

Summary. I am an applied economist and I study how location and the environment shape health and health care delivery in the United States. The health care industry accounts for 18% of U.S. GDP and has grown rapidly over the past five decades, reflecting both costly new treatments and environmental factors that contribute to disease burdens. Meanwhile, medical spending and health outcomes vary widely across places. Understanding how local and environmental factors affect health and medical use can help policymakers improve the design of health and environmental policies and direct limited resources to situations and subpopulations where they are needed most.

My research shows that local characteristics of the environments in which people live, work, or receive care play a key role in driving health care provision and population health outcomes. In my work, I use causal and machine learning methods that harness rich datasets such as individual health and employment records, administrative Medicare claims, and high-resolution satellite/remote sensing data. My research has been published in leading general interest economics and medical journals, has garnered over \$10 million in competitive grant funding, and has been profiled in numerous media outlets. Below, I describe my primary research themes. Paper numbers in brackets correspond to the attached bibliography.

1. Place-based determinants of physician practice styles. An enormous medical literature has shown widespread variability in medical use and spending across regions, even those with similar populations. Quality of care and health outcomes in high-spending regions are often no better than in low-spending regions, leading to the common interpretation that spending in many regions could be substantially reduced without sacrificing quality of care. But whether or how patterns of care can be changed—and assessing whether these changes are desirable—hinges on understanding what drives regional variations.

In [1], I explore the roles of physicians versus their practice environments in explaining regional differences in how similar patients are treated. Environment-specific factors such as financial and legal incentives, hospital capacity, and productivity spillovers extend influence across local groups of physicians, driving treatment style differences across practice settings. Physician-specific factors such as preferences, training, and experience may cause physicians to treat patients differently even under similar environments. Disentangling the roles of physicians and practice environments is difficult for two primary reasons: physicians may choose practice settings based on their individual style (“positive matching”), and their practice styles may be shaped by the practice setting. The primary contribution of [1] is to separate physician versus location factors by identifying physicians who move and exploring how their treatment choices evolve across the move as a function of the change in their environment. Physicians starting in the same region and subsequently moving to dissimilar regions practice similarly before the move. But after the move, their behavior in the first year changes by 0.6–0.8 percentage points for each percentage point change in the practice environment, with no further changes over time, suggesting environment factors can explain 60%–80% of regional disparities in physician behavior.

I build on these findings to explore the role of one specific component of the physician practice environment: geographic proximity to local opinion leaders. Classic work in sociology and economics argues that proximity may facilitate the spread of knowledge and innovations across individuals and firms. Thus, the influence of well-informed, prominent physicians might extend beyond the treatment of their own patients to shape the practice of medicine across their region. Yet producing direct empirical evidence supporting this hypothesis faces a key identification challenge: spatially clustered technology adoption could reflect local demand or taste for new technology rather than information spillovers.

We address this challenge in [2] by analyzing whether new cancer drugs approved by the Food and Drug Administration (FDA) are adopted more rapidly in the geographic regions containing study authors of the pivotal clinical study used in the FDA review process. Our analysis harnessed a novel data collection effort to identify the study authors of the pivotal clinical trials for 21 new cancer drugs and match these

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authors' locations to adoption patterns of the drugs using Medicare claims records from over 1.4 million patient cancer care episodes from 1998 to 2008. By comparing diffusion patterns across many new drugs with different locations of study authors, we can separate local demand or taste for technology from the role of knowledge spillovers. We find that geographic proximity to the lead investigator increases use of a new cancer drug by 36% (although this effect fades after four years) and find that “superstar” physician authors, measured by trial role or citation history, have broader influence than less prominent physicians.

2. Place-based determinants of population health. A second research theme is how place and the local physical and economic environments shape population health outcomes. Understanding how adverse environmental conditions like exposure to extreme weather and pollution affect human health and well-being are crucial for developing optimal environmental policies and regulations and for investing in costly adaptations and protective behaviors. The human response to environmental shocks can also illuminate factors that affect the accumulation or depreciation of health capital more generally.

Disasters

Life expectancy varies significantly across the United States, but to what extent does this variation reflect the causal effect of place on health [3]? To answer this question, we analyze the long-run health effects of Hurricane Katrina, which displaced more than one million residents and can serve as a natural experiment of how place affects health [4]. Quantifying long-run health impacts of disasters like Hurricane Katrina has proven difficult, largely due to a lack of data that capture pre-disaster outcomes and exhibit minimal attrition post-disaster. To overcome this challenge, we use Medicare administrative data that allow us to follow elderly and long-term disabled individuals over time and space and that provide exact dates of death. We find that individuals initially living in New Orleans experienced a substantial increase in their probability of surviving three or more years past the storm, and we show that this counterintuitive effect is largely explained by the migration response to the storm. New Orleans had among the highest mortality rates in the country before the hurricane, and migrants generally moved to regions with lower mortality. Those migrating to low- versus high-mortality regions look similar at baseline, but their subsequent mortality is 0.83–1.01 percentage points lower per percentage-point reduction in local mortality, revealing that places can have large effects on the health of residents.

Temperature

A recent literature in economics has shown that extreme temperatures—both cold and heat—can increase mortality, but the implied magnitude and geographic distribution of climate change damages depend crucially on current temperature effect heterogeneity and future adaptation across climate regions. In [5], we show that hot days are less deadly in warm places, while cold days are less deadly in cool places. Incorporating this heterogeneity into end-of-century climate change assessments reverses the conventional wisdom on climate damage incidence: cold places bear more, not less, of the mortality burden. Allowing places to adapt to their future climate substantially reduces the estimated climate change damages.

Air pollution

In [6], we match Medicare data to daily local pollution to provide the first large-scale, quasi-experimental estimates of the causal effects of acute fine particulate matter (PM_{2.5}) exposure on adult mortality, health care use, and medical costs.¹ This paper moves beyond prior studies of the health effects of air pollution in two important ways. First, we develop a new approach that uses machine learning and rich data on demographics and health histories to estimate the life-years lost due to pollution exposure, yielding estimates that are about 40% smaller than those obtained by a traditional approach that only accounts for age and sex. Second, we apply novel machine learning techniques to identify people most vulnerable to

¹ Paper [6] won iHEA's 28th Kenneth J. Arrow Award for Best Paper in Health Economics.

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air pollution exposure. These findings have important implications for policy and future research. For example, in [7] we show that targeting air pollution reductions in regions with a high fraction of vulnerable individuals could lead to efficiency gains relative to targeting pollution levels alone. More broadly, the approaches we develop in [6] for quantifying life-years lost and treatment effect heterogeneity can be applied in a wide variety of contexts, such as whether health insurance reduces mortality.

To provide a more complete understanding of the economic cost of air pollution, I have a series of papers that study the causal effects of air pollution caused by drifting wildfire smoke. In [8] we match Medicare data to satellite images of wildfire smoke plumes and use variation in small versus large smoke shocks to estimate a causal concentration-response relationship between air pollution and mortality. We find a concave $PM_{2.5}$ -mortality relationship: small air pollution shocks have proportionally larger mortality effects than large air pollution shocks. Paper [9] shows that pollution from wildfire smoke affects not just physical but also mental health: smoke exposure increases suicide rates in rural U.S. demographics with high outdoor air exposure and baseline suicide risk but not among urban groups. Finally, paper [10] shows that wildfire smoke exposure lowers U.S. labor earnings by an average of \$125 billion annually, a cost matching or exceeding that of increased mortality. These papers collectively highlight the escalating risks of wildfires, demonstrating that air pollution's impact extends beyond physical health to mental and financial well-being.

How environmental conditions affect population health is also an important issue in medicine and epidemiology. Motivated by claims that thunderstorms can trigger asthma outbreaks (“thunderstorm asthma”) caused by wet pollen grains rupturing, in [11] we use Medicare data to provide the first large-scale evidence that emergency department visits for respiratory illness increase before, but not after, thunderstorm events, aligning with antecedent rises in airborne PM and temperature rather than subsequent rupturing of wet pollen grains. In [12] we examine the link between weather and joint pain, failing to find evidence that rainfall events precipitate joint pain diagnoses.

Water pollution

Unlike air quality, where a wealth of data on air pollutant concentrations has led to widespread recognition of their adverse health effects, drinking water quality trends and their effects on health remain areas with significant knowledge gaps. Key to these knowledge gaps is a paucity of data on drinking water contamination levels. Prior studies have used EPA-reported water quality violation data, but these data only indicate if standards are met without accounting for variations within those standards or changes to the standards themselves. In an effort to close these gaps, paper [13] reports on our effort to collect 230 million readings on 1,800 pollutants over decades that we obtained from 48 US states via dozens of Freedom of Information Act and associated requests. Using these data, we study trends, causes, and consequences of US drinking water pollution. We find that US drinking water pollution is rapidly declining; for example, the share of readings exceeding current health standards fell by half from 2003 to 2019. We further document that loans from the Safe Drinking Water Act significantly reduce pollution and mortality rates among older Americans, at a cost of \$124,000 per premature death avoided.

Economic environment

Building on my research into the impacts of the physical environment on population health, I have also investigated the crucial role that the economic environment plays in shaping health outcomes and disparities. For example, Social Security Disability Insurance (DI) awards rise in recessions, especially for older adults. In [14], we use Medicare data to investigate how health and program entry costs shape this pattern. Higher unemployment rates at the time of application result in increased DI entry, reduced medical spending, and lower mortality among new entrants. We find no shift in the health of marginal entrants as unemployment increases, indicating that health changes play little role in cyclical DI entry.

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3. Workplace-based determinants of employee health and well-being. Workplace wellness programs are widely used by firms to reduce medical spending, improve health and healthy behaviors, and increase productivity. These programs are offered by nearly all large U.S. firms and are encouraged by the Affordable Care Act (ACA). To investigate the purported benefits of these programs and to characterize who benefits from them, we designed and implemented the Illinois Workplace Wellness Study, a large-scale randomized controlled trial (RCT) of a comprehensive two-year workplace wellness program (“iThrive”) at the University of Illinois.² Nearly 5,000 employees were randomly assigned either to a treatment group, which was eligible for the wellness program, or to the control group, which was not eligible. Using individual-level data from online surveys, university employment records, health insurance claims, and campus gym and running event records, we examine many novel outcomes in addition to the usual ones studied by the prior literature (medical spending and employee absenteeism).

In [15], we evaluate the economic impacts of iThrive.³ Despite strong program participation among the treatment group, we do not find significant causal effects of the program on total medical spending, health behaviors, employee productivity, or self-reported health status after 30 months. Our 95% confidence intervals rule out 84% of previous estimates on medical spending and absenteeism, and the return on investment (ROI) for iThrive rules out a widely cited ROI for these programs. However, we do find that baseline medical spending was lower and health behaviors were more prevalent among participants compared to nonparticipants, suggesting the large financial incentives permitted by the ACA may shift costs onto unhealthy employees. Our study further underscores the value of using an RCT in this setting by showing that an observational regression analysis of our data yields incorrect results, even after adjusting for selection bias using a comprehensive set of demographics and baseline risk factors.

In [16], we further evaluate the effects of iThrive on employee health, health beliefs, and medical use. While we do not find significant effects on biometric outcomes, medical diagnoses, or medical use after 12 or 24 months, we do find that iThrive significantly improved employee beliefs about their own health. These results show a mismatch between employee perceptions and physical/administrative measures of health. Future work will use the iThrive intervention and data on peer connections elicited in the baseline and annual follow-up surveys to test for peer effects in the workplace and to characterize the nature and evolution of the peer network over time.

² For more information on the Illinois Workplace Wellness Study, visit www.nber.org/workplacewellness.

³ Paper [15] won the NIHCM Foundation’s 26th Annual Health Care Research Award.

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Bibliography

- [1] Molitor, David. 2018. “The Evolution of Physician Practice Styles: Evidence from Cardiologist Migration.” *American Economic Journal: Economic Policy*, 10(1): 326–356.
- [2] Agha, Leila and David Molitor. 2018. “The Local Influence of Pioneer Investigators on Technology Adoption: Evidence from New Cancer Drugs.” *The Review of Economics and Statistics*, 100(1): 29–44.
- [3] Deryugina, Tatyana and David Molitor. 2021. “The Causal Effects of Place on Health and Longevity.” *Journal of Economic Perspectives*, 35(4): 147–70.
- [4] Deryugina, Tatyana and David Molitor. 2020. “Does When You Die Depend on Where You Live? Evidence from Hurricane Katrina.” *American Economic Review*, 110(11): 3602–33.
- [5] Heutel, Garth, Nolan Miller, and David Molitor. 2021. “Adaptation and the Mortality Effects of Temperature Across U.S. Climate Regions.” *The Review of Economics and Statistics*, 103(4): 740–753.
- [6] Deryugina, Tatyana, Garth Heutel, Nolan Miller, David Molitor, and Julian Reif. 2019. “The Mortality and Medical Costs of Air Pollution: Evidence from Changes in Wind Direction.” *American Economic Review*, 109(12): 4178–4219.
- [7] Deryugina, Tatyana, Nolan Miller, David Molitor, and Julian Reif. 2021. “Geographic and Socioeconomic Heterogeneity in the Benefits of Reducing Air Pollution in the United States.” *Environmental and Energy Policy and the Economy*, volume 2, 2(1): 157–189.
- [8] Miller, Nolan, David Molitor, and Eric Zou. 2023. “A Causal Concentration-Response Function for Air Pollution: Evidence from Wildfire Smoke.” Mimeo.
- [9] Molitor, David, Jamie T. Mullins, and Corey White. 2023. “Air Pollution and Suicide in Rural and Urban America: Evidence from Wildfire Smoke.” *Proceedings of the National Academy of Sciences*, 120(38): e2221621120. <https://doi.org/10.1073/pnas.2221621120>.
- [10] Borgschulte, Mark, David Molitor, and Eric Zou. 2022. “Air Pollution and the Labor Market: Evidence from Wildfire Smoke.” Forthcoming, *The Review of Economics and Statistics*.
- [11] Zou, Eric, Christopher Worsham, Nolan Miller, David Molitor, Julian Reif, and Anupam Jena. 2020. “Emergency Visits for Thunderstorm-Related Respiratory Illnesses Among Older Adults.” *JAMA Internal Medicine*, 180(9):1248–1250.
- [12] Jena, Anupam B., Andrew Olenski, David Molitor, and Nolan Miller. 2017. “Association between rainfall and diagnoses of joint or back pain: retrospective claims analysis.” *BMJ*, 359 :j5326.
- [13] Keiser, David, Bhash Mazumder, David Molitor, and Joseph Shapiro. 2023. “Water Works: Causes and Consequences of Safe Drinking Water in America.” Revision requested, *The Quarterly Journal of Economics*.
- [14] Carey, Colleen, Nolan Miller, and David Molitor. 2022. “Why Does Disability Insurance Enrollment Increase During Recessions? Evidence from Medicare.” NBER Working Paper 29988.
- [15] Jones, Damon, David Molitor, and Julian Reif. 2019. “What Do Workplace Wellness Programs Do? Evidence from the Illinois Workplace Wellness Study.” *The Quarterly Journal of Economics*, 134(4): 1747–1791.
- [16] Reif, Julian, David Chan, Damon Jones, Laura Payne, and David Molitor. 2020. “Effects of a Workplace Wellness Program on Employee Health, Health Beliefs, and Medical Use.” *JAMA Internal Medicine*, 180(7):952–960.