication co-authored by her and NIH Director Dr. Francis Collins in the *New England Journal of Medicine* of a plan to accelerate opioid addiction research in three crucial areas: overdose reversal, addiction treatment, and pain management. She noted complexity in managing this public health issue that is influenced not only by prescribing practices but by structural societal issues like access to integrated care that make clinical uptake very difficult.

In addition to ongoing enthusiastic support of the NIH Pain Consortium, the National Pain Strategy, and extensive investigator-led research in this area, NIH is embarking on a public-private partnership to accelerate knowledge for new therapeutic interventions (from basic to implementation to services).

Three upcoming meetings are planned, at which government, academic, and industry partners will discuss progress, challenges, and gaps in knowledge – toward creating new funding opportunities.

- Medications Development for Opioid Use Disorders and for Overdose Prevention and Reversal (June 5, 2017)
- Development of Safe, Effective, Non-Addictive Pain Treatments (June 16, 2017)
- Understanding the Neurobiological Mechanisms of Pain (July 7, 2017)

APPENDICES

Appendix I: Agenda

May 31, 2017

8:30 AM
Introduction
Executive Committee, NIH Pain Consortium

8:50 AM P
Panel Session: Pain Management and Opioids
Overview: Complex Pain Management with Addiction
Peggy Compton, R.N., Ph.D., F.A.A.N., University of Pennsylvania, School of Nursing

9:30 AM
Opioid Pharmacology and Safer Drug Development
Gavril Pasternak, M.D., Ph.D. Memorial Sloan-Kettering Cancer Center & Weill Cornell Medical College

9:50 AM
Implementation of Addiction Programs: Challenges for Pain Management
Todd Molfenter, Ph.D., Center for Health Enhancement Studies, University of Wisconsin Madison

10:10 AM
Questions and Answers
Panel

10:30 AM
Break and Poster Session with Junior Investigators in the Atrium

11:15
Mitchell Max Junior Investigator Presentations

Introduction of Junior Investigators – Finalists
Patricia Grady, Ph.D., R.N., F.A.A.N., Director, National Institute of Nursing Research

11:25 AM
CCR2 Mediates Mechanical and Cold Sensitivity in Chronic Sickle Cell Disease Pain
Katelyn Sadler, Ph.D., Medical College of Wisconsin, Milwaukee

11:40 AM
Variation in MC1R Gene Predicts Dental Pain Sensitivity
Cameron Randall, West Virginia University/University of Washington

11:55 AM

MRGB2 Contributes to Mechanical and Thermal Allodynia in Animal Models of Inflammatory and Neuropathic Pain
Dustin Green, Ph.D., Johns Hopkins University

12:10 PM
Lunch and Poster Session in the Atrium

1:20 PM
Keynote Address: Models of Integrated Pain Care
Robert Kerns, Ph.D., Psychiatry, Neurology, and Psychology, Yale University

2:10 PM
Panel Session: Moving Toward Multidisciplinary Care
Interdisciplinary Pain Rehabilitation – When Pills, Potions, and Procedures are Inadequate
Dennis C. Turk, Ph.D., Anesthesiology & Pain Medicine, University of Washington

2:50 PM
Multidisciplinary Pain Management in Complex Older Patients
Barbara Rakel, Ph.D., R.N., F.A.A.N., University of Iowa College of Nursing

3:10 PM
Managing Pain and Co-occurring Conditions
Martin Cheatle, Ph.D., University of Pennsylvania

3:30 PM Break and Poster Session in the Atrium

4:00 PM
Questions and Answers
Panel

4:10 PM
Mitchell Max Award for Best Junior Investigator Presentation

Martha J. Somerman, D.D.S., Ph.D., Director, National Institute of Dental and Craniofacial Research

4:20 PM
Adjourn

June 1, 2017

8:30 AM
Update from the American Pain Society
David Williams, Ph.D., Anesthesiology, Medicine, Psychiatry, University of Michigan
President American Pain Society

8:50 AM
A Patient's Perspective

Cindy Steinberg, U.S. Pain Foundation

9:10 AM
Panel Session: Preventing Chronic Pain Through Multidisciplinary Approaches
Preventing Chronic Pain through Multidisciplinary Approaches: An Overview
Katrina Maluf, P.T., Ph.D., School of Exercise and Nutritional Sciences, San Diego State University

9:50 AM
Prevention Strategies for Pediatric Headache
Andrew Hershey, M.D., Ph.D., F.A.H.S., Neurology, Cincinnati Children's Hospital

10:10 AM
Break and Poster Session with Junior Investigators in the Atrium

10:40 AM
***An Integrated Approach to Post-Operative Pain Management for Prevention of Chronic* Pain**
Dan Riddle, P.T., Ph.D., F.A.P.T.A., Physical Therapy, Virginia Commonwealth University

11:00 AM
Self-Management Strategies as Part of an Integrated Approach for Pain Management
James Fricton, D.D.S., M.S., Diagnostic and Biological Sciences, University of Minnesota School of Dentistry

11:20 AM
Questions and Answers
Panel

11:40 AM
Closing Remarks
Nora Volkow, M.D.

11:50 AM
Adjourn

Appendix II: Meeting Participants

Executive Committee

Walter Koroshetz, M.D. (Chair), Director, National Institute of Neurological Disorders and Stroke
Josephine Briggs, M.D. Director, National Center for Complementary and Integrative Health
Patricia Grady, Ph.D., R.N., F.A.A.N. Director, National Institute of Nursing Research
Martha Somerman, D.D.S., Ph.D. Director, National Institute of Dental and Craniofacial Research
Nora Volkow, M.D. Director, National Institute on Drug Abuse
Staff: NINDS Office of Pain Policy: Linda Porter (Director)

Speakers and Moderators

Josephine Briggs, M.D.
Director, National Center for Complementary and Integrative Health
Martin D. Cheatle, Ph.D.
Director of Behavioral Medicine at the Penn Pain Medicine Center; Director, Pain and Chemical Dependency Research at the Center for Studies of Addiction, University of Pennsylvania; Associate Professor of Psychology in Psychiatry, Perelman School of Medicine, University of Pennsylvania
Wen Chen, Ph.D.
NCCIH
Peggy Compton, R.N., Ph.D.
Associate Professor in the Department of Family and Community Health at the University of Pennsylvania School of Nursing
James Fricton, D.D.S, M.S.
Professor Emeritus in the University of Minnesota Schools of Dentistry, Medicine, and Public Health; Senior Investigator for the HealthPartners Institute for Education and Research; Pain Specialist at the Minnesota Head and Neck Pain Clinic
Patricia Grady, Ph.D., R.N., F.A.A.N.
Director, National Institute of Nursing Research
Dustin Green, Ph.D.
Johns Hopkins University
Andrew Hershey, M.D., Ph.D., F.A.H.S.
Endowed Chair and Director, Division of Neurology and Headache Medicine Specialist, Division of Neurology, Cincinnati Children's Hospital; Professor, University of Cincinnati Department of Pediatrics
Robert D. Kerns, Ph.D.
Professor of Psychiatry, Neurology, and Psychology, Yale University
Walter Koroshetz, MD
Director, NINDS; Chair, NIH Pain Consortium Executive Committee
Katrina Maluf, P.T., Ph.D.
Professor of Physical Therapy, San Diego State University
Todd Molfenter, Ph.D.
Senior scientist, Center for Health Enhancement Systems Studies (CHESS) at the University of Wisconsin, Madison; Faculty member of the University of Wisconsin, Madison College of Engineering
Gavril W. Pasternak, M.D., Ph.D.

Anne Burnett Tandy Chair in Neurology, Laboratory Head in the Molecular Pharmacology and Chemistry Program, Memorial Sloan-Kettering Cancer Center

Mark Pitcher, M.Sc., Ph.D.

NCCIH

Barbara Rakel, R.N., Ph.D., F.A.A.N.

Professor, University of Iowa College of Nursing

Cameron Randall

West Virginia University/University of Washington

Daniel Riddle, P.T., Ph.D.

Otto D. Payton Professor of Physical Therapy, Orthopaedic Surgery and Rheumatology, Virginia Commonwealth University

Katelyn Sadler, Ph.D.

Medical College of Wisconsin, Milwaukee

Martha Somerman, D.D.S., Ph.D.

Director, National Institute of Dental and Craniofacial Research

Cindy Steinberg

National Director of Policy and Advocacy for the U.S. Pain Foundation, Policy Council Chair for the Massachusetts Pain Initiative

David Thomas, Ph.D.

NIDA

Dennis Turk, Ph.D.

John and Emma Bonica Professor of Anesthesiology and Pain Research; Director of the Center for Pain Research on Impact, Measurement, & Effectiveness (C-PRIME); the University of Washington School of Medicine

Nora Volkow, M.D.

Director, National Institute on Drug Abuse

David A. Williams, Ph.D.

Professor of Anesthesiology, Medicine, Psychiatry, and Psychology, University of Michigan; Associate Director of the Chronic Pain and Fatigue Research Center; senior faculty member within the Neurosciences Program and the Institute of Healthcare Policy and Innovation

NIH Pain Consortium Members

National Cancer Institute
National Eye Institute
National Heart, Lung, and Blood Institute
National Institute of Arthritis and Musculoskeletal and Skin Diseases
National Institute of Biomedical Imaging and Bioengineering
Eunice Kennedy Shriver National Institute of Child Health and Human Development
National Institute of Dental and Craniofacial Research
National Institute of Diabetes and Digestive and Kidney Disorders
National Institute of General Medical Sciences
National Institute of Mental Health
National Institute of Neurological Disorders and Stroke
National Institute of Nursing Research
National Institute on Aging
National Institute on Alcohol Abuse and Alcoholism
National Institute on Deafness and Other Communication Disorders

National Institute on Drug Abuse
National Institute on Minority Health and Health Disparities
John E. Fogarty International Center
National Center for Advancing Translational Sciences
National Center for Complementary and Integrative Health
Warren Grant Magnuson Clinical Center
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- Office of Behavioral and Social Sciences Research
- Office of Technology Transfer
- Office of Rare Diseases
- Office of Research on Women's Health