

INNOVATORS & IDEAS: RESEARCH LEADER

Nora Volkow: Insights into the function of our brains through the science of drugs and addiction

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Dr. Nora D. Volkow is Director of the National Institute on Drug Abuse (NIDA) at the National Institutes of Health, where she has served since 2003 as the first woman and first Hispanic person in this role. NIDA is the world's largest funder of scientific research on the health aspects of drug use and addiction. Dr. Volkow's groundbreaking work has been instrumental in demonstrating that substance use disorder is a brain disorder, revolutionizing our understanding of addiction. As a research psychiatrist and pioneer in the field of neuroimaging, Dr. Volkow transformed the use of brain imaging to investigate how substance use affects brain functions. In particular, her studies have documented how changes in the dopamine system affect the functions of brain regions involved with reward and self-control in addiction, leading to fundamental shifts in how addiction is viewed and treated. She has also contributed to understanding the neurobiology of obesity, attention-deficit/hyperactivity disorder (ADHD), and aging. In this Genomic Press Interview, Dr. Volkow shares insights into her remarkable journey from a medical student in Mexico to becoming one of the most influential figures in addiction research while discussing her perspectives on the current challenges in addressing substance use disorders, including the ongoing opioid crisis.

Part 1: Nora D. Volkow – Life and Career¹

Could you give us a glimpse into your personal history, emphasizing the pivotal moments that first kindled your passion for science?

I was struck early on by how we, as humans, can be so vulnerable to the effects of addictive drugs, how they can change us in such profound ways, and lead some people to desperation and despair while prompting others around them to isolate and even reject them. The first example that I experienced of this phenomenon happened in my own family when I learned that my uncle suffered from alcohol use disorder. Years later, as a medical student, I would also see patients coming into the hospital with cirrhosis, collapsed veins, or cancer because they have been drinking or smoking throughout their lives. These accumulated experiences reinforced in me a sense that the study of addiction was an important goal, mainly because it was so devastating to people yet preventable. Hence, it had a profound impact on my future career choices.

We would like to know more about your career trajectory leading up to your most relevant leadership role. What defining moments channeled you toward that leadership responsibility?

I was born in Mexico and earned my medical degree from the National University in 1980, along with the Robins Award for the best medical stu-



Figure 1. Nora D. Volkow, MD, National Institute on Drug Abuse, National Institutes of Health, USA.

dent of my generation. My keen interest in research and brain pathology started early in my medical career. Some of the critical lab experiences that shaped my path during medical school include working as a Research Assistant in the electron microscopy department of pathology at the Registro Nacional de Anatomia Patologica and later in the Miles Laboratory of Experimental Therapeutics, both in Mexico City.

Not long after I got my degree, I headed to France for an internship rotation at the Centre des Maladies et de l'Encephale at Sainte-Anne Psychiatric Hospital in Paris. After that, I came to the US for a four-year residency fellowship in Psychiatry at New York University, where I earned a Laughlin Fellowship from The American College of Psychiatrists. By 1984, I was an Assistant Professor in the Department of Psychiatry and Behavioral Science at the University of Texas Medical School.

¹The content of this article is solely the responsibility of the author and does not necessarily represent the official views of the National Institutes of Health.





Much of my professional career was spent at the US Department of Energy's Brookhaven National Laboratory in Upton, New York, where I held several leadership positions, including Director of Nuclear Medicine, Chairman of the Medical Department, and Associate Laboratory Director for Life Sciences. I was also a professor in the Department of Psychiatry and Associate Dean of the Medical School at The State University of New York at Stony Brook.

Since May 2003, I have been the Director of the National Institute on Drug Abuse (NIDA) at the National Institutes of Health (NIH). I am proud to be the first woman and the first Hispanic person to serve as NIDA Director since the institute's creation.

As mentioned before, my specific research interests began with a desire to better understand how a drug can hinder a person's ability to stop its use. I wanted to know what drugs do to the brain with the hope that the knowledge we gleaned from such studies could one day help those whose lives have been altered by the devastating effects of addictive drugs.

Please share with us what initially piqued your interest in your favorite research or professional focus area.

As a medical student, I volunteered in a laboratory whose purpose was to discover a medication for pain based on opioids that would not be addictive. Since I was working with opioid drugs, I became immediately fascinated with the observation of animals (rats and monkeys) working compulsively to obtain a minimal amount of drug injected into them and how the animal would forgo everything else in the process. I was amazed by the ability of a simple chemical compound to so rapidly and profoundly derail adaptive behavior.

As I mentioned before, I have developed a keen interest in how this phenomenon manifests itself in the form of various substances and compulsive behaviors among people. However, what became both frustrating and pivotal for me was to see how much stigma surrounded people living with an addiction: doctors did not want to treat them, they dismissed them. That bothered me because it was antithetical to what I had learned in my medical training: to have empathy and care for all those in vulnerable communities.

Looking back, these were some of the experiences that motivated me to work in the addiction field.

What impact do you hope to achieve in your field by focusing on specific research topics?

I hope that this research will allow us to better understand the impact of drug use on brain structure and function so we are in a better position to identify therapeutic targets or strategies and help those who may be at higher risk for addiction. This hope is anchored in my firm conviction that the better the knowledge, the better the prevention and treatment interventions we can develop. In the long term, I believe this research will improve the pervasive stigma seen in communities across the US, which has made an already challenging recovery process even more of an uphill battle. Fortunately, we are already seeing encouraging signs in this regard, for example, in the slow but growing acceptance of addiction as a biobehavioral disorder (one in which genetic, social, environmental, and other factors interact to affect measurable and stereotypic changes to the brain) and of multipronged treatment interventions, in the spread of new approaches to deal with individuals with addiction who are also involved with the criminal justice system (e.g., drug courts), and in the steady adoption of harm reduction strategies that are so critical to saving lives and nudging people into a path for long term recovery.

Please tell us more about your current scholarly focal points within your chosen field of science.

I often position my work to make it relevant to a public health question or challenge. This is why I have studied the effects of acute cell phone radiofrequency exposure on brain glucose metabolism, the neurobiological overlaps between substance use disorder (SUD) and obesity, and the impact of stimulant medications in children with ADHD.

At present, a lingering opioid crisis keeps challenging our ability to tackle a devastating and constantly evolving public health threat. Drug overdose fatalities in the United States remain high, with an estimated

107,543 deaths in 2023, mostly from opioids. Despite the effectiveness of medications for opioid use disorder (OUD) in preventing overdoses, only an estimated 25% of individuals with OUD receive them, and close to 50% discontinue treatment within 6 months. There is an urgent need for alternative treatments for OUD. So, spurred further by the opioid crisis, the closing of the addiction treatment gap and the discovery of new, more effective addiction medications have become top priorities. Based on anecdotal reports of reduced drug craving in individuals using semaglutide, a new generation of Glucagon-like peptide-1 receptor agonists (GLP1-RA), along with empirical studies showing its therapeutic benefits in alcohol and nicotine use disorders, rigorous investigations of the potential of GLP1-RA medications to treat SUDs has become a particularly salient research interest. This is why I was heartened to learn about the latest study showing that the prescription of GLP1-RA appears to be associated with significantly lower rates of opioid overdose in patients with OUD; if confirmed by further studies, this could be a game changer.

In the meantime, and responding to the imperative of saving lives, I have become an advocate for the deployment of evidence-based harm reduction practices that focus on minimizing the negative effects of drug use for those already struggling, such as by providing safer environments and reducing the risk of overdose.

Nevertheless, in the long run, effective prevention is perhaps one of the most impactful priorities because it allows us to intervene early, reducing the likelihood that individuals will develop substance use disorders in the first place. By focusing on the root causes of substance use -such as stress, trauma, mental illness, and social and commercial determinants-we can focus on at-risk populations before drug use starts or escalates. Effective prevention strategies not only protect individuals but also reduce the broader societal and economic costs associated with addiction. Investing in prevention ultimately creates healthier communities and a more sustainable public health system.

What habits and values did you develop during your academic studies or subsequent postdoctoral experiences that you uphold within your research environment?

One of the most fundamental codes of conduct I have adhered to over the years is "listening and sticking to the data." I believe that professing the highest level of respect for the available evidence and viewing it as a guiding principle is a "*sine qua non*" requirement for successfully navigating what is often a complex and challenging scientific and policy environment. This stance has served me well over the years, combined with a non-negotiable commitment to due diligence, respect for others, and leading by example.

At Genomic Press, we prioritize fostering research endeavors based solely on their inherent merit, uninfluenced by geography or the researchers' personal or demographic traits. Are there particular cultural facets within the scientific community that warrant transformative scrutiny, or is there a cause within science that deeply stirs your passions?

I think both. Three of the most critical aspects of the condition I have decided to devote my professional life to are that it is a global phenomenon, personally devastating, and 100% preventable. From a public health standpoint, this combination, in my view, affords addiction research an incredibly high return on investment potential, which is why I am so passionate about our mission, albeit with a healthy dose of humility and commitment to empower and collaborate with other researchers, partners, and sectors. I see myself as a public servant and a clinician guided by a philosophy of pragmatism and empathy. My vision for the future relies heavily on the generation of data that can drive policy and health care practice and thereby significantly reduce the mortality and other medical consequences from substance use and SUDs. At the same time, I am increasingly cognizant of the importance of promoting research that considers the needs and complex circumstances of those most impacted by SUDs. This means making sure that any new solutions we generate reach those individuals and that they are part of that solution by



facilitating their participation, whenever feasible, at various points along the research design and implementation.

What do you enjoy most in your capacity as an academic or research leader?

Because of my innate curiosity, I derive great joy and intellectual reward from any activities that advance scientific understanding about the world and the inner workings of the brain in particular. These activities can take different forms; the feeling can be elicited by a discovery, a fertile exchange with a young mentee or established collaborator, or a lecture to raise awareness and educate the public and policymakers about the importance of neuroscience research to understanding the complexities of addiction. My primary source of fulfillment flows from an intense desire to make scientific contributions that can directly benefit society.

Outside professional confines, how do you prefer to allocate your leisure moments, or conversely, in what manner would you envision spending these moments given a choice?

I love to stay active: exercise is essential to me. I enjoy running and cycling because it clears my mind and helps me recharge. Being out in nature is something I value, as it gives me space to think and reflect. I also have a passion for reading, especially literature and history. It is an excellent way for me to disconnect from the intensity of my work while still stimulating my curiosity. Spending time with family is another priority for me. Although my work keeps me busy, I treasure moments with loved ones, whether simply having a conversation or sharing a meal.

Part 2: Nora Volkow – Selected questions from the Proust Questionnaire²

When and where were you happiest? And why were you so happy then?
Hiking in Nepal during my honeymoon. I was surrounded by astonishing landscapes and in love.

What is your current state of mind?
Excited but concerned.

²In the late nineteenth century, various questionnaires were a popular diversion designed to discover new things about old friends. What is now known as the 35-question Proust Questionnaire became famous after Marcel Proust's answers to these questions were found and published posthumously. Proust answered the questions twice, at ages 14 and 20. In 2003, Proust's handwritten answers were auctioned off for \$130,000. Multiple other historical and contemporary figures have answered the Proust Questionnaire, including among others Karl Marx, Oscar Wilde, Arthur Conan Doyle, Fernando Pessoa, Stéphane Mallarmé, Paul Cézanne, Vladimir Nabokov, Kazuo Ishiguro, Catherine Deneuve, Sophia Loren, Gina Lollobrigida, Gloria Steinem, Pelé, Valentino, Yoko Ono, Elton John, Martin Scorsese, Pedro Almodóvar, Richard Branson, Jimmy Carter, David Chang, Spike Lee, Hugh Jackman, and Zendaya. The Proust Questionnaire is often used to interview celebrities: the idea is that by answering these questions, an individual will reveal his or her true nature. We have condensed the Proust Questionnaire by reducing the number of questions and slightly rewording some. These curated questions provide insights into the individual's inner world, ranging from notions of happiness and fear to aspirations and inspirations.

What is your most marked characteristic?
Courage.

Among your talents, which one gives you a competitive edge?
Passion.

What do you consider your greatest achievement?
Providing evidence of addiction as a brain disease.

If you could change one thing about yourself, what would it be?
Obsessiveness.

What do you most value in your friends?
Kindness.

Who are your favorite writers?
Michael Lewis, Ian McEwan, Orhan Pamuk, Siddhartha Mukherjee, Toni Morrison, and Lionel Shriver.

Who are your heroes of fiction?
Odysseus.

Who are your heroes in real life?
Albert Einstein.

What aphorism or motto best encapsulates your life philosophy?
Don't ever give up.

Nora D. Volkow¹

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