Penn LDI
LEONARD DAVIS INSTITUTE of HEALTH ECONOMICS

DRIVING IMPACT

IN HEALTH CARE RESEARCH AND POLICY

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OUR MISSION

Penn LDI is dedicated to improving health and health care by catalyzing collaborative, multidisciplinary research that influences policy and practice.

When I'm asked what makes the Leonard Davis Institute of Health Economics stand out from its peers for its impact on research, practice, and policy, I sometimes refer to its longevity (as the first of its kind when it began in 1967), or the breadth of its research pursuits (including contributions by all 12 schools on Penn's campus), or its storied reputation (attracting some of the most creative minds across disciplines).

But when it comes down to it, what sets us apart is one thing: We solve problems. Our success stems from creating multidisciplinary solutions to our nation's most pressing health care problems.

Our Fellows engage in rigorous and timely research that improves health policy, clinical practice, and public health. Our work has shown how health insurance design influences utilization and coverage decisions for decades. It has demonstrated how financial incentives and even gamification can promote healthy behaviors. And it has produced care models that improve health outcomes while lowering costs. Our researchers also tackle the most consequential public health crises and make substantive advances on such issues as opioid overdoses, the pandemic, and gun violence.

On the following pages, we share 20 stories about the transformative power of our institute. They are inspiring stories of how a great unmet need can be overcome through the efforts of experts across fields, each imbued with drive and passion. They show both the critical need for data-driven research and how our institute can scale solutions to intractable problems confronting health care today.

And these accounts represent the institute's fulfillment of our founders' vision to build bridges between business and medicine. Most importantly, these stories can inspire future generations to tackle the great health care challenges of the 21st century. These are the stories that inspired me as a young physician and economist. I hope they will inspire you to help us write the next chapter of collaboration and success for the future.

RACHEL M. WERNER, MD, PhD
Executive Director, Penn LDI

> "Our success stems from creating multidisciplinary solutions to our nation's most pressing health care problems."

1

The Economics of Moral Hazard

Still Influential After All These Years

It was 1968, and two years after the launch of Medicare and Medicaid, health care costs were soaring. The debate on national health insurance was just revving up as the Nixon administration prepared to take office. That year, health economist and LDI Fellow Mark Pauly published a piece in the *American Economic Review* that would become one of the most influential articles in health economics, one that resonates in health care debates to this day.

Entitled, "The Economics of Moral Hazard: Comment," it was a response to another classic by Nobel Prize winning economist Kenneth Arrow, who published "Uncertainty and the Welfare Economics of Medical Care" in 1963.[1] In it, Arrow had discussed the concept of "moral hazard" in health insurance, the idea that the demand for health care goes up as the marginal cost of care to the individual (that is, out-of-pocket cost) goes down.

Arrow had brought up "moral hazard" in his discussion of why the market was failing to provide "optimal" (meaning full) insurance coverage, something people were willing to pay for. He considered it a practical limitation of insurance, but one that did not change the desirability and social gains of universal coverage. Pauly's key insight was that full coverage may not be the best option under conditions of moral hazard, and that some services should remain uninsured. As Pauly explained:

> *(T)he response of seeking more medical care with insurance than in its absence is a result not of moral perfidy, but of rational economic behavior. Since the cost of the individual's excess usage is spread over all other purchasers of that insurance, the individual is not prompted to restrain his usage of care....It is possible to conclude that even if all individuals are risk-averters, some uncertain medical care expenses will not and should not be insured in an optimal situation.*

Pauly's key insight propelled an entire field of research into incentives and insurance coverage; it was the impetus for the RAND Health Insurance Experiment, which estimated the impact of consumer cost-sharing on health care use.[2] It was central to the thinking behind managed care, high-deductible health plans, and value-based insurance design.[3–5]

More than 50 years later, Pauly's work on moral hazard continues to shape law and regulation. You can see it in the details of Medicare prescription drug coverage; it undergirds the Affordable Care Act's different required out-of-pocket payments for gold, silver, and bronze level plans.[6,7] And even more recently, it is informing current debates about creating a home care benefit within Medicare.[8]

Despite Good Intentions, Surgical Report Cards Didn't Make the Grade

The theory behind measuring and reporting surgical outcomes through "report cards" is sound. The goal of improving quality through public reporting is well-meaning. But sometimes they backfire and actually cause harm, as physician, health economist, and LDI Executive Director Rachel Werner found in her dissertation research that changed the way we design and implement quality improvement programs.[9]

In 1991, New York State began publishing report cards with cardiac surgeons' mortality rates following coronary artery bypass graft (CABG) surgery. The idea was to improve quality by tracking surgical outcomes and sharing the results with hospitals and the public. Surgeons would want to measure up when compared with their peers; patients would choose more highly ranked surgeons. But that wasn't what happened.

Instead, early results and surveys suggested that surgeons in New York avoided performing CABG surgeries on patients they perceived as high-risk, resulting in fewer surgeries among the patients who most needed the procedure. And that led Werner and colleagues to question the impact of New York's report card on known racial and ethnic disparities in patient access to CABG surgery.

Using data from nearly one million patients with heart disease, Werner, with colleagues David Asch and Dan Polsky, compared trends in the use of CABG surgery in New York to surrounding states that did not use surgical report cards. They confirmed that after New York began publishing the report card, surgeons performed fewer CABG surgeries on the sickest patients in New York, while no change in surgeries occurred in other states. Because sicker patients were more likely to experience complications, the report card gave New York surgeons an incentive to avoid high-risk patients to protect their scores.

What's more, this research was the first to document that racial and ethnic disparities in the use of CABG surgery worsened because of seemingly harmless incentives to improve quality. In the three years after New York began publishing the CABG report card, 19% fewer CABG surgeries were performed on Black and Hispanic patients in New York, even after controlling for illness severity and other factors. Although racial and ethnic minority patients were at no greater risk of poor outcomes, biases against these patients may have led surgeons to "profile" them as less likely to comply with treatment or more likely to have poor outcomes. The consequences were felt for years...in fact, it took nine years for these disparities to return to the pre-report card levels.

Werner's groundbreaking research has transformed the country's approach to enhancing quality of care, recognizing the crucial role of race and ethnicity in designing financial incentives to improve care.

3

Having an Impact on Health Equity with Community Health Workers

First, physician and socio-behavioral health scientist Shreya Kangovi listened. On porches, at bedsides, in emergency rooms, and in shelters, she and her team asked 1,500 community residents in Southwest Philadelphia, “What makes it hard for you to stay healthy, and what should we be doing differently?” Then, based on their answers, she reimagined how a 300-year-old workforce could deliver the services people wanted and needed, and designed an intervention that became the most widely used community health worker program in the country.

She heard about the real-life issues that made it hard to stay healthy: the loneliness, the fear of eviction, the cost of medicine. “They didn’t want more pills or needles or clinics. They wanted support from someone they could relate to, who had walked in their shoes and lived their experience,” LDI Fellow Kangovi said.

Community health workers (CHWs) are trusted laypeople from local communities, trained to work with patients to improve their health. Kangovi had studied the long history of CHWs internationally, and more recently, in the 1970s in the U.S. She realized that the difference between successful and unsuccessful programs was in how they were implemented, and so she designed and tested a structured, scalable model called IMPaCT (Individualized Management for Patient-Centered Targets).[10] The model provides the infrastructure for CHWs to succeed, including strategic planning, hiring, training, supervision, workflows, and quality metrics.[11]

In three randomized controlled trials, IMPaCT improved chronic disease control, mental health, and quality of care while reducing total hospital days by 34%.[12] Further, an economic analysis found that it had an impressive 2:1 return on investment: for every dollar spent on IMPaCT, Medicaid saved an estimated $2.47 within a year (about $2,500 per patient).[13]

These results were so persuasive that the University of Pennsylvania Health System incorporated IMPaCT into its service line, and since 2013, it has served nearly 25,000 people in the region. Since then, the model has spread to the Veterans Health Administration, 18 state Medicaid programs, and more than 70 health systems and organizations, including Kaiser Permanente, CVS Health, and United Way.

Kangovi sees a bright future for CHW programs because of recent “enabling policies” that create an environment in which programs can thrive. In particular, she points to Medicare, which just introduced the first-ever billing code for CHW services; exemplar Medicaid programs like Tennessee’s that are investing in the infrastructure to build evidence-based CHW programs; and a new national accreditation process for CHW programs, which sets the bar for organizational support of the CHW workforce.[14–16] Kangovi herself now leads a spinoff public benefit corporation, dedicated to scaling this work across the country and remaking the American health care workforce.

4

Building Bridges to Better Care

The Transitional Care Model

LDI Fellow Mary Naylor has improved the lives of millions of older adults living with complex health and social needs. She did this by creating the Transitional Care Model (TCM) and by pioneering the field of transitional care in recognition for which she received the National Academy of Medicine's prestigious Gustav Lienhard Award for exceptional and unique contributions to improving U.S. health care.

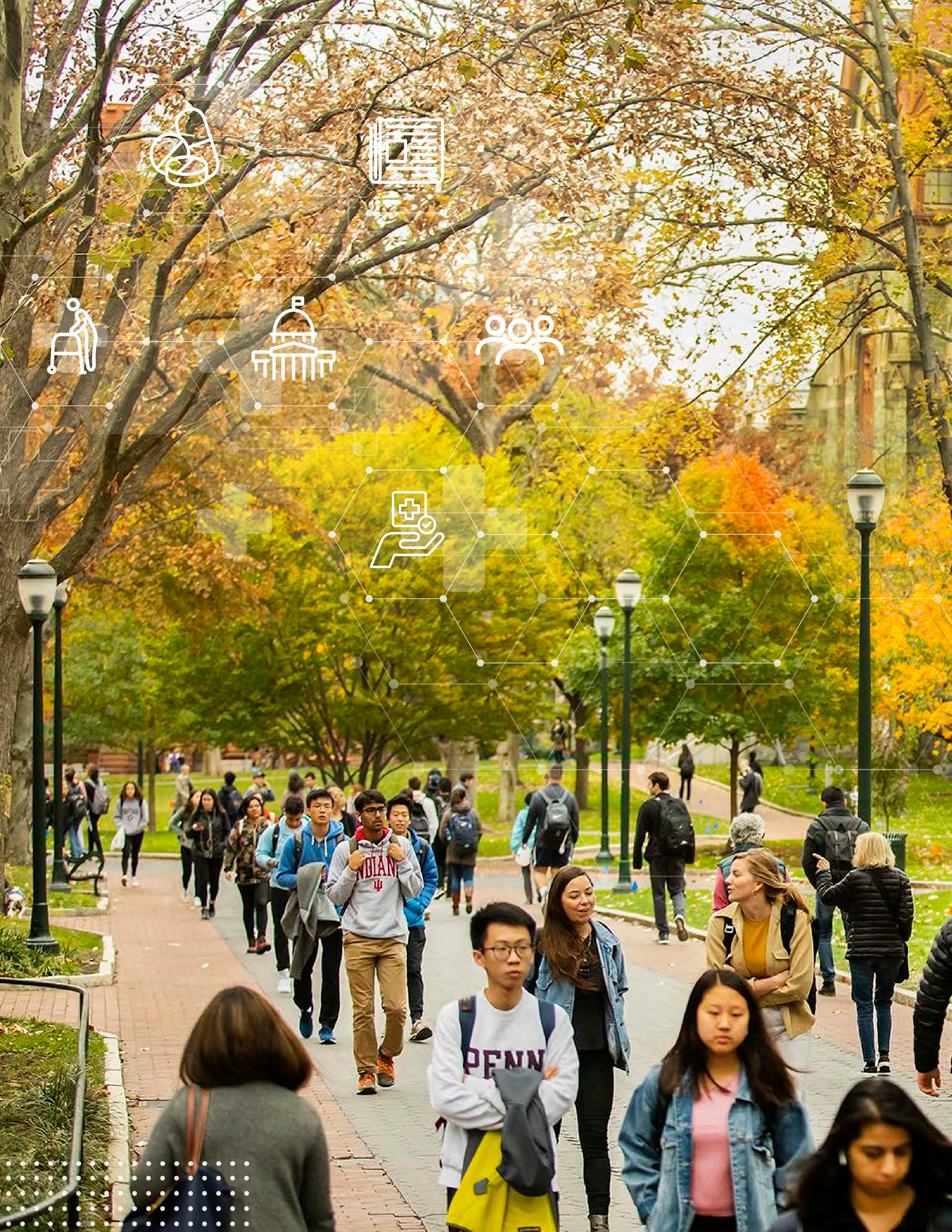
For people who are elderly or have multiple chronic conditions, the transition from hospital to home can be particularly challenging. Adverse events and complications are common, and about 20% will be readmitted within 30 days. All too often, these patients fail to get the attention they need in our fragmented health care system.

Naylor began the journey to bridge these gaps in care nearly 30 years ago, drawing inspiration from a model of discharge planning and nurse home visits for very low-birthweight infants. Could a similar approach ease the transition for chronically ill, older adults? And beyond filling the gaps, could this improve longer-term outcomes by focusing care on what was important to older people and their caregivers? To find out, Naylor and her team developed and refined a model that would become the gold standard of person-centered care for older people.[17]

TCM is delivered by an advanced practice registered nurse (APRN) who works with the patient, caregivers, and physicians in the hospital to develop an individualized plan of care. The same nurse visits the patient at home within 24 hours of hospital discharge, at least weekly throughout the first month, and bi-weekly for the next two months. The nurse accompanies the patient to the first physician visit and is available by telephone seven days a week. Along the way, the nurse establishes trusting relationships with the patient and caregivers, coordinates care with multiple clinicians and staff across hospitals, skilled nursing facilities, and homes, and advocates for older adults' goals to drive their plans of care.

Over 20 years and three randomized controlled trials, Naylor and colleagues found that TCM targeted to high-risk older people improves quality of care, physical function, quality of life, and satisfaction with the care experience.[18] It reduces avoidable rehospitalizations by up to 50% and leads to substantial net health care savings over the next year.

Naylor and her team at Penn's NewCourtland Center for Transitions and Health have revolutionized health transitions science by successfully implementing TCM across hundreds of health care organizations and communities. Powered by dedicated teams, comprehensive training, and online resources,[19] TCM has influenced transformative systemic changes, including metrics used to assess quality (e.g., care coordination measures advanced by the National Quality Forum[20]); standards of care (e.g., Joint Commission on Accreditation of Healthcare Organizations' standards related to hospital discharge[21]); and health care policies (e.g., Medicare's Hospital Readmissions Reduction Program[22]).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Financial Incentives at Work

Paying People to Quit Smoking

Can paying people who smoke help them to quit? The answer is a resounding yes. Cutting-edge research by LDI Fellows has shown that financial incentives can drive healthy behaviors, including smoking cessation, physical activity, weight loss, and timely vaccinations. Using behavioral economics interventions, LDI Fellows have improved the health of millions of people, increased the value of employee benefits and wellness programs, and revolutionized health insurer incentives across the U.S., Europe, and Asia.

This stream of research began more than two decades ago, when a group of LDI Fellows saw an opportunity to help people quit smoking using behavioral economic principles and financial incentives in the workplace. When they approached employers, General Electric (GE) became the first to test the hypothesis that you could pay people to quit smoking for good.

In the ensuing randomized trial of more than 800 GE employees, the team, led by behavioral economist and LDI Fellow Kevin Volpp and health innovation leader and LDI Fellow David Asch, found that incentives worth $750 paid out over a year nearly tripled smoking cessation rates.[23] The incentives helped people complete smoking cessation programs and stay smoke-free. Nearly 15% had quit in nine to 12 months, compared with 5% of people in the control group. And the intervention had staying power even after 15–18 months. GE was so impressed that it installed a program based on this approach for its 152,000 U.S. employees.

The researchers followed up their remarkable success with two larger randomized trials, yielding insights into the kinds of financial incentives that would be most effective. Volpp and critical care doctor and LDI Fellow Scott Halpern tested a variety of incentive structures among 2,500 employees of CVS and among 6,000 employees across more than 54 companies, making it the largest study of its kind.[24,25] Along the way, they learned that giving participants the opportunity to put their own money at risk and match it was no more effective than a direct reward; that group incentives were no more effective than individual incentives; and that framing the same incentive as money to be lost, rather than as a reward to be gained, made no difference.

These studies confirmed that properly structured incentives can triple quit rates compared to offering free smoking cessation aids alone or electronic cigarettes, which did not help people quit smoking. These groundbreaking insights continue to influence policy, process, and progress for corporations, governments, health systems, and NGOs across the globe.

6

Everything Old is New Again

Honoring the Legacy of Robert Eilers

It was November 1970. There was an air of inevitability about the passage of some form of national health insurance, with at least eight competing proposals on the national agenda. As LDI's founding director Robert Eilers noted,

> *The accelerated pace in the social acceptance of a national health insurance scheme is now readily apparent. The notion that national health insurance is inevitable is held even among some of the more conservative elements in the health care professions and health care financing organizations.*

To bring thoughtful analysis to a complex and often contentious national debate, Eilers had organized a conference at LDI. For two days, 90 of the most influential policymakers and researchers discussed and debated the best ways of structuring national health insurance. Their findings were summarized in Eilers' two-part *New England Journal of Medicine* article and presented in Congressional hearings. So began LDI's legacy of bringing experts together and applying thoughtful analyses to policy issues, all in service to improving the health care of the American people.

Eilers himself was an early architect of national health insurance policies and health maintenance organizations (HMOs) (having coined the term with Paul Ellwood). He authored much of President Nixon's ill-fated 1970 national health insurance plan as special assistant to the President, and he consulted on the use of private plans in Medicare, which would eventually become the Medicare Advantage program we have today. Eilers also created the first MBA program in health care management at Wharton.

Although Eilers, like many leaders of his day, was too optimistic about the passage of a national insurance plan, health care reform remains consequential and controversial. As health care costs surge, the U.S. remains one of the few developed countries that does not offer universal coverage. Despite spending more on health care than any other country, the U.S. has poorer health outcomes than other developed nations and many Americans lack adequate access to health care. Eiler's mission for LDI—to build a multidisciplinary community of scholars who would collaborate to redress "the rising cost and uneven distribution of health care" in the United States—remains as urgent today as when the institute first opened its doors in 1967.

7

Food for Thought

Increasing Access to Federal Food Benefits for Eligible Families

For pediatrician and LDI Fellow Aditi Vasan and colleagues at the Children's Hospital of Philadelphia, a pediatrician's job doesn't stop at the clinic door; it extends out to the community by helping families get the food and nutrition assistance they need to stay healthy. Although many low-income families are eligible for a federal food program—the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)—only about half actually receive those benefits. Vasan was determined to change that.

WIC provides families with nutrition education, breastfeeding support, and funds to buy nutritious foods selected for pregnant, postpartum, and breastfeeding women, and children up to age 5. Since launching in 1975, WIC has been a cost-effective way to improve the health and nutrition of low-income families. It is funded through federal grants to states, which administer the program. States can choose to require families to apply for WIC and complete the WIC certification process either online or in person.

In a series of studies, Vasan and colleagues found that WIC's low participation rate is due partly to the program's administrative burdens.[26] This includes the time it takes to fill out application paperwork and make an appointment, the requirement that families travel to WIC clinics in person for certification or recertification, and difficulties with identifying and buying WIC-eligible products in stores.

Vasan and her team have used changes in federal WIC policies to analyze the beneficial effects of reducing these burdens. Before the pandemic, for example, they documented that transitioning from paper WIC vouchers to electronic benefits transfer (EBT) cards boosted WIC participation by 8%.[27] Then they showed that states that took advantage of federal waivers to remotely reload WIC benefit cards during the pandemic saw a 9% relative increase in WIC participation compared to states that kept in-person requirements.[28]

Vasan and her team have also listened to what WIC-eligible caregivers say about the challenges in using WIC benefits.[29] From this base of both qualitative and quantitative evidence, they have recommended that all states allow for remote benefits reloading and remote WIC certification appointments and nutrition education visits, and that the USDA explore strategies for streamlining online ordering and internet-based transactions using WIC benefits.[30] Vasan and colleagues are building a powerful case for modernizing the WIC user experience.

Policymakers have taken notice. Pennsylvania, a state that kept in-person requirements during the pandemic, is now transitioning to remote reloading of EBT cards.[31] In 2022, the White House Office of Management and Budget cited Vasan's work in a memo outlining strategies to reduce administrative burdens in public benefit and service programs.[32]

8

Ensuring Adequate Nurse Staffing in Hospitals

A Case Study in Policy Research and Advocacy

When you are in the hospital, the number of nurses caring for you is hugely consequential. For more than 30 years, nursing experts and LDI Fellows Linda Aiken, Karen Lasater, Matthew McHugh, and colleagues have sounded the alarm about inadequate nurse staffing and advocated for state policy that would require minimum nurse-to-patient ratios. Their work laid the foundation for research around the country finding that adequate nurse staffing lowers costs and increases quality of care.

California became the first state to mandate minimum nurse staffing in 2004, requiring at least one nurse for every five patients in medical-surgical units. Since then, debates have raged in various state legislatures about the effects and costs of such a policy, which hospital executives generally oppose. While opposition stems from the additional expense of hiring more nurses, Aiken and colleagues have shown that adequate nurse staffing lowers overall costs to the health system by reducing complications and costly readmissions.

In a groundbreaking analysis of the California regulation, Aiken and colleagues found that California nurses cared for two fewer patients on medical and surgical units than nurses in two comparison states—Pennsylvania and New Jersey.[33] They estimated that the comparison states, if they were staffed at levels mandated in California, would reduce surgical mortality by 13% annually. And in another study that became the "gold standard" for prospectively evaluating nurse ratio legislation, Aiken and McHugh found that minimum staffing ratios in 27 public hospitals in Queensland, Australia led to 145 fewer deaths, 255 fewer readmissions, and 29,222 fewer hospital days in the first two years of implementation.[34]

Aiken and colleagues have not shied away from state political battles, testifying that, "implementing safe minimum nurse staffing standards will save lives and money." To influence the debates, they have recently conducted policy evaluations of pending legislation in New York, Illinois, and Pennsylvania.

Their efforts are a case study in building an evidence base to influence policy. In New York, Aiken and Lasater estimated that over two years, staffing hospitals at four patients per nurse would prevent an estimated 4,370 deaths and save at least $720 million due to shorter lengths of stay and fewer readmissions.[35] Their testimony in 2021 was central to a bill that finally passed, although the final regulation applied only to critical care and intensive care units, requiring 2:1 staffing ratios for these high-care demand units.[36,37]

In 2023, research from Aiken and Lasater played a similar role in Pennsylvania, which was considering a minimum 4:1 patient-to-nurse ratio.[38] In their testimony, Aiken estimated that each year, the proposed requirements could prevent 1,155 hospital deaths, avoid 771 hospital readmissions, and reduce length of stay by 39,919 days, which would save Pennsylvania hospitals $93 million per year.[39] The Pennsylvania House subsequently passed the requirement in the Patient Safety Act, which now awaits Senate approval.[40]

Based on this evidence, legislation requiring minimum nurse staffing ratios have been introduced in at least four other states, and in 2023, a bill establishing minimum nurse ratios on a federal level was introduced in Congress.


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9

Diversifying the Next Generation of Health Services Researchers

The Summer Undergraduate Mentored Research Program

It started small 25 years ago, with big dreams: to bring diverse voices to health services research, and to address the severe underrepresentation of minority groups in the field. So in that first year, LDI's Summer Undergraduate Mentored Research Program (SUMR) recruited three Penn students to a 12-week summer internship, matched them with a Penn faculty mentor, and hoped that the experience would inspire them to pursue graduate training and a research career. Over the next quarter-century, SUMR would grow into one of the premier educational pipeline programs in the country, training more than 350 students and building a more diverse and creative workforce. An astounding 85% have gone on to careers in health care, many of whom cite the program as pivotal in their career path.

Lorraine Dean, one of the first seven SUMR scholars, embodies both the dream behind SUMR and its success. "My SUMR experiences ended up leaving a handprint on virtually every stage of my career since 2001," said Dean, an Associate Professor of Epidemiology at Johns Hopkins. After graduating from Penn in 2005, she conducted health services research in Venezuela on a Fulbright scholarship and earned a doctorate from Harvard. She returned to Penn as a faculty member, becoming the first SUMR scholar to mentor in the program she had attended. She is now a social epidemiologist who examines how privilege and disadvantage influence chronic disease.

From its humble beginnings, the program has grown in depth and breadth. Since 2017, it has included first-year students at Penn Dental; in 2022, it expanded to launch undergraduate students in a 15-month fellowship focused on aging research.[41] But SUMR's core activity remains the same as that first year: hands-on experience in health services research over the summer, with a strong faculty mentor. Over the years, the program has introduced elements such as GRE prep, lectures from leading experts, critical writing programs, and skill workshops. The scholars attend AcademyHealth's annual research conference and present their own project at an end-of-program research symposium.

In 2024, 40 scholars participated in SUMR, coming from different universities, countries, and diverse backgrounds, including first-generation, low-income, international, and LGBTQ+ students.[42] These students, whether they come from the communities they are studying or have gained insight through their research and experiences, understand the health care disparities faced by these populations and are driven to create meaningful solutions.

Co-sponsored by LDI and Wharton's Health Care Management Department, SUMR is still led by Founders Joanne Levy and Mark Pauly, who remain the heart and soul of the program.

Hope, Opportunity, and Health

The American Dream of economic opportunity. It's a powerful idea, that anyone can rise up in social class, regardless of their background. While it's usually thought of in terms of the individual, it also has a large impact on population health. LDI Fellow Atheendar Venkataramani, with the tools of an economist and the compassion of a physician, is examining how the American Dream shapes health, and how health, in turn, drives economic opportunity.

A recurring theme in his work is the critical role of hope. It's a key piece of the growing evidence that restricted economic opportunities—the fading of the American Dream—is directly linked to worsening metrics in population health and well-being.

This conceptual framework, the connection between economic opportunity, hope, and health, has given him a novel lens through which he and his colleagues at the Opportunity for Health Lab study some of the most controversial and challenging social problems of our day, such as:[43]

Immigration policy, including the mental health benefit of the Deferred Action for Childhood Arrivals (DACA) program, and the negative affects of increased deportations on the health-seeking behavior of Hispanics.[44,45]

Police killing of unarmed Black men, and the negative mental health and sleep effects on the larger African American community.[46]

Closure of auto assembly plants, and the dramatic rise in opioid overdose deaths in counties where automotive plants closed.[47]

Bans on colleges using affirmative action, which are linked to increases in smoking and alcohol use among underrepresented minority adolescents.[48]

Taken in total, Venkataramani's research shows that higher economic opportunity is associated with better health outcomes. From there, he and his colleagues are advocating for evidence-based public policies to address widening gaps in economic and health outcomes, such as:[49]

- expanding early childhood health and educational investments,
- increasing the scope of programs that assist displaced workers in developing new skills and finding new jobs,
- reinforcing the social safety net, and
- improving the reach of public health efforts to moderate the health consequences of adverse economic shocks.

Venkataramani's work has garnered the attention of policymakers. He and colleagues have presented their work directly to officials at the White House, U.S. Department of Health and Human Services, and U.S. Social Security Administration. Specific studies have been cited in amicus briefs to the U.S. Supreme Court, regulatory rules, and congressional bills. Venkataramani's work is building a solid evidence base for policymakers to use in understanding the link between social conditions and health, and addressing both immediate problems and developing longer-term solutions.

Through economic research, program design, and policy advocacy, Venkataramani and his team are addressing "deaths of despair" with a focus on economic opportunities and the hope and promise that is embodied in the American Dream.

11

Making Sense of Prescription Drug Prices

If you want to understand why U.S. drug prices are so much higher than those in Europe and Canada, ask economist and LDI Fellow Patricia Danzon. For decades policymakers and regulators have done just that. She not only provided the reasons but suggested solutions that are widely used across the world, like aligning prices with their clinical benefit. In 30 years of groundbreaking research, Danzon often upended conventional wisdom. In virtually every aspect of pharmaceutical pricing, from patent protections to generic markets to pharmacy benefits managers to international reference prices, Danzon produced the theoretical and empirical evidence to guide policy in this critical health care sector.

Her early work was critical to understanding how U.S. prices compared to other developed nations. In a series of seminal papers in *Health Affairs* in 2003, 2006, and 2008, Danzon and colleagues showed that U.S. drug prices and volumes were higher, but roughly in line with differences in per capita income.[50–52] Variations in spending reflected differences in formulations, product mix, and use of generics: the U.S had relatively high use of new drugs and high-strength formulations while other countries used more older drugs and weaker formulations. And generics were actually cheaper in the U.S.

Still, by 2016, Danzon found that the price differential between the U.S. and other high-income countries had widened, due to high price growth relative to GDP in the U.S.[53] For on-patent drugs, for example, the U.S./Canada price index jumped from 1.83 to 3.08 between 2005 and 2016, with similar divergent trends between the U.S. and major European markets. The growing differential, she explained, was due to differences in insurance and payer strategies. In countries with universal insurance, payers try to maximize health for citizens within annual health budgets set at a stable percentage of GDP. In the U.S., by contrast, payers face fewer budget constraints and can raise premiums or program funding. The widely cited papers changed the nature and depth of the debate over prescription prices in ways that continue today.

Danzon's insights led to the broad implementation of value-based differential pricing of drugs in many countries with universal insurance systems, which aligns prices with their clinical benefit, at levels that reflect societal willingness to pay for health over other goods.[54] The approach has also influenced drug pricing in the U.S., with the National Academy of Medicine recommending it as a strategy to preserve incentives for innovation by linking prices to the magnitude of clinical benefit.[55]

12

When the Right Choice is the Easy Choice

Nudging Clinicians and Patients

Behavioral nudges can produce significant savings. Indeed, seemingly small changes can have major consequences – they change behavior and can even make people healthier. A decade ago, LDI Fellows realized that new technologies could automate "nudges" to help clinicians and patients make better decisions. And so LDI Fellows Mitesh Patel and Kevin Volpp began the Penn Medicine Nudge Unit, the first-ever behavioral design team embedded in a health system.[56]

The combination of behavioral science and scalable technology platforms such as electronic health records and wearable devices turns out to be a powerful tool to improve health and medical care, and the platforms have been widely adopted.

In one early example, the health system wanted to increase rates of generic prescribing in the hospital, which had lagged behind other systems in the region.[57] Patel and colleagues made a simple change in the electronic ordering system: they changed the default prescription to a generic, with an easy opt-out for a brand name. Almost overnight, generic prescribing rates rose from 75% to 99%, and the improvement persisted. Over the next two years, this one simple nudge, implemented in about an hour, resulted in an estimated $32 million in savings for Penn Medicine.

In another example, they tackled the challenge of improving referral rates for cardiac rehabilitation for inpatients recovering from a heart attack or stroke.[58] Although cardiac rehab reduces mortality and hospital readmissions by about 30%, cardiologists were referring fewer than 20% of eligible patients. Again, Patel and colleagues changed the default pathway, where cardiologists had to manually opt in to refer patients, to one that automatically identified eligible patients and prompted the clinician to sign orders during rounds, unless they opted out. The result? The cardiac rehab referral rate went from 15% to 85% in two years and stayed that way.

Patel and colleagues have also used this approach with patients. They combined financial incentives and wearable tracking devices to help heart disease patients reach daily step goals; and they've used gamification—incorporating game elements such as points and competition—to increase physical activity in a national study of overweight and obese adults.[59,60]

Patel and his colleagues described their approach in the *New England Journal of Medicine* and published guidance for other health systems considering their own Nudge Unit.[61,62] Now led by emergency physician and LDI Fellow M. Kit Delgado, the Penn Nudge Unit has transformed medical practice systemwide, having conducted more than 50 clinical trials testing the design of nudges, gamification, and wearable technology. And since 2018, they have organized an annual "Nudges in Health Care Symposium" to share insights on lessons learned from implementing nudges in health care, and to build collaborations across the health care sector. In 2024, the two-day symposium drew nearly 200 people from two dozen organizations from around the world.

Assessing the Impact of Duty-Hour Restrictions on Physician Training and Patient Safety

Do residents need more sleep? Do their long hours on the job hurt patient safety? For years, people assumed the answer was yes. But LDI investigators generated crucial evidence to the contrary and informed the way we train doctors today.

Their work began with health innovation leader and LDI Fellow David Asch's analysis of the Libby Zion case published in the *New England Journal of Medicine* in 1988, as well as a collection of observational studies published in *JAMA* and led by behavioral economist and LDI Fellow Kevin G. Volpp and outcomes researcher and LDI Fellow Jeffrey H. Silber. This research consistently found no evidence that shorter shift lengths improved patient safety.[63–67]

Meanwhile the policies about resident duty hours proceeded along their own path. In 2003, the Accreditation Council for Graduate Medical Education (ACGME) implemented national duty-hour regulations that established a maximum 80-hour work week and reduced shift lengths to no longer than 30 consecutive hours, addressing rising concerns about medical errors due to long resident work hours. In 2011, ACGME further instituted changes limiting first-year residents to 16-hour shifts.

No large prospective trial had been conducted until Asch, Silber, Volpp, and colleagues led iCOMPARE, the largest ever NIH-funded study to prospectively evaluate the impact of duty-hour limitations on patient safety, resident education, and resident sleep and alertness. iCOMPARE resulted in four papers in the *New England Journal of Medicine*, a host of other papers as well, and served as a primary justification for the ACGME extending the limit on resident shifts to 28 hours in 2017.

iCOMPARE randomized 63 internal medicine programs from around the U.S. to flexible versus standard shift length. All programs were held to an 80-hour work week, but flexible policies (with a special waiver from ACGME) had no limits on shift lengths and did not mandate time off between shifts.

The first study evaluated how well the residents learned in the two environments, finding no significant differences but revealing in both arms considerable evidence of resident burnout.[68]

In the second study, the authors found that 30-day mortality, 7-day rehospitalizations, and Medicare payments did not differ substantially between the flexible and standard programs.[69] However, flexible programs were potentially worse with regards to prolonged hospital stays and 30-day rehospitalization rates. This study was recognized by AcademyHealth as the best health policy paper published in 2020.[70]

The third study compared sleep and alertness among first-year trainees and found that those in the standard program received no more sleep per night than those in the flexible programs.[71] Sleepiness also did not differ between the groups. Alertness was decreased for all residents during and after extended shifts.

A fourth paper, a perspective in the *New England Journal of Medicine*, outlined how iCOMPARE helped raise the evidentiary bar for medical education policy.[72]

Overall, the studies undercut the erroneous intuition that the long resident duty-hour stretches common at the time are dangerous for patients. Just as importantly, these studies revealed how the design of medical education programs can be informed by research of the same rigor we apply to the evaluation of new drugs.

14

Responding to the Opioid Epidemic with Commitment and Compassion

For two decades, an epidemic of opioid overdoses has devastated families and communities across the country. LDI and its Fellows have been conducting life-saving research to identify humane and effective solutions to ease the crisis:

- By working to limit prescribing by the medical community and promote adequate pain management.
- By reducing the demand for opioids through increased access to effective treatment and recovery services for people with opioid use disorders (OUDs).

On the first front, LDI Fellows documented disturbing trends in opioid prescribing in the emergency department (ED). Emergency physician and behavioral design leader M. Kit Delgado and colleagues found that nationally nearly one in four patients with ankle sprains were being prescribed opioids in the ED, with larger doses associated with higher rates of prolonged opioid use.[73] Similarly, injury prevention researcher and emergency physician Zack Meisel and colleagues found that after a new opioid prescription in the ED, about 14% of Medicaid patients converted to persistent or high-risk opioid use, again finding larger doses linked to continued risky use.[74]

In response, Delgado and his team piloted a change in the default dosing options in the electronic health record (EHR) to promote safer use of opioids for pain management.[75] Their work showed that lowering default opioid prescription order quantities in the EHR significantly reduces the number of pills prescribed, and the defaults have now been changed throughout the University of Pennsylvania Health System.

On the second front, LDI Fellows were determined to address policy and practice barriers that limited access to two lifesaving medications: buprenorphine and methadone. Although these medications can reduce overdose deaths by 50%, fewer than 15% of people with OUD receive such treatment. With the goal of providing more effective care for people wherever they happen to seek help, teams of LDI Fellows led by emergency and addiction medicine physician Jeanmarie Perrone, internist and addiction medicine physician Maggie Lowenstein, M. Kit Delgado, family nurse practitioner and community-engaged health services researcher Shoshana Aronowitz, and Zack Meisel improved care within and beyond the health system, including:

- CareConnect Warmline, a telehealth service that gives same-day appointments for people to start treatment with buprenorphine. With funding from the Philadelphia Department of Public Health, the CareConnect team has answered more than 2,300 calls since November 2021.[76] The team's findings showing how clinicians could adopt buprenorphine telehealth prescribing to overcome barriers to care, were published in the *NEJM Catalyst*.[77]
- A successful ED triage and treatment protocol, in which nurse-led screening for OUD, combined with automated clinical decision support, led to significant increases in patients receiving a buprenorphine prescription at discharge.[78]
- A mobile overdose response program providing street-based buprenorphine initiation, stabilization, and referral to ongoing care.[79]

And while these initiatives are saving lives locally, they are also having an impact on the national stage, with Jeanmarie Perrone testifying before the U.S. Senate Committee on Finance about the necessity and success of "low-barrier" OUD treatments.[80]

15

Planting the Seeds of Change, Neighborhood by Neighborhood

For emergency medicine physician and LDI Fellow Eugenia South, it was not enough patch up young Black victims of gun violence, only to see them return to the neighborhoods in which violence was commonplace. “The heartbreak of seeing my community and people who look like me and my family being victims of violence is what drew me to the work I do,” she said. That work focuses on how places, rather than individuals, can be changed to break the cycle of violence and promote health and well-being in the most disadvantaged neighborhoods.

She and a team of LDI Fellows, including criminologist John MacDonald, epidemiologist Charles Branas, and urban planner Vincent Reina, have studied a variety of place-based interventions, such as vacant lot greening, abandoned house remediation, tree planting, and structural repairs to homes. They have developed and tested solutions to some of the country’s most intractable problems, and their success has begun to address the legacy of disinvestment and segregation in Black neighborhoods and structural racism. Their foundational work in Philadelphia has inspired similar community efforts in other cities, including Flint, Michigan, and Youngstown, Ohio.

In one randomized study, South and colleagues transformed hundreds of vacant lots across Philadelphia to assess the impact on crime and residents’ mental health.[81] They partnered with the Pennsylvania Horticultural Society to plant new grass and trees, install low wooden post-and-rail fences around the perimeter and perform regular maintenance. They found that gun violence went down significantly over 18 months, with no evidence that it was simply pushed to other parts of the city. Study participants reported feeling safer, and therefore went outside more often to socialize with neighbors. People around greened lots reported feeling less depressed.[82]

Greening vacant lots also had positive effects on nearby housing prices. One Wharton analysis found that prices for houses within 1,000 feet of a greened vacant lot rose by about 4% in one year, with the effects increasing over time.[83]

In another randomized study, South and her team remediated abandoned houses, by adding new doors and windows, and cleaning the outside of the house and the yard.[84] They found that full remediation was linked to substantial drops in weapons violations, gun assaults, and shootings.

And in another study, South and colleagues found important effects on crime when low-income homeowners received City of Philadelphia grants to make structural repairs to their homes, such as heating, plumbing, electrical systems, and roofing.[85] The presence of grant-funded property on a block face was associated with a nearly 22% decrease in neighborhood crime, including homicide.

Beyond pathbreaking research, South has also focused on community action to reduce violent crime, improve public health, and reverse health inequities. She leads a major initiative called Deeply Rooted, established in 2022 with multi-million-dollar investments from both Penn Medicine and Children’s Hospital of Philadelphia.[86] South’s team is partnering with 13 community and faith-based organizations and the Pennsylvania Horticultural Society to use the healing power of nature to promote health and well-being in Black and other minority Philadelphia neighborhoods. They plan to green over a million square feet of vacant lots in West and Southwest Philadelphia.

16

What $7 Billion Bought

Advising Congress on the Medicaid Fee Bump

Upon seeing that a news outlet had described the results of his study as: *Medicaid Pays Docs More, Patients See More Docs. Duh.*, former LDI Executive Director Dan Polsky laughed and said, “I should have used that headline for our *New England Journal of Medicine* paper.” But it was hardly a “duh” moment, when in early 2015 the journal fast-tracked the paper (actually entitled “Appointment Availability after Increases in Medicaid Payments for Primary Care”), so it could be used to inform policy in a new Congress.[87] It’s a story that’s notable for the billions of federal dollars up for renewal; an unorthodox research design using “secret shoppers;” and an intrepid research team that was determined to give Congress a timely answer about what $7 billion had accomplished.

For years, Medicaid had paid providers far less than Medicare and private insurers, and many physicians would not accept Medicaid patients. When the Affordable Care Act (ACA) expanded Medicaid coverage to millions of people, policymakers worried that there wouldn’t be enough primary care providers to see them. So the ACA included a two-year Medicaid “pay bump”; states would raise primary care rates to Medicare levels in 2013 and 2014, and the federal government would pay for it.

The size of the pay bump differed across states, because pre-ACA payment rates varied significantly from state to state. In Pennsylvania, for example, the Medicaid rate jumped from $62 to $115 for a typical 30-minute primary-care doctor visit. As the program was expiring, federal and state policymakers were asking the key question: did the pay bump actually improve access to care?

Polsky, with former LDI Fellow Karin Rhodes and colleagues from the Urban Institute, used a “secret shopper” approach to answer that question. Trained field staff acting as potential patients called 3,000 physician offices in 10 states beginning in 2012, then again in 2014 after the Medicaid pay bump. “Basically, they called and said: ‘I just moved into town, and I’m looking to get a primary care doctor. Can I get an appointment?’” Polsky explained. Some callers said they had Medicaid, while others said they had private insurance.

Overall, Polsky and his team found that the average appointment availability for Medicaid callers rose from 59% to 66%, while appointment waiting times and availability for privately insured patients did not change. The larger the fee bump in a state, the larger the increase in Medicaid appointment availability.

The *New England Journal of Medicine* released the paper online on January 22, 2015, just as a new Congress was considering whether to renew the program. Polsky went to Capitol Hill to brief policymakers, and the paper was cited in congressional testimony.[88]

In the end, Congress chose not to renew the program. But the impact of this study is still being felt, as many state Medicaid programs look to increase reimbursement rates to improve access to high-priority services, such as primary care and behavioral health.[89,90]

17

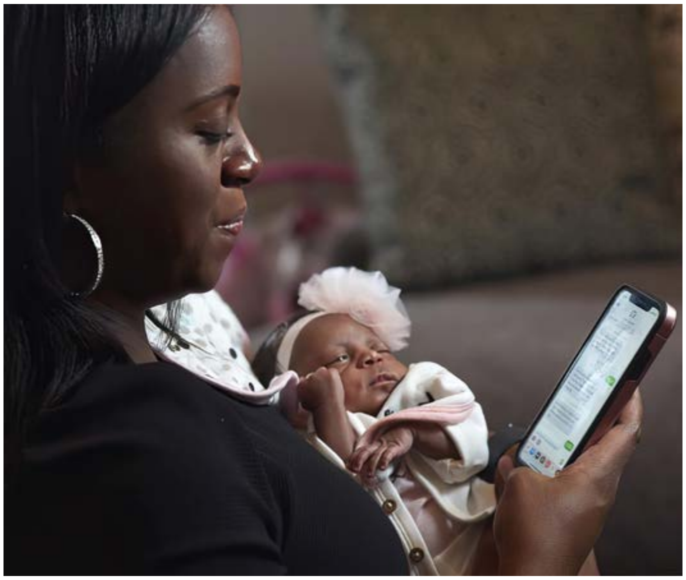
Heart Safe Motherhood

Catching Rising Blood Pressure Early to Keep New Mothers Safe at Home

It's rare for any innovation to improve the outcomes of care by 80%. Yet, that's what happened in 2014 when obstetrician-gynecologist and LDI Fellow Sindhu Srinivas and colleague Adi Hirshberg started using a unique approach: employing cell phones to monitor blood pressure in patients with preeclampsia, who are at risk for postpartum strokes, seizures, and organ damage. And today, nearly 25,000 patients across the country have used this platform, resulting in lower readmission rates.

About 10% of pregnant women experience preeclampsia (high blood pressure that develops during pregnancy). While most women's blood pressure returns to a healthy range after birth, about 15% remain high and are at risk for serious complications. It is the leading cause of seven-day obstetrical readmissions and responsible for about 20% of U.S. maternal deaths each year. Because of the risk, the American College of Obstetricians and Gynecologists (ACOG) recommends blood pressure monitoring at 72 hours and 7-10 days postpartum.

But Srinivas and Hirshberg knew it was almost impossible to get women to return for an in-person blood pressure check in the immediate postpartum period, characterized by hectic days and sleepless nights. Their "aha" moment came when they noticed all the patients using cell phones in their waiting room, and Heart Safe Motherhood (HSM) was born.[91]



Here's how it works: women with preeclampsia are sent home postpartum with a blood pressure monitor (after training on how to use it). The bi-directional, text message-based platform sends them twice-daily reminders to check and report their blood pressure. Patients receive automated, real-time feedback on these blood pressure readings based on a provider-determined algorithm, and the platform alerts providers to readings that are concerning.

From that "aha" moment, Srinivas and Hirshberg worked with the Penn Center for Health Care Transformation and Innovation to bring their idea to fruition, conducting rapid-cycle testing of their innovation, and then a randomized controlled trial comparing HSM to usual office-based care.[92,93] More than 90% of patients texted in their blood pressure, compared to 44% who attended their first office visit. And 80% of HSM patients met ACOG guidelines. Further, HSM eliminated observed racial disparities in postpartum blood pressure checks.[94]

HSM is now the standard of care for obstetrics patients across the Penn health system and has spread to other Philadelphia health systems as well, including Jefferson Health. Accelerating the impact of this work on a national scale, the team has expanded the program with implementation at Northwestern, University of North Carolina, Washington University in St. Louis, Women's Hospital-Alameda, and University of South Florida. With these changes, postpartum readmission rates have dropped from 5% to 1%. By thinking outside the traditional boundaries and habits of health systems, these obstetricians are saving lives, improving the patient experience, and reducing the cost of care.

Pivoting During the Pandemic

It happened so quickly in early 2020. A novel coronavirus upended our entire world, as hospitals struggled to keep up with desperately sick people and the body counts rose.

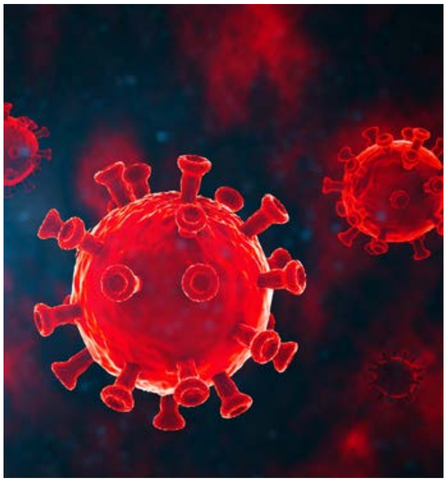
The usual pace of academic research would not help in this crisis. Recognizing the need to act quickly, LDI experts met the moment, conducting rapid-fire, creative research and analyses that could help policymakers understand the unimaginable and make data-driven decisions.

As many governments considered closing their borders and restricting the movements of their citizens, in March 2020 economist and LDI Fellow Hanming Fang and colleagues published one of the earliest analysis of the lockdown in Wuhan, China.[95] Using Chinese mapping app data, they showed that over five weeks, the lockdown reduced cases of COVID-19 in other Chinese cities and limited the spread of the virus. They noted, "Social distancing, and, if an epicenter can be identified as was the case for the city of Wuhan in China, a lockdown, can play crucial roles in 'flattening' the daily infection cases curve, giving the stressed medical system a chance to regroup and deal with the onslaught of new infection cases."

Similarly, in May 2020 economist and LDI Fellow Diane Alexander provided U.S. policymakers with valuable insight into the effects of county-level stay-at-home orders on mobility and consumer spending.[96] Using mobile phone data, she found that by mid-April, visits to non-essential businesses fell by 51% relative to pre-pandemic levels, total distance traveled fell by 33%, and sales at restaurant and non-restaurant small businesses fell by 37%.

Closer to home, an innovative group of clinicians and LDI Fellows launched COVID Watch, a text-based tool to remotely monitor patients with COVID-19 that were not sick enough to need hospitalization.[97] Launched in April 2020, the system enrolled more than 18,500 patients in its first year. A retrospective analysis showed that patients enrolled in COVID Watch were 68% less likely to die from COVID-19 than patients who received the typical course of outpatient care, while reducing the burden on clinical staff and decreasing costs for the health system.[98] The clinician and patient insights gained from this experience are now informing implementation of remote monitoring for other conditions, such as hypertension management, in-home administration of chemotherapy, and transitions between hospital and home.[99]

As an institute, LDI pivoted quickly to harness the expertise of its Fellows and staff as the pandemic emergency began. In May 2020, it provided 13 Rapid Response Grants to researchers proposing short-term studies to help inform and guide the emergency response.[100] As an example, one grant funded data scientist and LDI Fellow Hamsa Bastani and colleagues to develop unbiased estimates of the actual number of COVID-19 cases in Pennsylvania that were 1.5 times higher than state officials' public estimates. The innovative estimating strategy drew the attention of Greece's government, which commissioned Bastani's team of researchers to develop an AI-based COVID-19 screening and testing process at Greek ports of entry.[101] "Our project with Greece was partly initiated by the LDI Rapid Response targeting testing work…(it) opened that door for me," Bastani said.



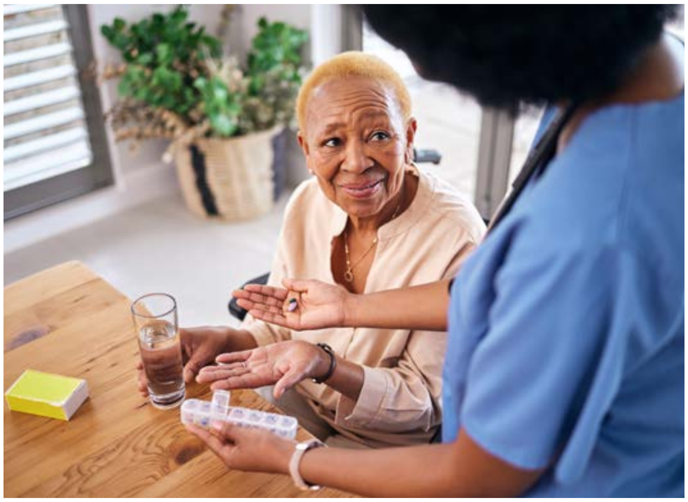
As the pandemic wore on, and COVID-19 vaccines emerged, LDI experts would bring their expertise to bear on telehealth, vaccine hesitancy, advanced care planning, infection control strategies, emergency care, preventive care, nurses' well-being, nursing home staffing, socioeconomic and racial disparities, and so many other COVID-19 topics.[102–110] They would advise the federal government and testify before Congress.[111,112] But in those early days of the pandemic, LDI and its experts came together to help a shocked and shattered world.

19

Smoothing the Rough Edges of Medicare Part D

Since 2006, Medicare Part D has helped enrollees pay for outpatient prescription drugs, filling a crucial gap in Medicare coverage. As with most new large programs, it was not a perfect solution at its onset; it needed further refinement to meet its goals of making prescription drugs more affordable and accessible to Medicare beneficiaries. That's where pharmaceutical health services researcher and LDI Fellow Jalpa Doshi comes in.

Early on, Doshi surmised that the design of Part D benefits would pose an insurmountable cost burden for certain patients needing specialty drugs—high-cost treatments for complex, chronic conditions like cancer, rheumatoid arthritis, and multiple sclerosis. This was because Part D required patients to pay a substantial coinsurance rate, ranging from 25% to 33%, with no annual cap on out-of-pocket spending. With the increasing number of effective specialty drug treatments, and with costs reaching thousands of dollars per year, a perfect storm was brewing.



Doshi and her team carefully documented the problem and created solutions. Their research demonstrated that with Part D cost-sharing, specialty drug users spent thousands of dollars out-of-pocket each year, and that these costs were typically "front loaded" in January when the Medicare Part D benefit resets each year.[113] "They were simply being asked to pay too much, too soon," Doshi explained.

Over the next few years, her research showed how out-of-pocket costs led many people to abandon new specialty drug prescriptions; delay the start of treatment after a new diagnosis or disease progression; and pause or discontinue specialty drugs, even potentially life-saving ones.[114–118]

But Doshi did not stop there. She proposed practical policy solutions, combining an annual Part D out-of-pocket cap with "smoothing," an option for enrollees to spread out and pay their out-of-pocket costs in monthly installments throughout the year.

Doshi pursued multiple strategies to communicate these ideas to policymakers and patient advocacy groups. She participated in national challenges asking researchers for strategies to improve access to critical medications.[119] She and her team wrote blogs and commentaries, participated in panels organized by *The Hill*, and partnered with the Patient Access Network Foundation to create an infographic that was widely used in advocacy efforts and shared with congressional staffers and in written testimony.[120–122]

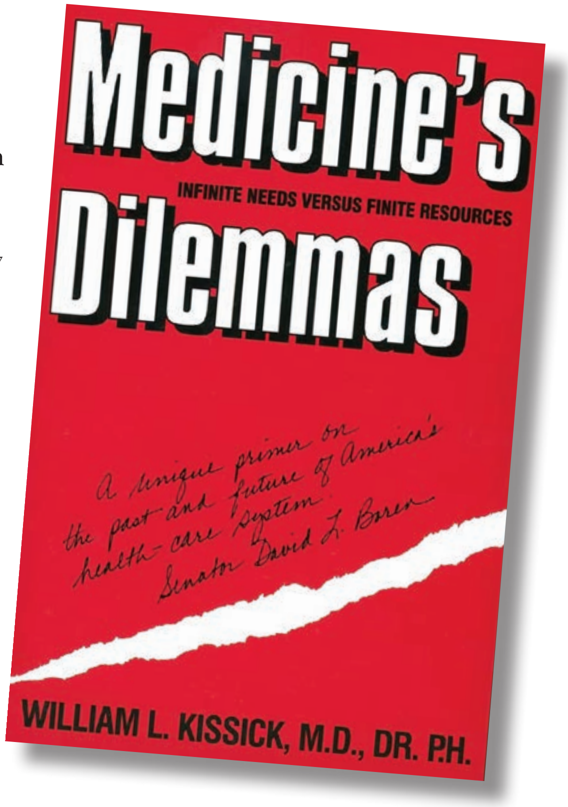
And these efforts paid off for Medicare beneficiaries, when the Inflation Reduction Act of 2022 incorporated these policy fixes into law.[123,124] As of 2025, people with Medicare Part D drug plans will have an annual out-of-pocket maximum of $2,000 for medications. Furthermore, they will have the option to "smooth" their out-of-pocket costs by enrolling in a monthly payment plan.[125]

The $2,000 annual out-of-pocket cap is projected to save nearly 19 million beneficiaries an average of $400 in 2025; patients on specialty drugs will save thousands.[126] The "smoothing" option is expected to improve affordability for more than 2.6 million beneficiaries. And millions more will benefit in the future, as innovative and high-cost drug treatments emerge in nearly every disease area.

20

The Irony of Limited Resources and Unlimited Needs

The Legacy of William Kissick



It was the elephant in the room in U.S. health policy, and it had been that way for decades. No nation could finance and deliver all the health care that its population needed, and hard choices had to be made. William Kissick understood that dilemma, as one of two physicians on the small team that had designed the Medicare program in the early sixties.[127] Around the time of the Clinton health care plan, Kissick decided to give that fundamental tradeoff a name (and a shape), and the "Iron Triangle" was born.[128]

In this triangle, access, quality, and cost containment have equal angles, representing identical priorities; the iron part is that these angles are rigidly interconnected, in that an expansion of any one angle compromises one or both of the other two. Kissick, one of LDI's first Fellows, drew on seven years of experience as a federal policymaker and in-depth analysis of health systems around the world to note:

> *"All societies confront the equal tensions among access to health services, quality of care, and cost containment. Tradeoffs are inevitable regardless of the size of the triangle. Call them resource allocation or rationing, they are choices our society must make."*

After his stint in Washington, D.C., Kissick spent 31 years at Penn, becoming one of LDI's early leaders and helping to launch Wharton's Health Care Management Program. He also established the Department of Preventive and Community Medicine within the medical school, and introduced generations of students to the importance of policy in medical care.

The Iron Triangle has been fundamental to the way health economists think about our health system to this day. It's the thread that runs through all of the health reform proposals in our lifetimes, from Medicare and Medicaid to the HMO movement, to the Clinton plan, and even the Affordable Care Act. It looms large in ongoing debates about how to cover new, expensive medical technologies, such as gene therapy and specialty drugs.

Over time, policy experts have questioned the framework itself, suggesting that the Iron Triangle could be bent, softened, or even broken by automation, value-based payment, or artificial intelligence. Some have suggested that it be replaced by the Triple Aim, in which systems can simultaneously achieve population health goals of improving care, promoting health, and reducing costs by targeting waste and inefficiency. But as of yet, no one has successfully cracked the Iron Triangle, and it remains a symbol of the tradeoffs that policymakers must make, and the challenge to them to do so, that William Kissick issued 30 years ago.

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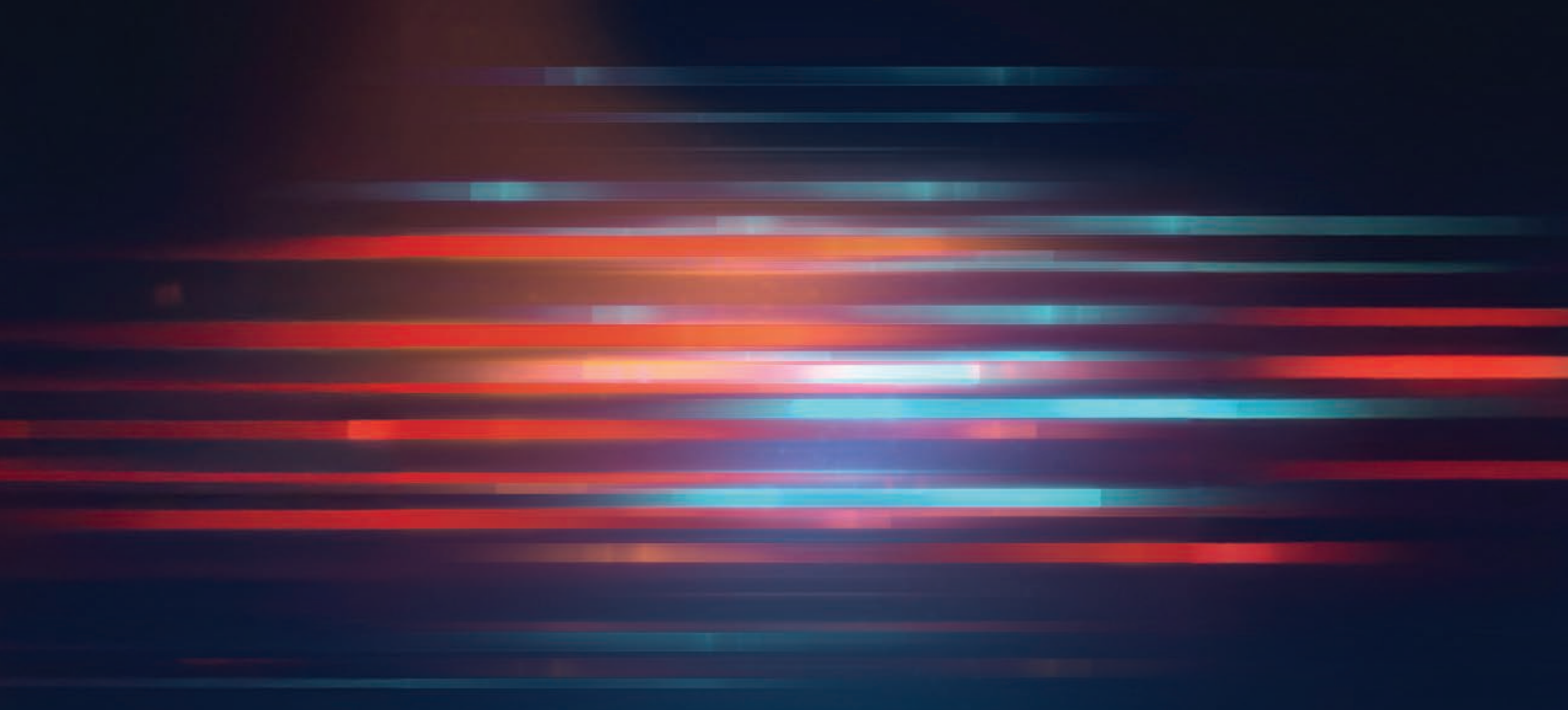

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