

Algorithms *for innovation*

**FIXING
THE FLOW**
OF HEALTH CARE
IN TURBULENT TIMES



UNIVERSITY OF UTAH
HEALTH SCIENCES
INNOVATION REPORT 2014

Suspend disbelief for just one moment and imagine

that we have enough...

*enough brilliance, resources, people, data, even money
to solve the impossible problems we face in health care today.*

Having trouble? Well, consider these numbers. Americans spend \$2.8 trillion on health care every year, and an estimated 30 percent of that is wasted. Figure out how to carve that out, and we'd have an easy \$840 billion to take better care of people.

**PERHAPS WHAT WE NEED ISN'T MORE OF ANYTHING,
BUT TO CONNECT EVERYTHING.**

That's the opportunity before us, and the idea we're exploring in this year's *Algorithms for Innovation*. How we can remove barriers and bottlenecks, real and imagined, local and global, so that money and patients and data and discovery and careers can flow. These are turbulent times, rushing us toward an uncertain future. From here, it looks like white water ahead. If we can harness that energy – and direct the flow – we believe the future looks bright.

Since 2012, Algorithms for Innovation has been asking questions and searching for solutions to some of the most impossible problems facing health care today. We believe there's an unprecedented opportunity to invent a new vision for health care, and academic medicine is poised to lead the way. Algorithms for Innovations is designed to spark conversations, highlight best practices, and foster collaboration to help transform the future.



Algorithms for Innovation is powered by University of Utah Health Sciences.
See more at: ALGORITHMSFORINNOVATION.ORG

THE ALGORITHMS INDEX

Amount that the U.S. spends annually on health care: **\$2.8 trillion**

Number of countries that spend more: **0**

Amount each American spends: **\$8,915**

Amount they'd save if they lived in Norway, the second-highest spender: **\$3,563**

Number of countries¹ with longer life expectancies than America: **25**

Percent of Americans who rate their health care as good or excellent: **79**

Percent of Germans able to schedule same- or next-day doctor appointments: **76**

Percent of Americans: **48**

Weekly patient encounters per doctor, including phone calls: **93.2**

Minutes of face time spent on average per patient: **16**

Newly insured Americans: **32 million**

Percent of elderly patients readmitted within 30 days of leaving a hospital: **20**

Amount of federally imposed readmission fines on hospitals: **\$227 million**

Petabytes of health data amassed on Americans: **500**

Petabytes of health data predicted to be collected by 2020: **25,000**

New articles cataloged by the National Library of Medicine in a year: **700,000**

Fraction of health information expected to be digitized by 2020: **half**

Percent of providers sharing health data outside of their system: **14**

Number of people worldwide predicted to have their genomes sequenced by 2015: **1 million**

Fraction of physicians who say they're uncomfortable interpreting genetic test results: **2/3**

Number of Americans living with an orphan disease: **30 million**

Percent of rare diseases for which federally approved treatments exist: **5**

Cost to develop a drug: **\$1 billion**

Percent drop over five years in inflation-adjusted federal research funding: **22**

Number of applicants to American medical schools: **48,014**

Percent of medical students who suffer burnout: **53**

Physicians who believe the practice of medicine is in jeopardy: **6 in 10**

Number of doctors who commit suicide each year: **400**

Percent of nurses who say they've experienced or seen rude and abusive behavior on the job: **98**

Utah's rank in United Health Foundation's scorecard of healthiest states: **6**

States with lower per capita health spending than Utah: **0**

Years of average life expectancy in Utah: **80.2**

Number of years that University of Utah Health Care has ranked among nation's top health systems: **18**

Percent of University of Utah physicians who place nationally in top 10th percentile for patient satisfaction: **46**

Percent who rank in top 1st percentile: **25**

FLOW OF MONEY

FLOW OF DATA

THE FLOW STATE

FLOW OF PATIENTS

FLOW OF DNA

WHY UTAH?

LEADERSHIP
PAGE 4

ALGORITHM 1
The Flow of Money
PAGE 8

ALGORITHM 2
The Flow of Patients
PAGE 16

ALGORITHM 3
The Flow of Data
PAGE 26

ALGORITHM 4
The Flow of DNA
PAGE 34

ALGORITHM 5
The Flow State
PAGE 44

WHY UTAH?
PAGE 55

¹ Switzerland, Japan, Italy, Spain, Iceland, France, Australia, Sweden, Israel, Norway, Netherlands, New Zealand, Luxembourg, Austria, United Kingdom, Korea, Canada, Germany, Greece, Portugal, Finland, Ireland, Belgium, Slovenia, Denmark
Figures cited are the latest available as of August 2014.

ALIGNING A SYSTEM



“
EVERY STAKEHOLDER HAS A DIFFERENT
AGENDA, BUT THERE’S ONE PLACE WHERE
THEY ALL ALIGN AND THAT’S AROUND
THE PATIENT.
”

CARRIE L. BYINGTON, M.D.
Associate Vice President for
Faculty and Academic Affairs
Health Sciences

VIVIAN S. LEE, M.D., PH.D., M.B.A.
Senior Vice President, Health Sciences
Dean, School of Medicine
CEO, University of Utah Health Care

DAVID ENTWISTLE, M.H.A.
Chief Executive Officer
University of Utah Hospitals and Clinics

When you have alignment, everything flows. That’s been our focus these past few years – redesigning our system so that it acts as a conduit rather than a barrier to reaching our goals.

It can be tough restructuring a complex organization at a time when the entire U.S. health system is in flux. Many of the external pressures – reductions in health care reimbursements, competition for NIH funding, threats to graduate medical education, changing regulatory issues – are out of our control. Like everyone, we’d like more resources. Imagine the discoveries we could make. The students we could educate. The care we could deliver.

Rather than lament the present, we’re looking at this constrained economic environment as an opportunity. We’ve got to break down barriers, get lean, and figure out new and better ways to leverage the remarkable resources we already have – especially our deep academic bench strength – to deliver value. Our responsibility is to produce great outcomes and results at affordable costs, whether in clinical care, research or education.

The sheer magnitude of the task has brought us back to our center – patients. We’re here to improve the health of the people we care for. When we look at everything through the lens of what’s best for our patients, obstacles fall away and solutions come into sharp focus. We have the tools and talent and vision to create the virtuous cycle of innovation and discovery. And we have the innate capacity to be learning organizations.

Change is constant: Once we accept that this is our new normal, we can learn how to survive and thrive in turbulent times. To help guide us through, we’ve identified highly collaborative leaders. Together, we are finding flow.

“
JUST AS A CONDUCTOR NEEDS TO LEAD
BRILLIANT SOLOISTS IN A COMMON UNITED
VISION, WE HAVE THE OPPORTUNITY TO
CREATE THAT ONE BEAUTIFUL SOUND FROM
A DIVERSE ENSEMBLE.

”

“For a million years, we’ve been educating students in silos. Today, we’re teaching students about the value of others – their roles and responsibilities – and the benefits of working in teams. I’m excited to watch these students create an entirely new model of care.”



JEAN P. SHIPMAN, M.S.L.S.
Director, Spencer S. Eccles
Health Sciences Library



DAVID H. PERRIN, PH.D.
Dean
College of Health

ELIZABETH D. WINTER, J.D., B.S.N.
Chief Counsel
Health Sciences



RENA N. D'SOUZA, D.D.S., M.S., PH.D.
Dean
School of Dentistry

WAYNE SAMUELSON, M.D.
Vice Dean for Education
School of Medicine



DEAN Y. LI, M.D., PH.D.
Associate Vice President for
Research and Chief Scientific Officer
Health Sciences



PATRICIA G. MORTON, PH.D., R.N.
Dean
College of Nursing

SEAN J. MULVIHILL, M.D.
Associate Vice President for
Clinical Affairs, Health Sciences
CEO, University of Utah Medical Group

KRISTEN A. KEEFE, PH.D.
Interim Dean
College of Pharmacy

“People are afraid they will not have a place in the new landscape, and that can be paralyzing. Our job as leaders is to convey a grand vision of what that landscape looks like when everything settles and reassure them about where they will fit in.”

ALGORITHM No. 1
The Flow of Money

RIGHT MISSION. RIGHT MARGIN.

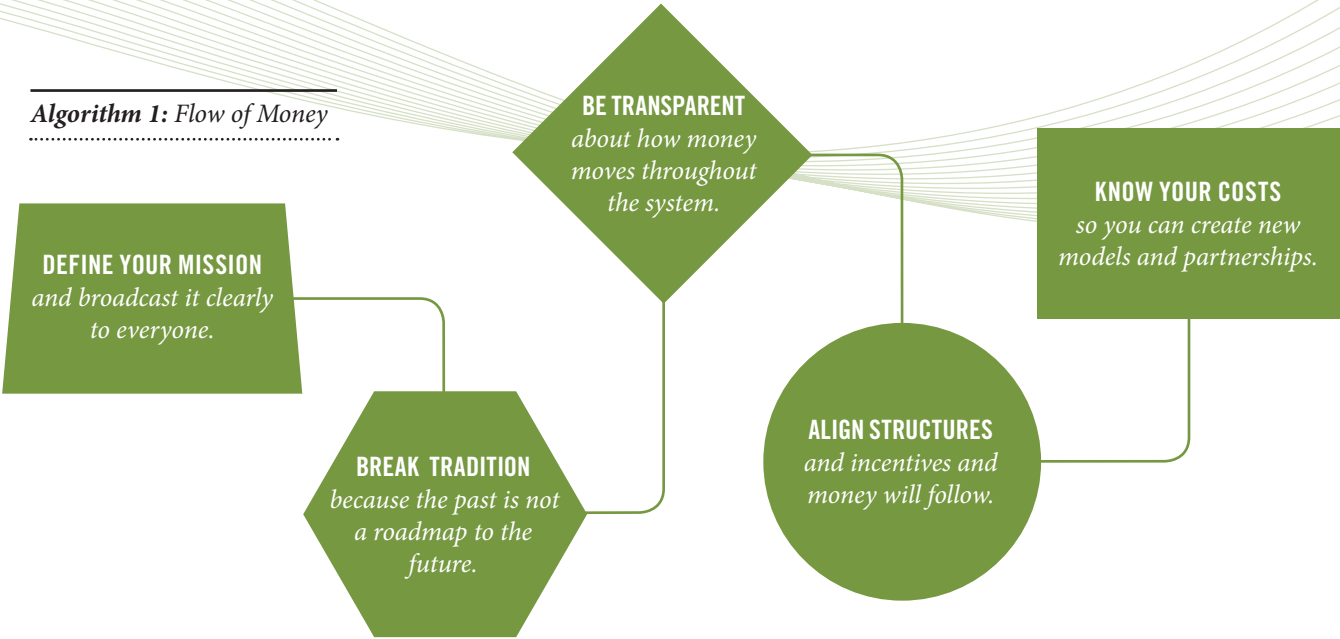
*It may be as true today as it always
has been: No margin. No mission.
But has our focus on the former
confused our understanding of the
latter? That's what we've been
working on clearing up this year.
Figuring out who we are and
who we want to be so that the
right alignment, incentives
and money will follow.*

“Whenever anyone says it’s not about the money, I grab my wallet,” quips Grant Lasso, M.B.A., associate vice president for strategy. In health care, it both is and is not about the money. “Money isn’t everything. But it is our lifeblood,” says Randall Olson, M.D., chair of ophthalmology and visual sciences. “Without it we’re dead.”

It’s complicated. That may be the most straightforward way to describe the uneasy relationship between health and money – a relationship that both defines and confuses our identity. Are we a business or a public service? Are they consumers or patients? Is it a job or a vocation? Are we here to treat sick people or keep them healthy? To add to our identity crisis, we’ve been operating under the assumption that the more money we spend, the better care we’ll provide. We now know that’s simply not true. While spending in the U.S. is outpacing inflation and incomes, when compared to the spending of other developed nations, our overall health hasn’t kept up. Until recently, there really was no economic imperative to fret over those issues or to change. As providers and health systems, we could afford to be duplicative and disjointed and survive – even thrive – in our patchwork system. Now with money tight and public and political scrutiny intensifying, the fragmented worlds of physicians, hospitals, payers, health systems and patients are all colliding. Our world is shifting and we need to respond. The question is how ... and how quickly. Breathtakingly fast and worrisomely slow. That’s how the pace of change feels right now. While providers and health systems feel that we’re moving at an unsustainably fast pace, payers, employers and patients are increasingly impatient. “Fundamentally, the problem has been the misalignment of incentives,” says Senior Vice President Vivian S. Lee, M.D., Ph.D., M.B.A. “Everyone in today’s fee-for-service model is paid for what they do. We’re not incentivized to do less, to work together or to prioritize and invest in what we really care about.”

We’ve been treating the symptoms, but we haven’t yet addressed the root cause of our problems: changing the organizational and financial models we’ve held sacred, however outdated. “Money follows the structures that we’ve set up,” says Lee. In health care in general but in academic medicine, especially, those structures have made for a winding, complicated and well-hidden path of money throughout our system. The tripartite mission is beautifully designed: patient care, research and education all symbiotically working to provide the best care and treatments for patients. But the hodgepodge of funding streams we’ve relied on to support that ideal came about haphazardly, even arbitrarily. Medicare covers a portion of what it costs to train residents, the state chips in for education, federal and private grants help fund research. But that has never been enough. The gaps to fund buildings, technology, researchers and students has been filled by the generosity of donors and revenue from the clinical enterprise. When the economy was strong and business was good, we didn’t have to be too particular about how exactly that was all happening. But in this constrained economy, those funding streams are drying up. Now it’s critical for us to be clear about not only how money is flowing throughout our system but what good it’s doing. “We’re starting to measure value in the clinical enterprise, but we have a long way to go to figure out how the money we’re spending affects the quality of education and research,” says Lee. It’s the old business maxim: you can’t manage what you don’t measure. And frankly, we haven’t been measuring. Building a new pipeline that’s sustainable,

Algorithm 1: Flow of Money



realistic and aligned around a singular purpose will take buy-in from everyone. “Everything is derivative of alignment,” says Chief Financial Officer David Browdy, M.B.A. To start the process, we hosted a retreat this past spring and invited the chairs of our 22 basic science and clinical departments, the deans of five schools and colleges and a handful of leaders from the hospitals and medical group. The fundamental questions we explored were: Who are we? And how do we want to move forward? Harvard business strategist Michael Porter, Ph.D., M.B.A., says, “Sound strategy starts with having the right goal.” Out of that retreat, we determined that our goal, our mission, is to advance health. Everything we do – discovery, education and clinical care – will focus on taking care of the health and well-being of the population we serve, not just during episodes of care but throughout their lifetime. “In our current system, the best strategy for our cardiovascular service line is to sell cigarettes, not prevent disease,” says Chair of Surgery Sam Finlayson, M.D., M.P.H. “I want to be paid to keep people healthy, not just to treat them when they’re sick.” Chair of Internal Medicine John Hoidal, M.D.,

agrees. “I want to see medicine operate where the patient always comes first, and that our commitment is to their health and well-being. When we’re driven by a social desire to help the population, everything flows from there.” It’s no small feat to get a room full of dedicated leaders to agree, but it’s a different thing altogether to change an entire culture, especially when the future is so uncertain. “It’s really hard to go from something we know to something we don’t,” says Browdy, when asked what keeps him up at night. “We have an entire system and lots of smart people within it who need to change.” Darrell Kirch, M.D., president and CEO of the Association of American Medical Colleges, recently said about change: “It’s almost as if you have to mount a campaign to win the hearts and minds of people.” One mission. One system. How that looks, what that means, how we change is still unfolding. One thing we know for sure: What we’ve done in the past will not take us to where we need – and want – to go. “We need a whole new vision,” says Lee. “And organizations like ours are the ones that can come up with the good ideas and innovative solutions.”

15 YEARS TO TRANSPARENCY: Lifting the Veil on Funds Flow

As if health care financing isn’t complicated enough, academic medicine layers on another level of complexity, thanks to its tripartite mission. Since tuition and grants fall short of funding education and research, the government and the clinical enterprise pitch in to help subsidize these important missions. How exactly these pots of money have been divvied up is one of the most opaque and contentious processes around. Traditionally, department chairs meet one-on-one with deans and CEOs, and behind closed doors they negotiate the best deal they can. Fifteen years ago that long tradition began to change at the University of Utah. Following is a timeline that shows how lifting the veil on funds flow fundamentally changed our culture.

15 YEARS AGO Lorris Betz, M.D., Ph.D., arrives in Utah to lead the health sciences and finds that, like most medical schools, ours is a loose federation of highly autonomous departments. His highest priority is to understand how much education and research are costing each of the 22 departments and what cross-subsidies are covering those expenses. “You can’t manage a budget if you don’t know where the money is going,” says Betz. He asks the chairs to identify how much time each faculty member is spending on clinical care, education and research. In November, Betz hosts a retreat, reports the findings and asks a radical question: How do you want to allocate the central state funds primarily earmarked for educational purposes? They create a committee and launch Mission Based Management (MBM), a central database to track all funds flow.

CASE STUDY

WHAT DOES IT COST? Getting Granular

It's hard to create a value-based health care system when you can't figure out what your actual costs are, let alone map them back to a patient encounter. The ability to do that with accuracy and specificity has eluded health centers. Last year in *Algorithms*, we reported on a revolutionary tool we created that does just that. Called Value Driven Outcomes (VDO), it combines vast amounts of data from a wide range of sources, loads it into the data warehouse, organizes it and serves it up as a user-friendly, Web tool. Leadership can pull up charts, like the one below, see all of the providers who perform gall bladder removal surgeries for example, and then drill down to specific costs for labs, pharmacy, radiology, etc.

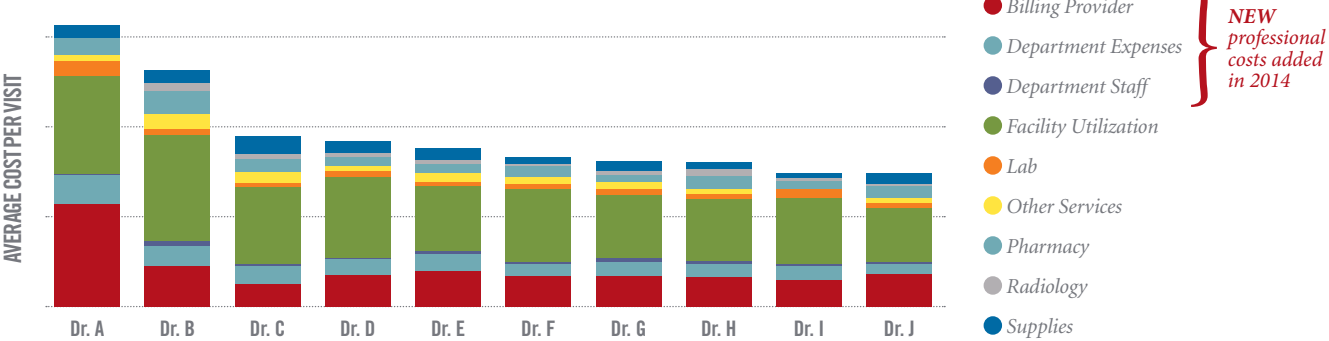
While VDO did a remarkable job with facility costs, there was an important piece missing – professional costs. Divining this isn't as simple as calculating how much a provider is charging. You also need to know how much it costs to run that provider's department, from copy machines to front desk and clinical staff.

The new challenge given to the VDO team this past year was: find a way to quantify and articulate those professional costs and tie them back to a patient encounter. Because academic departments also support

research and education, parsing out clinical expenses is even trickier. Success required total cooperation from departments who were asked to assign all of their expenses to a mission: clinical, education or research. Departments at other institutions might balk at the intrusiveness of such a request, but our School of Medicine chairs had long ago established a centralized management system (see timeline below), so the tradition of tracking expenses by mission, and the tool to do it, were securely in place.

Now, when department leaders pull up a VDO chart, they find bars that correspond to facility fees, provider costs and department expenses. "This is just one more step toward our goal of becoming a value-driven organization and providing the best care at the lowest cost," says Senior Vice President Vivian S. Lee, M.D., Ph.D., M.B.A., who championed the VDO tool. Lee points out that the reports are meaningless without input from providers. They're the ones who bring the expertise to eliminate outliers and identify opportunities to redesign care. "VDO doesn't give answers," says Lee. "But it provides precise and accurate data to have the conversation."

VALUE DRIVEN OUTCOMES (VDO) REPORT
MS-DRGs 411-419 – Cholecystectomy (inpatient)



CASE STUDY

IS IT WORTH IT? Linking Outcomes with Costs

Is it worth it? When it comes to health care, that is not a question we ask as a nation. When we do, the answer has been a resounding "yes." The moral impulse to save a life, regardless of the costs or consequences, is instinctual. Our gut instinct has been that it is worth it, no matter what.

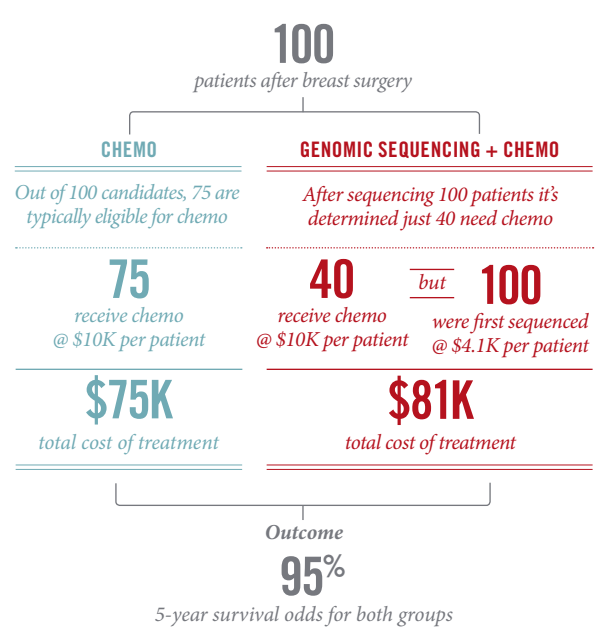
With rising insurance premiums and co-pays, the American public is becoming more cost-aware, if not cost-conscious. "Patients aren't asking how much tests and treatments cost," says Chief Medical Information Officer Michael Strong, M.D. "But they are questioning if they're necessary." Chief of Pediatric Surgery Eric Scaife, M.D., was curious about how patient families would respond to pricing information. He chose a procedure – pediatric appendectomy – with two surgical approaches that produced the same outcome and gave parents a choice between an "open" operation or the more expensive laparoscopy. When outcomes were the same, parents were almost twice as likely to choose the open procedure.

Often the calculus is more complicated. Take a breast cancer patient deciding whether to undergo chemotherapy. Through sequencing of tumors, oncologists can better predict which cancers will respond to chemo, sparing some patients the cost and negative outcomes associated with toxic side effects. But sequencing isn't cheap. "When we're developing new drugs or technology or when we're choosing between treatments, we have to be able to weigh its costs against its potential benefit for patients," says Pharmacotherapy Chair Diana Brixner, Ph.D., R.Ph. Her research team looked at the electronic health records of thousands of breast cancer patients, using a new tool called WartHog (see page 30) that searched text notes to ensure they were comparing patients at similar stages of disease. They analyzed the effectiveness of different chemo drugs, identified patients who faced the decision of whether to proceed with chemo, and then modeled the costs of different treatment options (see infographic).

As the executive director of the Pharmacotherapy Outcomes Research Center, Brixner is bringing even more data sources together to build a breast cancer dashboard to be used at the point of care. The dashboard, which will either be an app or integrated into the EHR, will describe the treatment choices and subsequent outcomes of similar patients to help people make decisions. "We're pulling it all together, and it's at this nexus where some surprising answers to the question of value can be found.

DECISION TIME

With genomic testing, we can target breast cancer patients who will respond to chemo and spare others the costs and toxic side effects. Here's how the numbers play out:



IS IT WORTH IT?

To pay an extra \$6,000 to spare 35 women chemo, considering quality of life, risk of complications and potential downstream medical costs?

14 YEARS AGO

The following spring, Betz invites chairs to present and discuss their budgets with their peers. The books are literally thrown open. Highly secretive department budgets are passed around in binders for further scrutiny. "The room was packed," remembers John Zone, M.D., chair of dermatology. "After four hours, we realized that no one had been dipping into a pot of gold, and that started to build trust." Finally, we had good data to drive decision-making, says MBM Director Cynthia Best, M.B.A., who since has been building a computer system that meticulously tracks faculty and budgets. "Money pulled us together instead of breaking us apart and brought alignment to what we do, why we do it, and how we pay for it." With solid data in hand, Betz shows the Utah Legislature how medical education had been underfunded by \$20 million per year. The legislature kicks in \$5 million, and Betz secures a \$10 million match in federal funds, increasing the pie by \$15 million.

12 YEARS AGO

Gordon Crabtree, M.B.A., joins as CFO of the hospitals and clinics. He begins advocating for transparency and consistency with another, bigger pot of money – the margin used to make clinical transfers to the School of Medicine. Crabtree begins preaching the "unified margin gospel." There aren't different buckets of hospital revenue and margin for each specialty and patient care unit. There's just one bucket for the enterprise that needs to support academic and research missions as well as patient care and clinical capital needs. It's a finite margin and a zero-sum game.

7 YEARS AGO

CEO David Entwistle, M.H.A., arrives to lead the hospitals and clinics. A task force, led by John Zone as chair of the MBM Advisory Committee, is formed to develop principles that align transfers with clinical productivity and reaching targets and goals. The intent is to ensure transfers don't become entitlements, especially during times of reduced clinical margins/resources.

3 YEARS AGO

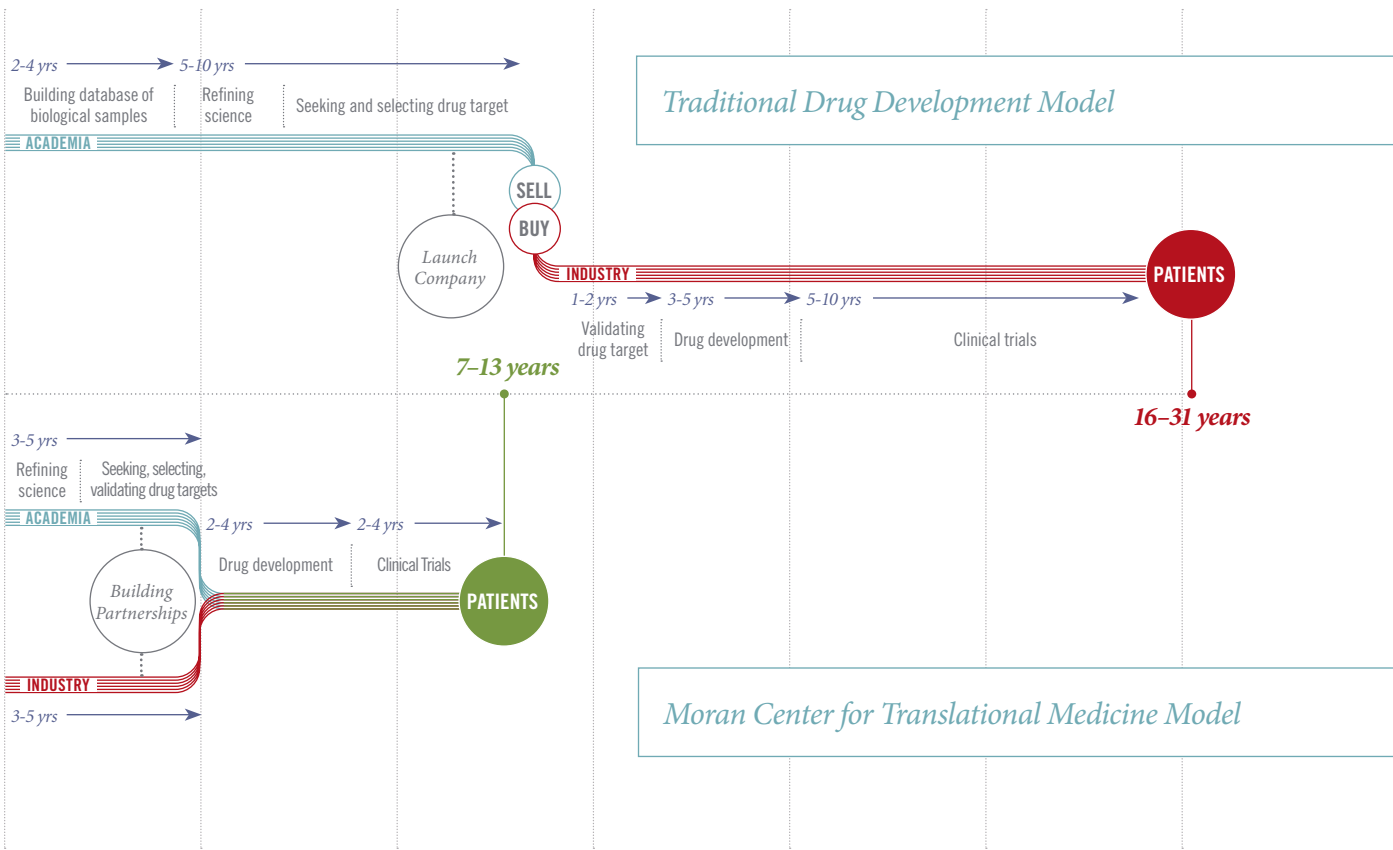
In a bold, unprecedented move, Entwistle throws out the long-held tradition of meeting with School of Medicine chairs privately and invites them to collectively make recommendations on how clinical transfers are allocated to the departments through an initiative he names the Share Institutional Resource Committee (SIRC). MBM had paved the way for shared decision-making, but this is a radical move that shifts responsibility from hospital administrators to the chairs to decide how to balance capital and strategic needs of the clinical enterprise while supporting the needs of individual departments. The chairs agree that we need more transparency and principle-based approaches and over the next two years initiate many changes to the SIRC process. Eventually it's determined that collectively deciding on 500-600 transfer line items is not the most efficient use of their time. An eight-member working group is formed to put more structure and a methodology around the process and formalize principles to guide decision-making.

TODAY

We've created one of the most transparent funds flow processes in the country and learned a lot along the way. Now, we're thinking about how we can create a model that's even more responsive and agile. A model that allows us to be proactive about making strategic capital and operational clinical investments for the future rather than reactive through a once-a-year budgeting process. One that supports departments to be self-sustaining and less reliant on transfers. This past year, a small portion (\$2 million) of the FY 2014 hospital transfers and improved margin were held back and put in a SIRC strategic fund. And for the first time, the amount of transfers approved for FY 2015 were reduced by \$6 million. We're not sure what the future holds, but we think that slowing down and realigning the transfers will put us in a better position to respond.

CASE STUDY

FUELING DISCOVERY:
A tale of two models



Cure macular degeneration. Plain and simple. That’s how Gregory Hageman, Ph.D., professor of ophthalmology and visual sciences, describes his lifetime goal. Hageman has already discovered many genes associated with age-related macular degeneration (AMD), and over the past 20 years, he has built the largest collection of eyes – roughly 6,500 at last count – donated by people from all over the world. “Most people agree that Hageman has the biggest and broadest vision of AMD today,” says Randall J Olson, M.D., chair of ophthalmology and visual sciences.

If Hageman’s focus and vision for discovery is crystal clear, his patience for traditional academic funding models has long worn thin. At 60 years old, Hageman isn’t interested in spending the next 25 years taking a discovery from the lab to patient care. Neither is Olson. “Discovery is what changes the world,” says Olson,

“DISCOVERY IS WHAT CHANGES THE WORLD. WE NEED TO FIND A NEW MODEL TO FUND IT.”

— RANDALL J OLSON, M.D.
CEO, John A. Moran Eye Center
Chair, Department of Ophthalmology
and Visual Sciences

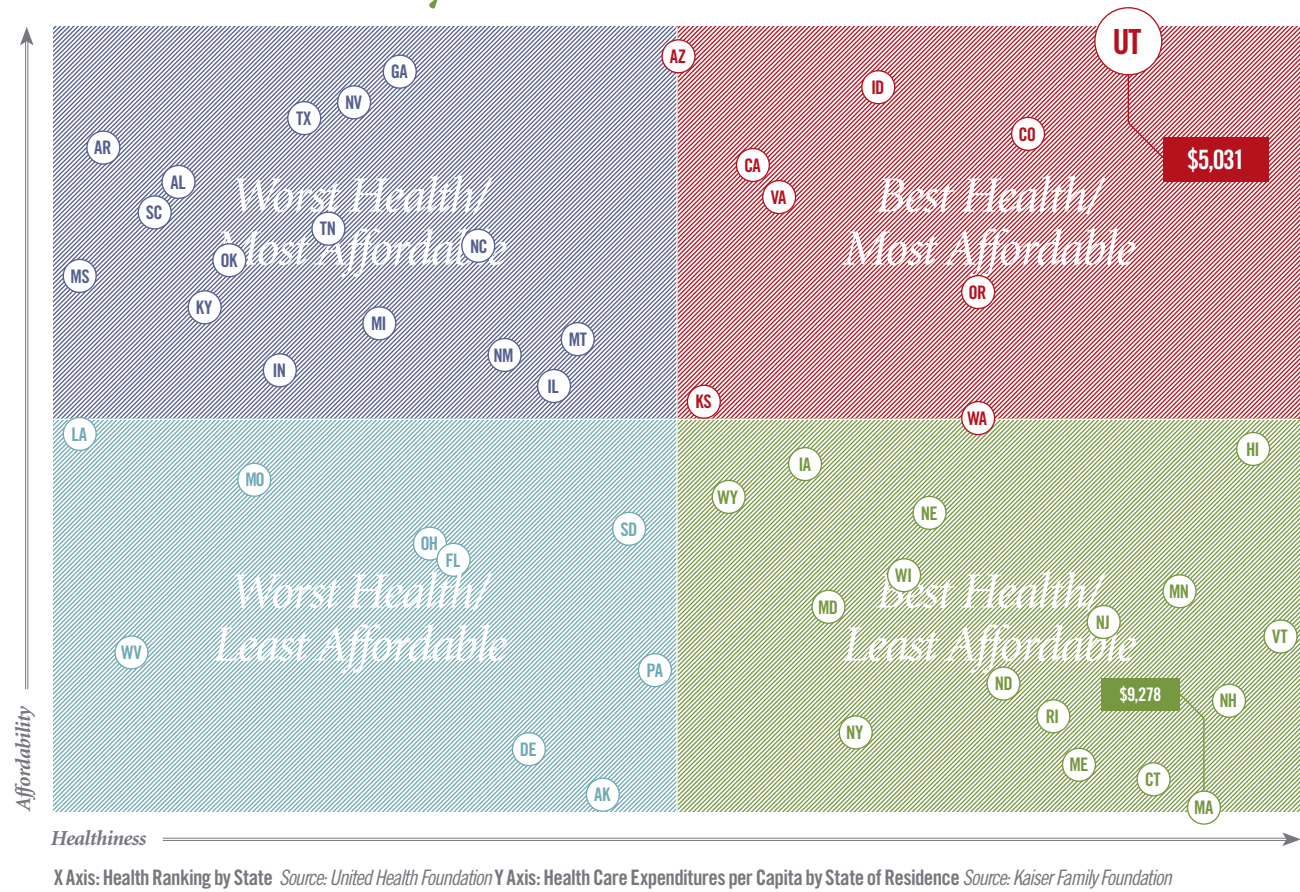
CEO of the John A. Moran Eye Center. “We need to find a new model to fund it.” He feels the current funding system is broken and inefficient, rewarding conservatism instead of risk-taking, individuals instead of teams, publishing instead of producing. So when Hageman arrived in Utah with his semitrailer full of donor eyes, and an ambitious dream to cure macular degeneration, Olson told him to, “focus on the science, and I’ll work with you to raise the money.”

Hageman and Olson have created a solution to the traditional academic funding model called the Center for Translational Medicine (CTM). Under Hageman’s leadership, CTM is designed to fuel faster and less expensive discovery by strategically partnering with private industry early on. While academia has traditionally been cautious about such collaborations, Olson and Hageman have embraced such partnerships as the way to the future. “Industry has deep pockets and resources academia couldn’t dream of, and we have magic pieces of the puzzle,” says Hageman, referring in his case to donor eyes, patients, brilliant faculty and the Utah Population Database. The key is to set up a win-win partnership where everything is transparent, the science is squeaky clean, incentives are aligned, funding is based on reaching milestones and everyone is racing toward a singular goal: to get new treatments to patients.

To find that cure for AMD patients, Moran has set up a partnership with the pharmaceutical company Allergan. “Finally we have the resources to run as hard and as fast as we can toward one goal – to get a product out the door,” says Hageman. “We have access to brilliant people on both sides of the fence. I’ve always wanted to say that I couldn’t keep up with my team. And I’m there. I’m so there.”

CASE STUDY

BENDING THE COST CURVE:
The Utah Way



In the race for better, cheaper health care, Utah comes out on top. No other state spends less per capita and few register higher on the wellness meter.

There’s a national debate about how spending affects health. Louise Sheiner, Ph.D., senior fellow and policy director at The Brookings Institution, points to a number of possible explanations, including demographics, access to care, social supports, education and variation in how doctors practice medicine. “All these factors are correlated and tough to disentangle,” says Sheiner.

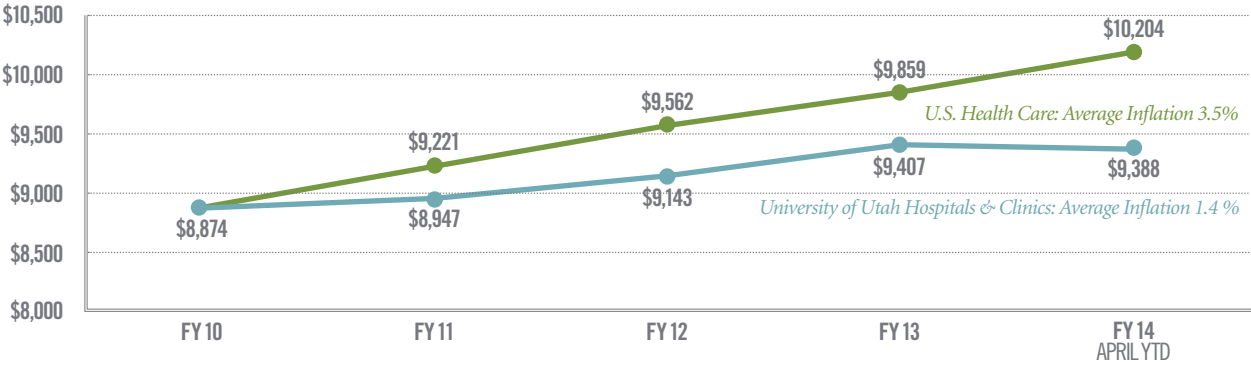
Doubtless, some of our success is due to demographic luck. We’re a young state with the lowest median age in the country. About 40 percent of Utahns are active in the Church of Jesus Christ of Latter-day Saints, which eschews alcohol and tobacco. That healthy lifestyle contributes to lower rates of chronic disease, including obesity, diabetes and stroke. Utah is also home to three

top-rated health systems recognized for delivering low-cost, high quality care.

Whatever the root cause of our success, we’re not taking it for granted. These past few years, University of Utah Health Care has started to bend the cost curve, charting a slight decline in our average cost per hospital discharge in FY14. We’re doing that by getting a handle on our costs, through our Value Driven Outcomes (VDO) tool (see page 12), which can break down the cost of any procedure or episode of care. We’re also getting Lean, focusing on continuous process improvement as an integral part of our culture.

It’s true that Utah may be demographically worlds apart from Mississippi or Massachusetts. But instead of looking overseas for answers to America’s health cost problem, there may be lessons to be distilled from closer to home – from the Utah model.

AVERAGE HOSPITAL COST PER PATIENT ENCOUNTER
(ADJUSTED FOR DISCHARGE AND ACUITY)



Source: U.S. Bureau of Labor & Statistics; Centers for Medicare and Medicaid Services; University of Utah Hospitals and Clinics

STREAMLINING CARE

A hassle. That's how many patients, and providers, describe the U.S. health care delivery system. From the time patients enter, we're asking them to wait longer, return more often, and navigate their way through a Byzantine maze of fragmented services to receive the care they deserve. Streamlining the flow of patients isn't about hiring more people or adding more beds. It's about listening to patients and then working together to create a seamless continuum of care.

“If our patients need a navigator, then we haven’t designed a system that works.” That’s how David Entwistle, M.H.A., CEO of University of Utah Hospitals and Clinics, sees our current health care delivery system. While patient navigators can be invaluable in today’s world, their very existence highlights how broken health care really is.

We may pay a lot for health care in this country – \$2.8 trillion, by last count – but at least we can count on a doctor being able to see us in a pinch, right? This may be what we tell ourselves, that we pay for what we get: efficient, top quality care. But the truth is less flattering. Patients in this country wait an average of 20 days to see a primary care physician, 29 days to see a dermatologist, and six months to see some sub-specialists. Once in the system, they meet with further, sometimes harmful, delays, which too often trace back to poor communication: lost paperwork, duplicate tests or long waits to be admitted, transferred, prepped and discharged. According to the Joint Commission’s Center for Transforming Healthcare, about 80 percent of serious medical errors happen because of miscommunication when patients are handed off from one provider or care center to another. Every week, there are up to 40 wrong-patient, wrong-procedure, wrong-site and wrong-side surgeries.

Here’s the thing: If we don’t get it right soon, how will we handle the influx of an estimated 32 million newly insured patients as a result of the Affordable Care Act?

“Every system is perfectly designed to achieve exactly the results it gets,” says Donald Berwick, M.D., former administrator of the Centers for Medicare and Medicaid Services. In the case of academic medicine, we’ve built our system around providing highly specialized care to patients. From that viewpoint, we’ve produced spectacular results. “The model we’re trained in is an army of one,” says Chief Medical Officer Thomas Miller, M.D. “We’re operating little islands. You come to my island and get coconuts, go to the other islands to get mangos. The system’s not set up so that we’re paid or aligned or incentivized to collaborate, and that shows in the way we see patients.”

Entwistle admits that trying to fix health care can

often seem like trying to turn the Titanic, especially when many of the best ideas to streamline care are not reimbursable or apply to patients outside our reach. The complexity of the patients in academic medicine multiply our challenges. There are a thousand points of variation and an equal number of opportunities to get it wrong. One thing is certain. We can’t solve everything at once. There is no silver bullet. No one master plan.

Management consultant and author Adrian Slywotzky, J.D., M.B.A., recommends we start by creating a hassle map – identifying all of the irritations, frustrations and delays – first from the patient’s experience and then from all of the stakeholders’ perspectives and then work our way backward to fix them one by one. “We need to find the confluence of convenience and ease and value for patients and providers alike,” says Michael Magill, M.D., chair of family and preventive medicine.

Hassle maps look different from different perspectives. Part of creating sustainable solutions is to address everyone’s. That means including important voices in

the conversation that traditionally have been excluded, primarily the patient’s, but also those who work in environmental services, transport, social work and case management. “We have incredibly bright people who haven’t been told the whole story,” says Tracey Nixon, R.N., nursing director of capacity management. “When we’re only able to see the patient through our unique angle, it makes figuring out flow very difficult.” Instead, the tendency is to finger point or create work-arounds that shift responsibility to someone else. Nixon believes that

if people had a better sense of the whole picture, they’d be invested in figuring out ways to move the patient throughout the whole system and not just through their piece of it. It makes everyone’s lives easier.

Times are changing. In academic medicine, we’re finally starting to think about our patients’ health more holistically and, to Berwick’s point, we need to create a new system that will produce results to match that vision. “We want to be lifelong partners with our patients

“ WE WANT TO DESIGN A SYSTEM THAT WRAPS OUR PATIENTS IN CARE. ”

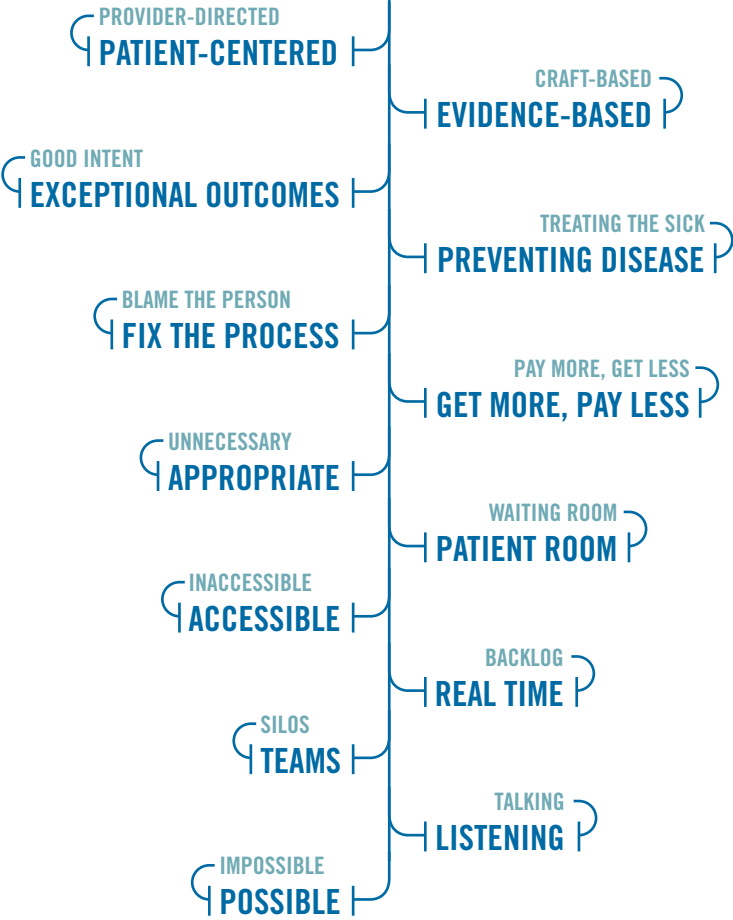
— MICHAEL K. MAGILL, M.D.
Chair, Department of Family and Preventive Medicine



and our communities, and that requires integration across all of our specialties,” says CEO of University of Utah Health Care Vivian S. Lee, M.D., Ph.D., M.B.A. “We’re thinking about the whole continuum of care – from primary to secondary to tertiary care, from rehab to recovery, from wellness to chronic care.” It’s a long process, says Lee, one that requires us to define our goals more clearly and find ways to engage everyone in working towards them.

“We need to communicate the vision and the context to people and then inspire people to believe that they can do great things,” says Robert Pendleton, M.D., chief quality officer, who adds that he sees kernels of magnificence happening all over. By many metrics, University of Utah Health Care is a highly functioning system. For four years running, University HealthSystems Consortium (UHC) has ranked us in the top 10 for quality, and according to Press Ganey rankings we’re leading the country in physician satisfaction for outpatient care. Part of our success flows from being transparent and honest about our weaknesses. We were the first academic medical center in the country to post patient reviews online, both positive and negative.

Even still, Entwistle is quick to point out, there’s room to improve. “When we were awarded No. 1 in quality by UHC, our score was 68.4 out of 100,” says Entwistle. “You can’t ever think you’ve arrived. You have to be anxious and constantly looking to improve.” Every patient gives us an opportunity to learn and get better at what we do, says Lee. Eventually, we want to turn that hassle map into a value stream. Magill puts it this way. “We want to design a system that wraps our patients in care.” On the following pages, we highlight examples of how we’re working toward that goal.



CASE STUDY

ACCESS

Six months. That's how long patients suffering with chronic, and sometimes debilitating, pain were told to wait at our headache clinic. "Let's face it, people in pain can be painful to treat, especially for time-strapped primary care providers," says headache specialist Susan Baggaley, M.S.N. "Patients come in for a physical and say, 'Oh, and by the way, I also have splitting headaches.'" The path of least resistance for providers, who on average receive three hours of headache training in medical school, is to write a prescription and recommend that patients get in line, a very long line, at the headache clinic. Desperate to help alleviate pain, providers often prescribe opiate drugs, which are not only addictive, but can also worsen migraine headaches.

The seriousness of the situation was not lost on the small staff at the headache clinic. For years a solution had eluded them. Headache is considered an epidemic, and neurologists are in short supply.

When migraine researcher K.C. Brennan, M.D., received an email announcing a round of "Lean Projects" last fall, he and Baggaley quickly signed up. The six-week process improvement course paired them with a "value engineer" and gave them structure and a deadline. It also opened up access to system resources they'd never had before. They queried the data warehouse to see how headache patients were moving through the system, and after studying 50,000 encounters coded as "undiagnosed headache," they discovered four out of five patients were prescribed a controlled substance. "We were making disease instead of healing it," says Brennan.

Increasing capacity to meet the over-

26 DAYS

Average time patients wait to be seen in specialty clinics nationwide

whelming demand wasn't an option. "We realized we needed to turn the problem around," says Baggaley. "This wasn't about increasing access, but about decreasing need." Instead of approaching their primary care colleagues with an "it's-your-problem, you-fix-it" attitude, they built three simple questions into the electronic health record that helped diagnose headache and created corresponding treatment protocols. "Doctors are algorithmic," says Brennan. "We just need to empower them by giving them a tool." They also embedded an enthusiastic primary care doctor, Karly Pippitt, M.D., into the clinic to triage patients and support colleagues with phone consults.

Six months after launching the project, there was a 20 percent reduction in the misdiagnosis of migraines, a 7 percent reduction in opioid prescriptions and a four-month reduction in wait times for patients referred by primary care providers within our system. "We have plenty of access," says Michael Magill, M.D., chair of family and preventive medicine. "We've just clogged up our clinics with patients who don't need to be there."

"No one mandated we do any of this," says Brennan. "But the institution created an opportunity for us to work on a problem we'd been concerned about for years and provided the resources we needed to solve it."

“WE REALIZED WE NEEDED TO TURN THE PROBLEM AROUND. THIS WASN'T ABOUT INCREASING ACCESS, BUT ABOUT DECREASING NEED.”

— SUSAN K. BAGGALEY, M.S.N.
Vice-Chair of Clinical Operations,
Department of Neurology

Headache Clinic staff members Karly Pippitt, M.D., assistant professor of family and preventive medicine and adjunct assistant professor of neurology; K.C. Brennan, M.D., assistant professor of neurology; and Susan K. Baggaley, M.S.N., vice-chair of clinical operations for neurology

TRANSITIONS

CASE STUDY

2/3

of hospital execs say they don't have an effective discharge process

“L”et’s be honest. When it comes to discharge, everyone wants to blame everyone else,” says Tracey Nixon, R.N., nursing director of capacity management. Doctors haven’t written discharge orders, physical therapy hasn’t come, pharmacy is backed up, nurses are busy with other patients . . . the list of finger-pointing goes on. This lack of coordination is not lost on patients waiting for hours to go home. From a system perspective, it’s inefficient. From a payer’s perspective, it’s expensive. “Patient throughput is a choke on hospitals,” says Nixon, also known as the Czar of Patient Flow.

But what if discharge is not actually the problem? What if the problem is much less intuitive and much further upstream: admissions? No one knows their names or medical condition, but we know – anecdotally and statistically – that new patients will be admitted every day. Yet curiously when they arrive, we are caught completely off guard and frankly inconvenienced. How could something so predictable be so surprising?

The problem, Nixon explains, is that no one has ever created a workflow that accounts for the time it takes time-strapped nurses to get a patient settled. “This is just one example of how we don’t use historical data in health care to create workflows that are realistic,” says Nixon. Instead we’ve relied on feelings and perceptions. We’ve also misaligned incentives. “By holding nurses accountable to discharge patients by a certain time, we take away the incentive to admit the patient waiting for hours in the ED or the PACU.”

Guided by demand-capacity management and queuing theory, Nixon set out to pilot changes on two units. If the theories are highbrow, the solutions are low-tech, mostly involving better communication and planning on the unit level and the system level. Being proactive about admissions instead of reactive about discharge had a ripple effect. In just the first two months of launching the program in two units, discharges before 5 p.m. increased 9 percent. Even more impressive, the units were able to predict admissions and discharges with 87 percent accuracy, a 50 percent improvement.

Thinking about patient throughput was a huge culture change, Nixon says. Now everyone is accountable. “If I ask a physician to write discharge orders and that patient is still sitting there five hours later, I’ve lost all credibility. It’s a deal breaker,” says Nixon. “Everyone owns a piece of the discharge pie. We’re one system. We’re all partners.”

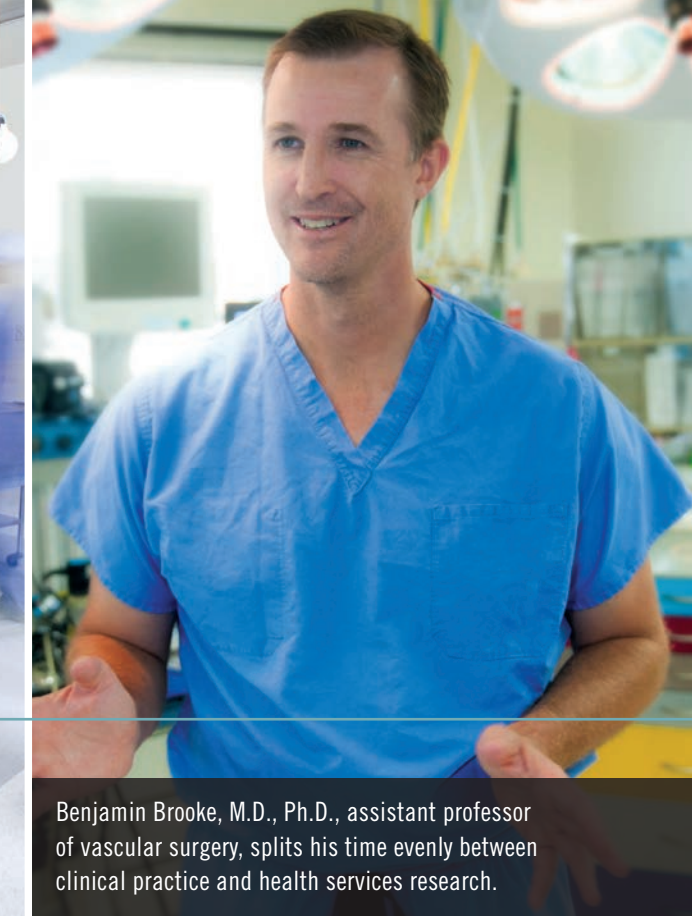
Tracey Nixon, R.N., nursing director of capacity management is also known as the Czar of Patient Flow



Brent Wilson, M.D., director of the Cardiovascular Center, Echocardiography Lab, and Cardiology Clinical Services, and Steven Tew, M.H.A., M.B.A., outpatient services director of the Cardiovascular Service Line standing outside the newly remodeled Cardiovascular Center. Medical assistants guide patients throughout their entire visit.



24%
of Medicare vascular
surgery patients are
readmitted within
30 days



Benjamin Brooke, M.D., Ph.D., assistant professor of vascular surgery, splits his time evenly between clinical practice and health services research.

CASE STUDY

Volume gets a bad rap these days, and focusing on market share seems old-school compared to the post-Affordable Care Act emphasis on value. But Cardiovascular Center Director Brent Wilson, M.D., Ph.D., believes that volume and market share were the necessary means to growing out of problems and into value. They were also a means to survival.

Five years ago, the cardiovascular service line (CVSL) faced a bleak reality. It was ranked number four in market share in the region. Specialists were siloed in their departments. Care was fragmented. Patient satisfaction scores fell below the 25th percentile nationally.

Then CVSL Medical Director John Michael, M.D., M.B.A., and Administrative Director Don Zarkou, M.B.A., both agreed: The old system, which had been in place for decades, was not the path forward. Michael wanted to hire people with experience and vision and rethink how the service line did business. Meetings with hospital administration were frequent and spirited. It became clear that success depended on a willingness to bridge the great divide between faculty and the health system, work together and trust one another. Wilson remembers Dan Lundergan, M.H.A., then executive director of University of Utah Hospital, saying, “We’ll support what the School of Medicine thinks is best.” Both sides took a leap of faith.

What followed was a complete transformation. “The entire structure was redesigned

to provide seamless, efficient and coordinated care for patients,” says Outpatient CVSL Director Steven Tew, M.H.A., M.B.A. Together, hospital and School of Medicine leaders organized the medical assistants (MAs), previously hired by individual physicians, into a coordinated group practice. They created a central phone line staffed by MAs that offered a single, easy-to-access portal of entry for CV patients, many of whom have complex treatment plans that span multiple specialties. From shifting appointments, coordinating consecutive visits with multiple providers, and greeting patients when they arrive, MAs guide patients, a third of whom live more than 100 miles away, through every step of clinical care.

The Cardiovascular Center grew to more than 95 providers. “We looked for strong personalities who wanted to make a difference,” says Wilson. “Higher clinical volumes and diversity of patients opened up greater possibilities for both training and research.” It also allowed them to expand outreach, with cardiologists now seeing patients in more than 20 sites in five states.

Today, the CV service line is ranked No. 2 in market share, patient satisfaction has skyrocketed to the 85th percentile, and last quarter was the most clinically productive ever. “Volume, and alignment with the hospital, has done many good things for us and for our patients,” says Wilson.

THE CARE
CONTINUUM

CASE STUDY

Benjamin Brooke, M.D., Ph.D., has all the right degrees from all the right schools (University of Virginia, Utah, Hopkins, Dartmouth). After 15 years of rigorous training, the path he chose as a vascular surgeon, however, is much less traditional. Today, you’re as likely to find him sitting in a focus group talking to patients about their recent surgery as you are to find him in the operating room performing a complicated bypass graft.

“**I FEEL LUCKY TO BE HERE. A LOT OF DEPARTMENTS ARE SO DRIVEN BY PRODUCTIVITY AND CLINICAL REVENUE, THEY WOULD NEVER ALLOW SURGEONS TO DO THIS TYPE OF WORK.**”

— BENJAMIN S. BROOKE, M.D., PH.D.
Assistant Professor, Vascular Surgery

Defying the archetype of the surgeon who’s eager to hand off the patient’s care, Brooke has focused his research precisely on those transitions of care, from the clinic to the OR, to the ICU, to the floor, to a post-acute facility and back home.

Brooke splits his time evenly between his clinical practice and health services research.

“I feel lucky to be here,” says Brooke, assistant professor of vascular surgery. “A lot of departments are so driven by productivity and clinical revenue, they would never allow surgeons to do this type of work.” Clearly, surgery generates more revenue than focus groups, but Vascular Surgery Division Chief Larry Kraiss, M.D., says the institution is taking the long view. “Eventually we’ll be held financially responsible for poor outcomes,” says Kraiss. “More importantly, we’re doing what’s right for the patient.”

Finding ways to improve processes is far more exciting to Brooke than economic incentives. But he doesn’t believe he’s unique. “All surgeons are interested in improving outcomes,” says Brooke. “No surgeon wants to have a patient readmitted because they weren’t given an anticoagulant at a post-acute care facility. You take it personally. It’s not trivial.” Brooke envisions a new paradigm where surgeons are not just technicians but co-managers of a patient’s health.

With funding from a Patient-Centered Outcomes Research Institute (PCORI) grant, he’s studying patient outcomes and gaps in care coordination. He talks to patients about the problems they experience and the opportunities they see to improve. “We need to ask patients what their goals are and then clearly communicate what they can expect.”

Collaborating with colleagues from across the country, he’s hoping his research will lead to changes that are scalable and widely disseminated. “Patients often become pawns in a big, complex structure,” says Brooke. “We need to look at the care we’re providing from their perspective.”

INTEGRATING EDUCATION



Danielle Roussel, M.D., associate professor of anesthesiology and Katherine Anderson, M.D., assistant professor of internal medicine, co-founded the Clinical Method program to support medical students.

CASE STUDY

Slowing down care delivery, even for the noble task of educating the future generation, is not possible in today's economic and political climate. Physicians are under enormous pressure to increase clinical revenue, efficiency, quality and patient satisfaction, and no one's going to cut them any slack because they have a trainee in tow. "We're losing so much of the craft of teaching because we don't have time to explain what's not immediately necessary for students to know," says Katherine Anderson, M.D., assistant professor of internal medicine.

“**THE MILLION-DOLLAR QUESTION IS: HOW CAN PHYSICIANS TRAIN STUDENTS, SEE MORE PATIENTS AND GO HOME BEFORE 10 P.M.?**”

— DANIELLE ROUSSEL, M.D.
Assistant Dean for Clinical Curriculum

But the truth is that when students finally make the leap from student to doctor, there are gaps in skills. The question is how to fill them. "We want to educate students. That's why we chose to work in academic medicine," says Danielle Roussel, M.D., assistant dean for clinical curriculum and associate professor of anesthesiology. "The million-dollar question

110K+

residents and fellows in accredited training programs in the U.S.

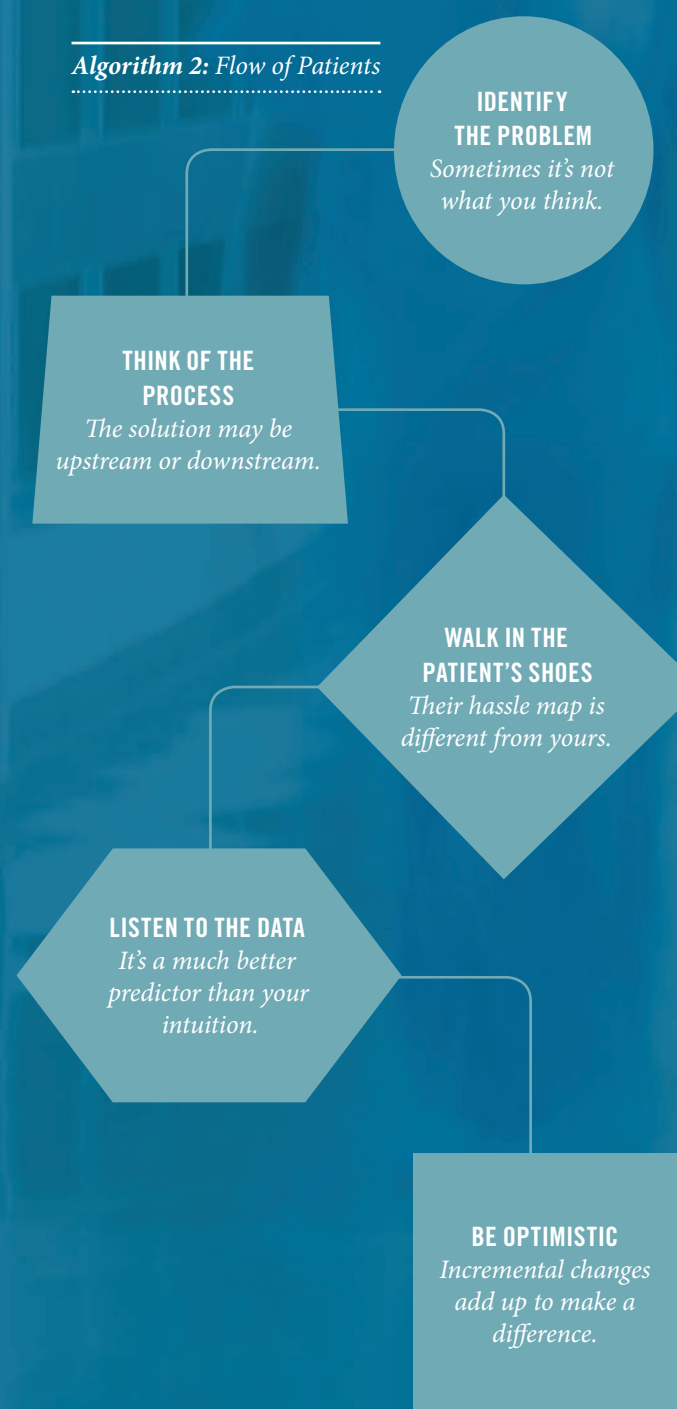
is: How can physicians train students, see more patients and still go home before 10 p.m.?"

Systemic reforms in training and funding residents are likely on the horizon, especially after this summer's release of the controversial Institute of Medicine's report on graduate medical education. Roussel and Anderson aren't waiting around. They saw an opportunity to fill those gaps by creating a four-year Clinical Method program in the School of Medicine. Twenty-four core faculty physicians coach groups of 10 students. They meet with them weekly and provide insight and training for life as physicians, inside and outside of the hospital. From improving communication to navigating the electronic health record, the program emphasizes critical clinical skills that can't be taught in the classroom.

Clinical Method, now in its second year, is a hit with students and mentors alike. "Core faculty feel this has reminded them why they love academic medicine," says Anderson, who directs the program. They're able to tap into a new network of energetic students and colleagues across specialties. "Burnout can be so high in medicine, so being able to really connect on a personal level makes such a difference."

MORE WAYS WE'RE FIXING PATIENT FLOW

Algorithm 2: Flow of Patients



REMOTE CARE

Every month, when child psychiatrist James C. Ashworth, M.D., drove 10 hours round-trip to rural Utah to see patients, he was reminded of how many children didn't have access to the care they needed. Three years ago, he and colleagues created Giving Access to Everyone (GATE), a Web-based program that educates and supports community providers so they can triage and treat child psychiatry issues. "This is the future," says an enthusiastic Ashworth. "It's the answer to so many of the barriers that have prevented us from providing affordable and accessible care."

CLINIC FLOW

You know the old adage: Change is good. You go first. Dermatologist Mark Eliason, M.D., might be one of the few people to take that saying literally. Eliason wanted to figure out how to move patients through the dermatology clinic more smoothly and efficiently, so he first studied his own workflow. Armed with that knowledge, he created ways to reduce wait times throughout the clinic by standardizing every step, from the intake process to printing common medication instructions.

EMERGENCY DEPARTMENT

For an increasing number of patients, the emergency department is the front door to the hospital. So when charged with creating an ED at one of our community clinics, Jamie Quinlan, D.N.P., listened carefully to patients and realized they "don't care about having cutting-edge technology – they just want to be treated quickly by knowledgeable doctors." Quinlan took their advice, hired strategically and built an ED that ranks in the 99th percentile in patient satisfaction.

SAME-DAY RADIOLOGY

There's nothing fun about waiting anxiously for days to learn the result of a medical test. Radiologist Matthew Stein, M.D., and a team at Huntsman Cancer Institute are piloting a project that delivers breast imaging results to patients within five to seven minutes. If additional imaging or a biopsy is needed, it can often be taken care of in the same visit, expediting care, saving time and reducing unnecessary worry.



TO LEARN MORE ABOUT THESE PROJECTS, VISIT:
ALGORITHMSFORINNOVATION.ORG/PATIENTS

ALGORITHM No. 3
The Flow of Data

LIQUID KNOWLEDGE

Every day, our scientific and medical communities generate torrents of data. Most of it, however, is trapped behind floodgates. From valuable clinical trial research to lifesaving genetic information to the wellness data patients generate with their Fitbits, much of the knowledge we need to transform health care is out there. The challenge is getting it to flow.

“The patient crawls to her mailbox every day.” From those eight words, written in the progress notes of a patient’s electronic health record, an entire story unfolds. In an instant, we understand that the patient can’t walk, but she’s alert enough to want her mail. We know she has no one to go to the mailbox for her, and she’s motivated to do it herself. We realize she needs more help.

That one sentence arguably gives more insight into the patient’s condition than the pages of notes, billing information, lab values and vital signs that are crammed into an electronic health record (EHR). The problem is that it is buried within all of that data. “When we bring everything forward, providers can’t tell what’s critical,” says Charlene Weir, Ph.D., R.N., professor of biomedical informatics, who uncovered the statement while studying the use of contextual information in EHRs. “Sure, you can

see the whole medical record, but the meaning is completely obscured.”

The example highlights one of the great paradoxes of modern medicine. On the one hand, we haven’t captured or can’t get our hands on the vital information we need to solve patients’ complex health problems. Health care is the last sector of our economy to go digital, and most information still remains trapped in the paper filing cabinets of hospitals, doctors’ offices and research labs. Some estimate that by 2020 only half of health information will be digitized,

FIVE BIG DATA BARRIERS

1

WE’RE NOT CAPTURING IT ALL

From costing and quality data to research and wellness data, there’s a vast amount of information that’s inaccessible.

2

WE CAN’T MAKE SENSE OF IT

According to a 2014 *JAMA* article, 80% of clinically relevant medical data is unstructured, making it challenging to analyze and use the information.

3

WE’RE NOT SHARING IT

Valuable health data is intentionally withheld to protect patient privacy or maintain competitive advantage.

4

WE DON’T TRUST WHAT WE’VE GOT

Data entered into the EHR can be inaccurate, incomplete and highly variable — and therefore unreliable.

5

WE CAN’T SEE THE PATTERNS

Without effective user interfaces and robust visualization tools, it’s difficult to find meaningful connections in large data sets.

“

WE NEED SOLUTIONS THAT MAKE KNOWLEDGE LIQUID, SO INFORMATION CAN MOVE EVERYWHERE.

”

— KENSAKU KAWAMOTO, M.D., PH.D.
Associate Chief Medical Information Officer

and even then the majority of that information will be locked in software systems that either can’t or refuse to talk to one another.

On the other hand, we are overwhelmed with data. By 2020, it’s predicted that we’ll have 25,000 petabytes of health data, enough to fill 500 billion four-drawer filing cabinets. From personal health records to clinical trial and genetic data to 3-D imaging and biometric sensor readings, the explosion of data has outpaced our ability to stay on top of it all. In 2010, 700,000 new articles were cataloged by the National Library of Medicine. “I’d have to read 100 published trials a day to keep up with all the new medical knowledge,” says Robert Pendleton, M.D., chief medical quality officer. The problem is that much of the data we’ve generated is unreliable, disconnected and irrelevant. Only a fraction of it is accessible, let alone actionable, at the point of care, where it could make a difference in people’s lives.

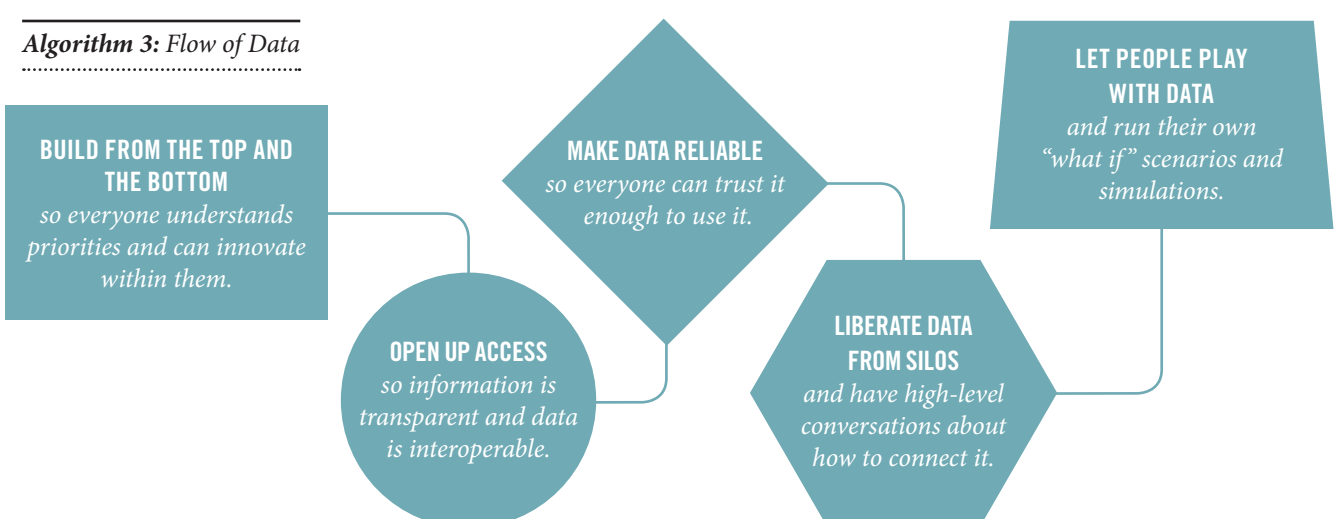
The data puzzle is the same riddle facing the entire U.S. health care system: How is it possible to have so much and so little at the same time? U.S. adults receive only half the recommended care they need, according to a study published in *The New England Journal of Medicine*, and yet our health system wastes billions of dollars on unnecessary tests, treatments and hospitalizations. An estimated 400,000 Americans are killed every year due to preventable medical errors.

The knowledge to care for these patients exists. It’s just not being used. “We’re the only industry that knows best practices but doesn’t apply them systematically,” says informaticist Kensaku Kawamoto, M.D., Ph.D., assistant professor of biomedical informatics and associate chief medical information officer. There’s also a lag in translation. He points to research that shows it takes an average of 17 years following a landmark clinical study for a significant medical discovery (such as the use of beta-blockers after heart attacks) to be adopted into routine patient care. “In the flow of knowledge, there’s a real gap between what is known and what is implemented.”

REDEFINING MEANINGFUL

Computers and EHRs have the power to change that. Ahead is an unprecedented opportunity to standardize and revolutionize care by hardwiring knowledge into the EHR so that the computer can walk providers through best practices. “When we take knowledge and put it into a form that interacts with the computer, we take an asset and make it liquid,” says Kawamoto, who is working on a national, open-source repository of electronic clinical decision-making tools. We need to shift our thinking from pushing data to pushing knowledge. And we need to abandon the notion that implementing an EHR is the end goal, says Jonathan Nebeker, M.D., M.S., associate chief medical informatics officer for Veterans Health Administration. “Making information available isn’t the same as making it useful,” says Nebeker, who believes that Federal Meaningful Use requirements forced adoption of the EHR before it was ready. “We basically just took a paper filing system and made it electronic. We need to move to a dynamic 3-D chart that’s intuitive for providers, that gives them information useful in their daily practice and that’s easy to navigate and populate with data.” He and Weir are in the throes of a complete makeover of the EHR.

Algorithm 3: Flow of Data



FINDING STRUCTURE IN FREEWHEELING TEXT

It sounds straight out of a science fiction movie: a physician talking to a computer as if talking to another human colleague. No worries about citing the right medical code or struggling with arduous drop-down menus. Just talking naturally while the computer translates it into the right coding data and regulatory details. Such is the distant promise of natural language processing. In the meantime, data warehouse architect Reed Barney has developed a poor-man's version of it literally overnight, and it's proving to be a valuable way to capture critical information from volumes of difficult-to-use, unstructured data spanning our entire enterprise — from the billing office to the research lab to the hospital room.

Barney created the tool in a 24-hour turnaround to make it easier for clinical researchers to mine our data warehouse. It may never have been put to broader use if he hadn't met Chief Medical Utilization Officer Russell Vinik, M.D., and data engineer John Arego. The two were working on a coding process when they heard about Barney's search tool and were struck by its ability to automatically search unstructured, free text for meaningful, discrete data points. Barney's unassuming tool, they realized, could be the answer to their medical coding challenges — and shortly thereafter, "WartHog" was born. "It's not pretty, but it's powerful," says Barney of the name choice.

WartHog can instantly pull data from EHRs — medical orders, vitals, lab results and radiology reports — with a simple keyword search. "The processes for entering discrete data in the EHR are slow, and they come at the expense of provider productivity," says Vinik. "With WartHog, providers aren't required to point and click everything. It helps us tell a more accurate story about patient acuity and demonstrate just how good our care really is."

The program has saved thousands of staff hours previously spent on manual searches of text notes, and it's responsible for adding \$5 million to our hospital's bottom line in one year alone. However, this only scratches the surface of its clinical and research potential. WartHog is being used in dozens of projects throughout our academic medical center. The Pharmacotherapy Outcomes Research Center uses the tool to find text terms associated with chemotherapy drugs so they can make quick, accurate evaluations of each drug based on cost and patient satisfaction. A deep vein thrombosis research group used WartHog to find qualified study participants in 10 minutes, instead of manually searching medical records for days. Future applications include using the tool to identify in real-time type 1 diabetes patients throughout the hospital to help monitor their insulin.

Can WartHog ever shed its brusque exterior and transform into something more like an elegant thoroughbred? "It doesn't use fancy natural language processing algorithms, but it works," says Barney. It's a solution for now, and it's quietly taking medicine and science into the future.



WARTHOG IN ACTION

WartHog uses Boolean logic (similar to the "advanced search" feature in Google) to create refined search queries within text notes in the EHR and produce quick and accurate results. Take, for example, the term "shock" — a serious condition with high morbidity and mortality.

Prior to WartHog it would have been

IMPOSSIBLE

to search 10,000 inpatient records for the term "shock" buried within pages of text notes.

Time it took WartHog to search?

5 MINUTES

Number of patients found to have shock who didn't get properly coded:

33

Annual revenue from improved shock coding:

\$850K

Beyond improving usability of the EHR is the equally vexing challenge of interoperability. Right now the snapshots that tell the complete story of our personal health live scattered in hospital EHRs that can't talk to one another or are squirreled away in offices of doctors whose names we might not even remember.

"When small physician practices aren't technically or financially capable of hooking up to an EHR it hampers our ability to take care of patients," says Chief Medical Information Officer Michael Strong, M.D. Roughly half of all hospitals and systems nationwide use EPIC as their EHR vendor and can connect through Care Everywhere. Coordinating with the other half can be difficult, especially since our system's referral area spans five states and 10 percent of the continental U.S. Some progress is being made by giving referring providers and community hospitals access to our EHR in a "view only" manner. It's a baby step, but of measurable value to those providers who now can access the notes, labs, radiology reports, etc., of their patients.

PUTTING DATA INTO PATIENTS' HANDS

It doesn't help that the public is of two minds about health data. "On the one hand, people want access to it anywhere, anytime and without a lot of barriers. On the other hand, they want all their information protected," says Biomedical Informatics Vice Chair Julio Facelli, Ph.D., who is working on a HIPAA-compliant data sharing solution for researchers. Once people see the power of personal information to improve not just their health but to propel medicine forward, information will begin to flow more freely, he believes.

Health systems, meanwhile, need to get past fears that sharing data with patients is adversarial, says Wendy Chapman, Ph.D., chair of the nation's first biomedical informatics department. "Being open with data pushes us to be a better system. Much of the information we need to connect is out there, but it's stuck in silos, and so are we."

Ultimately, Kawamoto says, "We need solutions that make knowledge liquid, so information can move everywhere."



LEARN MORE ABOUT OUR EFFORTS TO INTEGRATE:
ALGORITHMSFORINNOVATION.ORG/DATA



SEARCHING FOR A DATA UTOPIA

IMAGINE IF...

A PATIENT JUST DIAGNOSED WITH BREAST CANCER could access online reviews of oncologists, compare the outcomes for various cancer centers and even see the costs for treatments to choose the best provider for her care. She could compare symptoms, treatments and experiences of similar patients, share her own health data so other patients and researchers could learn from it, and align the latest research on her condition with her personal health goals to jointly develop a treatment plan with her provider.

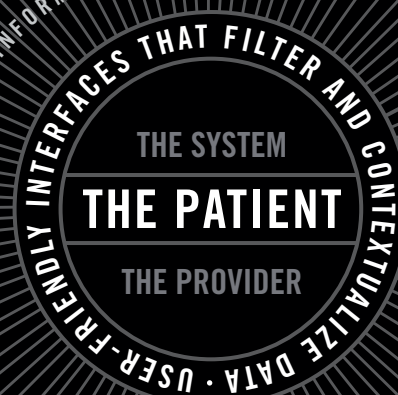
THE CANCER CENTER SHE CHOOSES could run algorithms to find relevant information about her family history, current medications and other existing conditions that might inform her treatment. Combining this personal information with the latest population and research data, the center could suggest treatment options and even rank the options based on their potential for success, lowest cost and highest quality.

THE ONCOLOGIST SHE CHOOSES could access her entire family medical history, complete genome sequence, the latest scientific research and public health trends about her particular type of cancer. The provider could quickly identify patients with similar disease characteristics and view their treatment outcomes, and even see the way similar patients talk about their disease and treatment on social media. The patient and oncologist would work together to customize a treatment plan using the latest care pathways, evidence-based knowledge and the patient's specific health goals. All providers on the patient's care team, regardless of where they work, could access this information.

THE CANCER RESEARCH COMMUNITY could access the patient's information and aggregate it with data from other patients. The results of that research would then become the evidence base for future decision-making, empowering the patient to help effect change for her children and grandchildren, who may experience the same cancer in the future.

CREATING A PATIENT-CENTERED HEALTH SYSTEM, POWERED BY DATA

Limitless. Those are the possibilities for data to transform health care in the future. The sheer volume of information produced will be mind-boggling; but the ways we'll be able to contextualize, manipulate and interface with data are even more intriguing. Imagine grocery store purchases connected to environmental data linked to wearable devices analyzed with the latest scientific discoveries through an electronic health record accessible to anyone involved in our care. Here we try to imagine just a few of those futuristic scenarios and the power they have to revolutionize health care.

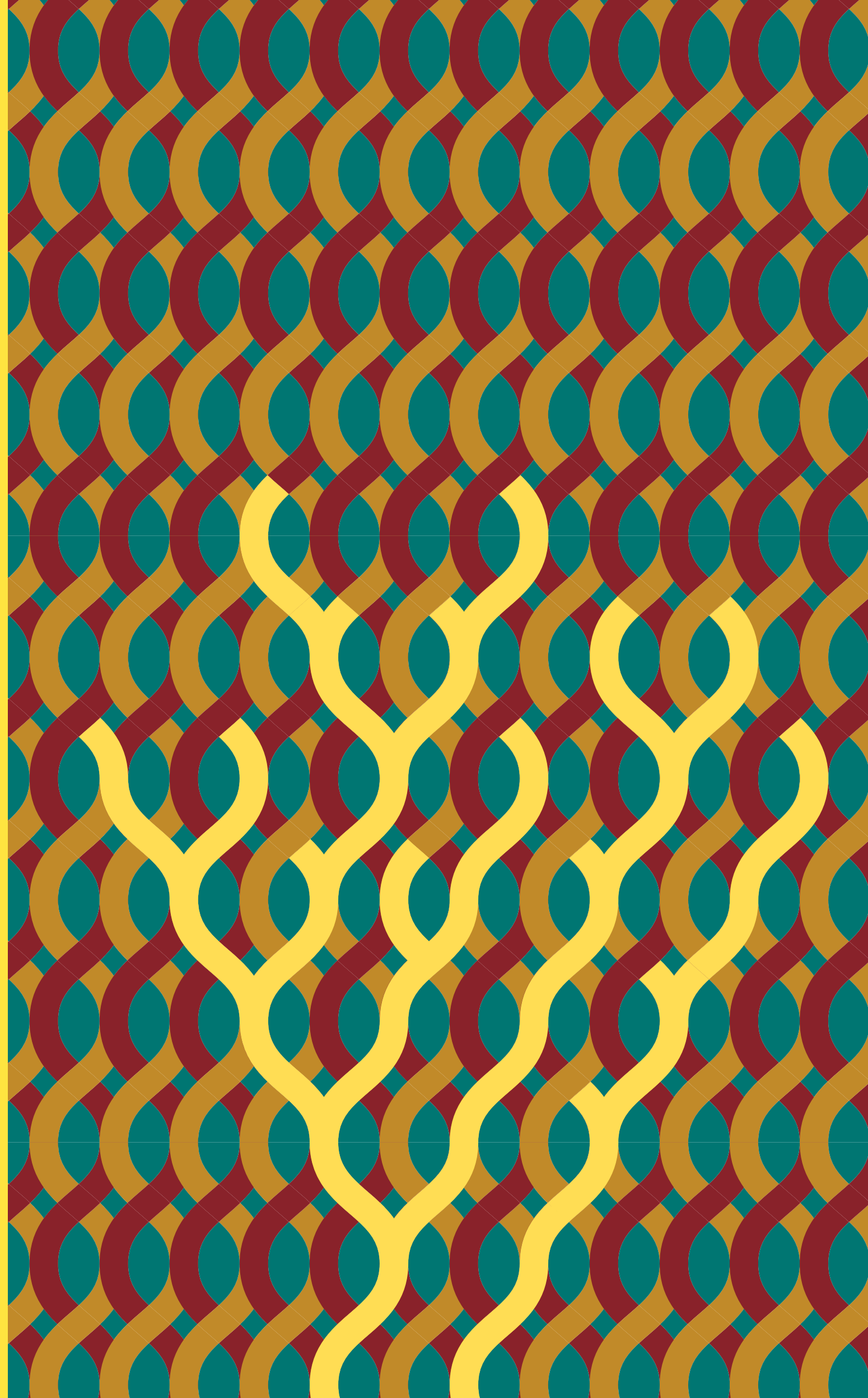


DATA UTOPIA INFOGRAPHIC ADVISORY COMMITTEE Wendy Chapman, Ph.D., Chair, Department of Biomedical Informatics; Kensaku Kawamoto, M.D., Ph.D., M.H.S., Associate Chief Medical Information Officer; Ramkiran Gouripeddi, M.S., M.B.B.S., Biomedical Informatics Research Assistant Professor; Mollie Cummins, Ph.D., R.N., Associate Professor of Nursing and Adjunct Associate Professor of Biomedical Informatics; Matthew Samore, M.D., Chief, Division of Epidemiology, Adjunct Professor of Biomedical Informatics; Jonathan Nebeker, M.D., M.S., Director of VA Informatics

ALGORITHM No. 4
The Flow of DNA

OUTLIVE YOUR FAMILY HISTORY

That was the promise when the first human genome was sequenced 11 years ago. That we would be able to change, perhaps even direct, exactly where the proverbial apple fell. Today, sequencing our genome is the easy part. The hitch is how to draw meaning from the flood of genetic information.



Imagine a train barreling down a track that is not yet fully laid. So it is with genomic medicine. A feat once thought impossible, we can sequence a genome – 3 billion base pairs of DNA – in less than a week for the price of a laptop. That was the easy part. What comes after is the greater challenge.

The ability to interpret our genetic blueprint promises new treatments and knowledge that will transform our entire understanding of medicine. “Right now, genetics falls under the umbrella of medicine,” says Chair of Human Genetics Lynn Jorde, Ph.D. “But it won’t be long until medicine falls under genetics.”

While successes roll in on a case-by-case basis, health care is not yet prepared for the complex procedural and ethical questions that are being unleashed on a grand scale. “We don’t yet know what it means to have a 20 percent increased risk of getting a certain disease,” says Nicola Camp, Ph.D., professor of genetic epidemiology, citing one example. “Is it responsible to give people information that scientists don’t fully understand?”

According to the FDA, the answer is no. In November 2013, the federal agency prohibited the consumer-based genetic testing service 23andMe from releasing health information to its 650,000 customers. The conflict is a harbinger of what’s to come.

Genome interpretation and ethics are but a few of the missing pieces of a track that meanders through medical practice, technology, research and development. The points at which discovery and medicine intersect are where success stories emerge: a disease is diagnosed, new procedures are invented and illnesses are treated. “At an academic medical center, the interplay

between research and medicine drives medicine to evolve,” says Chief Scientific Officer Dean Li, M.D., Ph.D. “It becomes a living being. It makes the wrong turns. It finds the right.”

Embracing genomic medicine means throwing away the cookbook and welcoming a culture of discovery that challenges practitioners to draw on their highest level of thinking and creativity. “Our patients are all opportunities to make discoveries,” says John Bohnsack, M.D., chief of pediatric rheumatology. Bohnsack makes a point of accepting cases that others won’t touch, and pursuing the most intriguing ones with basic scientists. His unorthodox approaches have led to a series of discoveries on the genetics of childhood diseases.

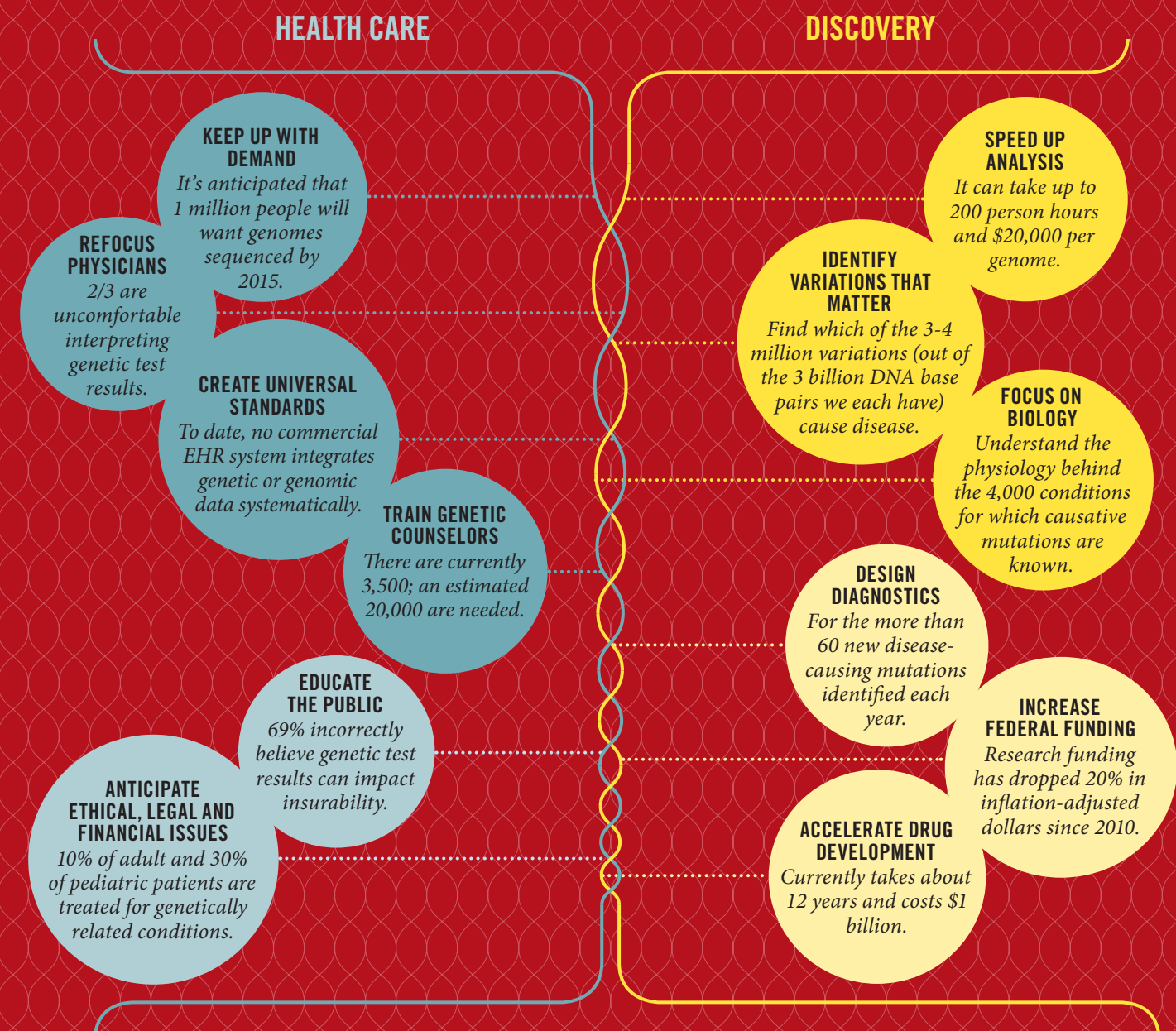
“Those discoveries are gateway discoveries,” says Li. “They don’t simply affect the individual, but all family members and all of medicine.” Following are examples of success stories laying the track that leads toward outliving our family history.

“
RIGHT NOW, GENETICS FALLS UNDER THE UMBRELLA OF MEDICINE. IT WON’T BE LONG UNTIL MEDICINE FALLS UNDER GENETICS.
”

— LYNN JORDE, PH.D.
Director, Utah Genome Project
Chair, Department of Human Genetics

OUR GENETIC TO-DO LIST

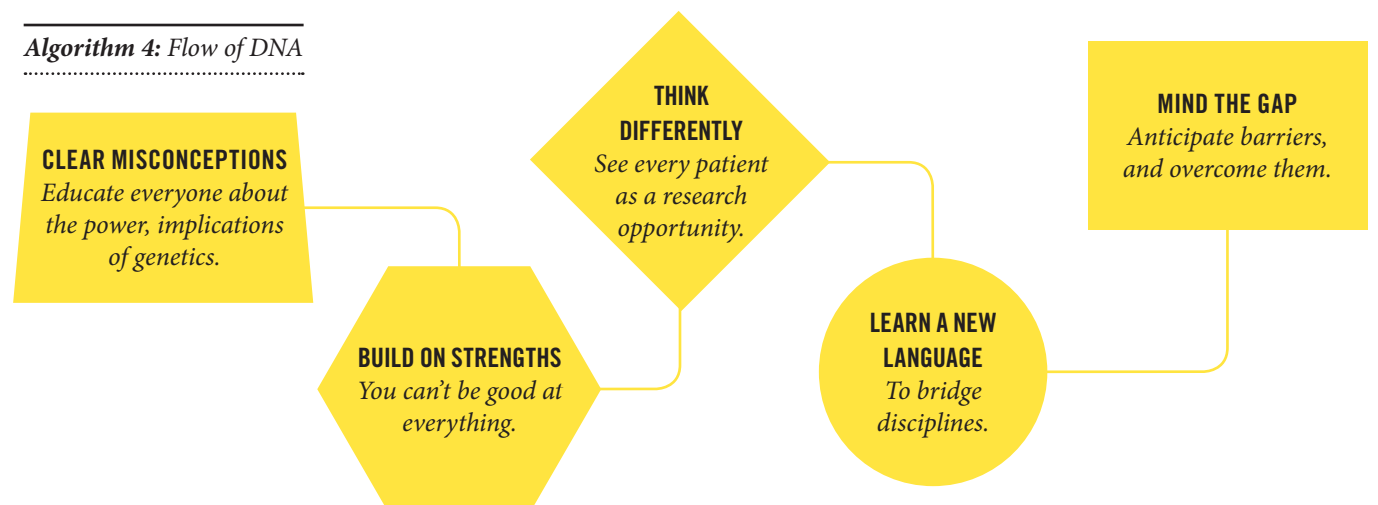
We all have diseases that run in the family. Scientists are racing to discover the genes that cause them and develop new, more powerful treatments. The to-do list is long and will take Herculean efforts from a wide range of specialists to complete. In order to outlive our family history, we’ll have to share knowledge, pool resources, learn one another’s language and effortlessly weave in and out of each other’s worlds.



THE PROMISE OF PERSONALIZED MEDICINE

Everyone will have his or her genome sequenced. Doctors will examine your genomic health record for conditions for which you and your family are at risk and prescribe preventive screening and early treatment. Scientists will develop designer medicines tailored to your personal genetic profile.

Algorithm 4: Flow of DNA



Strength in Numbers

Cajsa Allen couldn't have guessed the ripple effects of discovering the cause of the rare genetic illness that plagued her family. She and two of her children share a new class of common variable immunodeficiency (CVID) — a rare disease affecting as few as one in 50,000 people. The discovery sparked physicians from across the globe to identify other patients with the same mutation. The Allens now feel part of a community. “Knowing there are other people who have gone through the things we are facing makes us feel less alone,” she says. “You draw strength from each other.”



TO LEARN MORE ABOUT THE FAMILY'S STORY, VISIT:
ALGORITHMSFORINNOVATION.ORG/DNA

Case Study 1:

Knowledge Is Power

There was something different about Cajsa Allen and her son and daughter, now ages 12 and 15. On top of constant battles with pneumonia, sinus infections and other ailments the body ordinarily defeats with ease, the trio showed signs of an autoimmune disorder and adrenal insufficiency, which had caused Allen's son to suffer hypoglycemic seizures. They had been diagnosed with common variable immunodeficiency (CVID), a rare illness causing dangerously low levels of infection-fighting antibodies. But their particular constellation of symptoms appeared to be a new class of the disease.

The family piqued the interest of the children's immunologist, Karin Chen, M.D. If she could find the cause of the Allens' condition, she realized, it could give clinicians a better grasp of CVID. “When I see families like this, where there must be something hereditary going on, I always want to know why,” says Chen. “Because that knowledge allows you to take medicine a step further.”

Chen came to the University of Utah for the chance to solve medical genetics mysteries such as this one. As a resident she was inspired by the work of Lynn Jorde, Ph.D., chair of human genetics, on a study that sequenced an entire family for the first time, resulting in identification of a genetic disease — Miller Syndrome. Years later, Chen jumped at the chance to work with Jorde to make similar discoveries.

Genomic sequencing holds huge promise for the estimated 30 million Americans

living with an orphan disease, 80 percent of which are inherited. Currently, patients lucky enough to know the cause of their illness have often had to endure an agonizing diagnostic odyssey that lasts years. Even after diagnosis, they face a dearth of treatment options; no FDA-approved drug exists for 95 percent of rare diseases. “‘Rare’ has lost all meaning,” says Allen matter-of-factly. “These illnesses aren't rare to our family.”

As the Allens' symptoms suggest, CVID is complex. The “variable” in the name refers to the more than 10 different mutations that have so far been found to trigger the disease, though the genetic causes of 90 percent of CVID cases remain unknown. Chen believed the Allens' condition was the result of a unique mutation. She thought Karl Voelkerding, M.D., professor

“
**WE WERE MEDICAL MARVELS
FOR A MINUTE INSTEAD OF
JUST MUTATIONS.**
”

— CAJSA ALLEN
Patient

of pathology and medical director at University of Utah-owned ARUP, one of seven labs in the country to offer clinical-grade genome sequencing, could help her find it. “We were coming at the question from different angles, but we had a shared motivation in understanding what was going on with the patient,” says Voelkerding. He agreed to put his team, led by bioinformaticist Emily Coonrod, Ph.D., and genetic immunologist Attila Kumánovics, M.D., on the case.

Months later, Kumánovics asked Chen to come to ARUP for a meeting. The excitement in the room was infectious. The night before, he chased down Coonrod and told her excitedly, “We found the gene! We found it!” Kumánovics explained to Chen that they used bioinformatics tools, including the VAAST algorithm developed at the University, to narrow the 22,000 DNA changes found in affected family members down to one candidate. Searching a bank of DNA samples from CVID patients, they found the same mutation in an unrelated man. To their amazement, he had the same unusual presentation of CVID as the Allens. “With these types of studies, the chance that you will find a genetic cause is only 25 to 30 percent,” says Chen. “Our discovery came from a little bit of luck and a lot of hard work.”

Certainty would come only after Chen experimentally proved that the gene was the bona fide cause. This required a different sort of expertise. She contacted Guy Zimmerman, M.D., and Andrew Weyrich, Ph.D., investigators in the University of Utah molecular medicine program who train physician-scientists in translational research. After many late nights spent

coaxing secrets from her patients' cells, Chen found that the mutation prevents a protein from functioning properly, interfering with the body's ability to fight infection. Now sure of her findings, she shared them with Allen and her husband, who peppered Chen with questions. “That was miraculous,” recalled Allen. “We were medical marvels for a minute instead of just mutations.”

Do You Want to Know Your Genetic History?

A national poll from the University of Utah's Huntsman Cancer Institute shows the public is divided on undergoing genetic testing to predict risk.

34% of respondents would not seek genetic testing for cancer

OF THESE RESPONDENTS



40% are concerned the results would impact employment opportunities



69% are concerned the results would adversely impact insurability

Based on the discovery, ARUP is creating a new diagnostic panel to screen patients for specific CVID-causing mutations so they can receive personalized care. Chen, meanwhile, is further investigating the gene's role in the immune system, which she hopes will provide insights into how immunodeficiencies develop, one day leading to new treatments. “Finding the cause of a rare disease often teaches us a lot about other diseases,” Jorde told Chen. “It's like this little window, but it opens up a big room.”



It took a team of physicians, bioinformaticists, computer scientists, geneticists and molecular biologists to find the cause of the Allen family's rare disease. From left to right: Karin Chen, M.D., Emily Coonrod, Ph.D., Karl Voelkerding, M.D.

Case Study 2:

From Bedside to Bench and Back Again

Scientific inspiration is fickle. It can't be summoned or forced. Often the most actionable insights come wrapped in the unexpected. For Steven Bleyl, M.D., Ph.D., a medical geneticist, it came in the form of an infant admitted to the NICU with several birth defects. The family's medical history didn't point to any known genetic clues, but it was riddled with atrial fibrillation (AFib). This abnormal heart rhythm affects more than 3 million Americans, but it usually occurs in older people. It rarely runs in families. Was it genetic in her family, the baby's mother wondered, and could finding the faulty gene help her child's treatment and prognosis? Bleyl was intrigued and emailed her question to pediatric cardiologist Martin Tristani-Firouzi, M.D., a young clinician-scientist studying arrhythmias. "It was a great question," recalls Tristani-Firouzi. "I just didn't have the resources to be assured we'd find an answer."

That was six years ago. Tristani-Firouzi was just getting his lab started. Like most physician-scientists – a rare and increasingly valuable breed – he straddles two worlds: he uses the tools of basic science to push medicine, but grounds scientific inquiry in his experience caring for patients. It's gritty, groundbreaking work. Comparing the 3 billion base pairs of DNA found in every human genome has been likened to looking for one misspelled word in all the books in the Library of Congress. Tristani-Firouzi had at his disposal state-of-the-art sequencing facilities and the medical, public health and

genealogical records of 7.3 million people housed within the Utah Population Database (UPDB). The database, the world's largest of its kind, works like a magnifying glass for scientists to spot genes based on their transmission of disease across generations. "We had the families, the personal interest and the technology. All the pieces were in place. What was missing was the money," says Tristani-Firouzi.

He put the project aside, but by 2012 the cost of sequencing had plummeted, new funding had become available, and new analysis tools made finding troublemaker genes much more promising. With a \$50,000 grant from the Utah Genome Project, Tristani-Firouzi began looking for answers to questions posed years prior by the family of that tiny baby.

His team sequenced three families: relatives of the infant and other patients with high rates of early-onset arrhythmia. To analyze the data, they used a new software algorithm developed by biomedical informatics expert and genetics professor Mark Yandell, Ph.D., that ranks genes according to their likelihood of stirring trouble. Within minutes, the software identified that two of the families shared changes in a gene that had already been linked to AFib and an inherited arrhythmia known as Long QT syndrome. In the third family, it uncovered a new gene linked to AFib.

Because two of the families lived in Utah and shared the same mutation, they were almost certainly related, but it was unclear

Building on a history of genetic discovery

Lots of academic medical centers can sequence patients. What they're missing are the family pedigrees to make connections between those genomes. The Utah Population Database at Huntsman Cancer Institute, the world's largest repository of medical and genealogical records, makes it easier to spot problem genes as they transmit disease in families. Our collaborative discoveries include BRCA1 and BRCA2 (breast and ovarian cancer), APC (colon cancer) and HERG (every single drug approved for use in the U.S., Europe and China is tested against this gene). World-renowned geneticists – Ray White, Mark Skolnick, Lynn Jorde, Mark Yandell and resident Nobel Laureate Mario Capecchi – have made their home here at the Eccles Institute of Human Genetics. We know there's no time to rest on our laurels. To catalyze disease gene discovery further, we've created the Utah Genome Project, and to find lifesaving therapeutics, we've formed the USTAR Drug Development Platform.

"By pooling our expertise and effort, we can make a lasting impact on families with inherited arrhythmias," says Martin Tristani-Firouzi, M.D., who is leading a multidisciplinary research team (Ken Smith, Ph.D.; Steven Bleyl, M.D., Ph.D.; Chuanchau "Jerry" Jou, D.O., Ph.D.) that's uncovering new truths about heart disease.



Mending Hearts, Families

Merin Swasey has atrial fibrillation, the leading cause of stroke and heart failure. He inherited the heart disease from his mother, and odds are 50/50 that his children inherited it too. University of Utah researchers are sequencing their genomes and will be able to tell Swasey which of his five – soon to be six – kids carry the defective gene. With preventive screening, early treatment and the promise of new, targeted treatments, the Swasey children are poised for long, healthy lives. "Knowledge is power, the power to leave my children with a different health legacy," says the 35-year-old engineer.

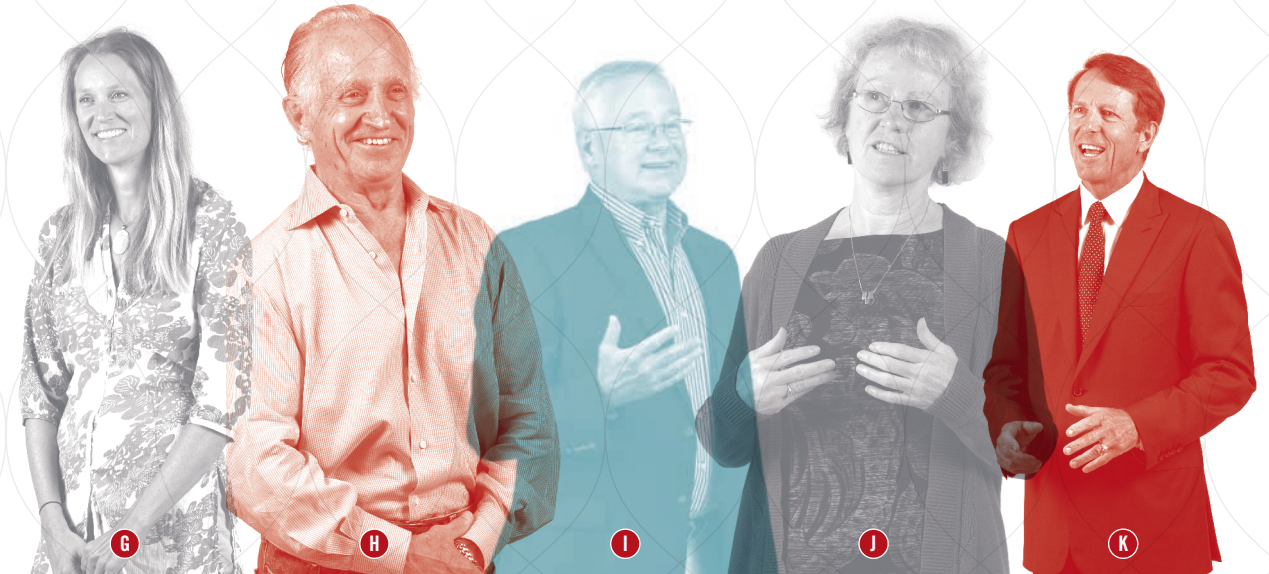
“IT’S LIKE DETECTIVE WORK. WE KNOW THESE TWO FAMILIES ARE RELATED. BUT WHERE’S THE BRANCH THAT CONNECTS THEM?”

— KEN SMITH, PH.D.
Director, Utah Population Database

how. Finding the familial relationship was critical because their ancestors likely had passed the gene to branches of the family residing in other parts of the country or world. "This gene might explain a large proportion of young-onset atrial fibrillation," says Tristani-Firouzi. One family member supplied names and birth dates of distant relatives. Ken Smith, Ph.D.,

director of the UPDB, filled in the blanks. "It's like detective work. We know these two families are related. But where's the branch that connects them?" Smith says. The team built a pedigree of thousands tracing back to a European couple in the 1800s. Nearly 50 of the family's descendants have atrial fibrillation, Long QT syndrome, or both.

If early diagnosis is important for atrial fibrillation patients, it's absolutely critical with Long QT syndrome, which often goes unnoticed until someone dies of sudden cardiac arrest. Both diseases can be diagnosed with an electrocardiogram and treated with medicine or surgery. Tristani-Firouzi is reaching out to individuals identified through UPDB as having one of these conditions and encouraging them to contact siblings and children. "It's a delicate conversation," Tristani-Firouzi says. Jerry Jou, D.O., Ph.D., a pediatric cardiologist, often follows up by driving to the patients' homes with an electrocardiography device to make diagnosis convenient, and blood tubes and consent forms to fuel further research. They can't tell the families how they're related because of federal privacy laws. But the information they can share might just save their lives.



CATALYSTS FOR CHANGE

Faster, cheaper DNA sequencing is sparking optimism that cures are just around the corner. But to turn genetic data into knowledge that's meaningful for patients, we need experts with wildly different skill sets to connect with one another. Academic medical centers are singularly poised to help foster those collaborations, and at the University of Utah, that's what we do best. Here we highlight just some of the brilliant minds who are forging new paths to discovery.

THE PHYSICIAN-SCIENTIST

A **Joshua D. Schiffman, M.D.**, Associate Professor, Pediatrics; Adjunct Associate Professor, Oncological Sciences

"When we have a child in front of us who is sick and dying, we intuitively focus on treatment – not genetic risk," says pediatric oncologist Joshua Schiffman, M.D. He believes that eradicating cancer – his ambitious goal – will require us to expand that clinical focus to include a hereditary mindset. "Heart disease, diabetes, even gout – we're learning now that almost every disease has some sort of genetic basis." At Schiffman's urging, a family history is now taken on every child with cancer in Utah. Families with enhanced risk are referred for preventive screening or enrolled in research, yielding new discoveries that may point the way to targeted treatments and cures. "I was trained first as a general pediatrician, and as a pediatrician we try to prevent disease," he says. "I wake up every morning thinking about how I can bring together people, resources and expertise to do that."

THE CONNECTORS

B **Deborah Neklason, Ph.D.**, Research Associate Professor, Internal Medicine

C **Lynn Jorde, Ph.D.**, Chair, Department of Human Genetics

As astute specialists often make clinical observations that hint at genetic causes but lack the training or resources to act. "They need to be in an environment that encourages a research perspective," says Deborah Neklason, Ph.D., program director for the Utah Genome Project (UGP). Neklason and Executive Director Lynn Jorde, Ph.D., spearhead efforts that link physicians and scientists with informaticists, epidemiologists and geneticists, and assist them in using a powerful resource – the Utah Population Database – to find what they're looking for. In two years, UGP research has, so far, identified new risk factors for preterm birth, heart arrhythmia, immunodeficiencies, breast cancer and the causes of three rare diseases, and developed new disease gene identification tools. Each success helps build a pipeline from DNA to diagnosis. "It's a great leap forward for science, for genetics, for medicine and for the quality of life for families," says Jorde.

THE METHODOLOGIST

D **Lisa A. Cannon-Albright, Ph.D.**, Chief, Division of Genetic Epidemiology; Professor, Internal Medicine

Utah's genealogical riches have yielded discovery of dozens of disease-causing genes, including the breast cancer genes BRCA1 and BRCA2. "Those genes don't explain all hereditary breast cancer," says one of the geneticists credited for their discovery, Lisa Cannon-Albright, Ph.D. "What about all the other people who are at risk for breast cancer or other diseases, but we haven't found the gene that explains their family's risk?" While looking for new genetic signatures of disease, Albright develops algorithms, or recipes for calculating risk, based on family histories. She's also working on a prototype of a national database for consumers to build their own health pedigrees matched to their medical records. "People say someday you'll go the mall and give them a drop of blood and get your genomic profile. But for now the best indicator of risk for common disorders is a family history. We can do it today and it doesn't cost you anything."

THE ANALYSTS

E **Gabor Marth, D.Sc.**, Professor, Human Genetics

F **Mark Yandell, Ph.D.**, Professor, Human Genetics

If predictions hold, and the number of new genomes sequenced grows 20-fold in the next three years, we'll have a big problem on our hands – the capacity to analyze them. That's the impossible problem that Gabor Marth, D.Sc., and Mark Yandell, Ph.D., co-directors of the USTAR Center for Genetic Discovery, are trying to solve. "We are building an information highway that will be able to transport huge amounts of genetic DNA information from the sequencing machine to the clinic," says Marth, who earned his chops on the 1,000 Genomes and other heavyweight projects. The duo develops genomic analysis software tools such as VAAST, which is used by more than 250 institutions worldwide. They're collaborating with industry to build a user-friendly, Web-accessible platform to distill genomic data into clinically relevant findings. "Our goal is to be able to go from DNA to diagnosis within minutes," says Yandell.

THE TRANSLATOR

G **Karen Eilbeck, Ph.D., M.Sc.**, Associate Professor, Biomedical Informatics

For all of their bright spots, computers are terrible at some things. Inference is one of them. If one scientist describes the location of a DNA variant as "chromosome 1" and another as, "chr 1," computers won't connect the dots. Multiply those kind of notation ambiguities by 3.5 million – the average number of variants in a person's genome – feed them into software, and the result is a total genetic mishmash. "We can't communicate if we're not using the same language," says informaticist Karen Eilbeck, Ph.D., M.Sc. To rein in the free-for-all, Eilbeck is working with people from the CDC, clinical laboratories, software development, accrediting agencies and research communities to create a worldwide standard. "Misinterpretation poisons the data. We can't afford to let that happen."

THE SCIENTIST

H **Mario Capecchi, Ph.D.**, Nobel Laureate; Distinguished Professor, Human Genetics

Finding a genetic mutation is just the beginning of the scientific story. One of the longest chapters to come is figuring out how changes in DNA spell trouble within the body. "If you formulate the questions appropriately, the answers will come," says Mario Capecchi, Ph.D., distinguished professor of human genetics. He received the 2007 Nobel Prize for inventing gene targeting in mice, a revolutionary technique used by researchers around the globe to test how mutations morph into disease – the first step in uncovering novel treatments. "No story is one gene. It's always the interaction of many genes together. It has a beginning, a middle and an end," Capecchi says. "My end is always understanding." Push understanding – push basic research – and translation, he says, will follow.

THE ETHICIST

I **Jeffrey R. Botkin, M.D., M.P.H.**, Professor, Pediatrics; Adjunct Professor, Human Genetics; Adjunct Professor, Internal Medicine

Should every newborn have his or her genome sequenced at birth and are we, as a society, prepared for what we might find? Genetics lets us visualize our bodies on the molecular level, revealing weaknesses that confer risk for various diseases. "But we don't yet have the ability to intervene on many genetic conditions. So we have a gap between the ability to analyze this information and do something constructive

about it," says ethicist and pediatrician Jeffrey Botkin, M.D., M.P.H. Springing from this scientific challenge are ethical quandaries that Botkin – as a leading member of government advisory panels and director of the Utah Center for Excellence in the Ethical, Social and Legal Implications of Genetics – is helping to anticipate. Botkin and his team craft tools for education and informed consent to guide families in choosing the right path. "This is a domain where there aren't right or wrong answers."

THE COUNSELOR

J **Bonnie Jeanne Baty, M.S., C.G.C.**, Professor, Pediatrics; Adjunct Professor, Nursing

Health providers are obligated to put the interests of the patient first, but genetic counselors treat the whole family, says Bonnie Baty, M.S., C.G.C., director of the graduate program in genetic counseling. They support patients along the emotional journey of comprehending not just their test results, but also how those results apply to loved ones. "We worry about the right to know, just as much as the right to not know." The much-hyped promise of personalized medicine is driving up demand for genetic testing, and there's a concern that we may have a national shortage of counselors to help interpret the results. Utah is insulated from the shortage due, in large part, to the pioneering work of Baty, the first genetic counselor in Utah, the first state to license counselors.

THE ADVOCATE

K **Mark Miller, CEO, Mark Miller Auto Group; Chair, University of Utah Hospitals and Clinics Board of Trustees; Chair, Utah Genome Project**

With all the suffering in the world, why invest in genomics, a budding science with uncertain payoff? Why not spend your money on medical advances that are saving lives now – a new surgical technique or drug trial? Because sometimes you have to play the long game, says auto dealer and philanthropist Mark Miller of his decision to give a \$250,000 seed grant to start the Utah Genome Project. The gift has sparked millions more in donations at a time when federal research funding wears thin, including \$12 million from the California surgeon and entrepreneur Patrick Soon-Shiong, M.D., and his foundation. "If you pay attention to what's going on in medicine, it's clear genetics plays an important role," Miller says. "We have such a huge opportunity to have a global impact on how we treat not just horrible diseases like cancer, but also common maladies, such as high cholesterol."

ALGORITHM No. 5
The Flow State

HAPPINESS 2.0

The 20th century and its Golden Age of Medicine are over. And while some – excited about the opportunity to create something new in the 21st century – might respond, “good riddance,” many more health care providers and biomedical scientists feel stressed and discouraged. Their collective malaise isn’t just affecting individual careers, it’s impacting the quality of our health system – jeopardizing everything from scientific discovery to patient safety. If we ever hope to fix health care, creating a new version of happiness should be on top of the to-do list.



Let's face it. Many of us in science and medicine just aren't happy. Funding is scarce. Work-life balance is an oxymoron. And everyone expects us to do more with less.

While the dissatisfaction hangs over every discipline, there's no doubt that physicians are at ground zero. Sharp commentaries such as, "How Being a Doctor Became the Most Miserable Profession," by Daniela Drake, M.D., paint a grim picture of what it's like to be a physician, in her words "a humiliating undertaking." On KevinMD, Pamela Wible, M.D., examines a time when she was plagued by suicidal thoughts. The reason? "Bureaucrats and middlemen had inserted themselves between me and my patients and sucked the joy right out of my career." These aren't just isolated rants. A growing number of studies point to widespread pessimism: Roughly seven out of 10 physicians said they would not recommend the profession to others. More than half of physicians said they are planning to retire early or scale back practice hours.

Unhappy as they may be, physicians do not have the corner on dissatisfaction. Basic and translational scientists don't appear much cheerier. The pressure to publish, acquire funding with increased competition for fewer grants, and balance the demands of work and personal life make being a scientist challenging. If you're one of the lucky ones, and you get tenure, the first moment of real security comes at around age 45.

HOW ACADEMIC MEDICINE LOST ITS MOJO

For a good majority of people who trained in a different era, health care reform can feel like bait-and-switch. They played by the rules. Powered through years, even decades, of rigorous education and training. Sleepless nights. Difficult bosses. Challenging cases. Heartbreaking losses. And now? The rules of engagement are changing...

THE STATE OF DISSATISFACTION

6-in-10

physicians believe the practice of medicine is in jeopardy.

≈ 400

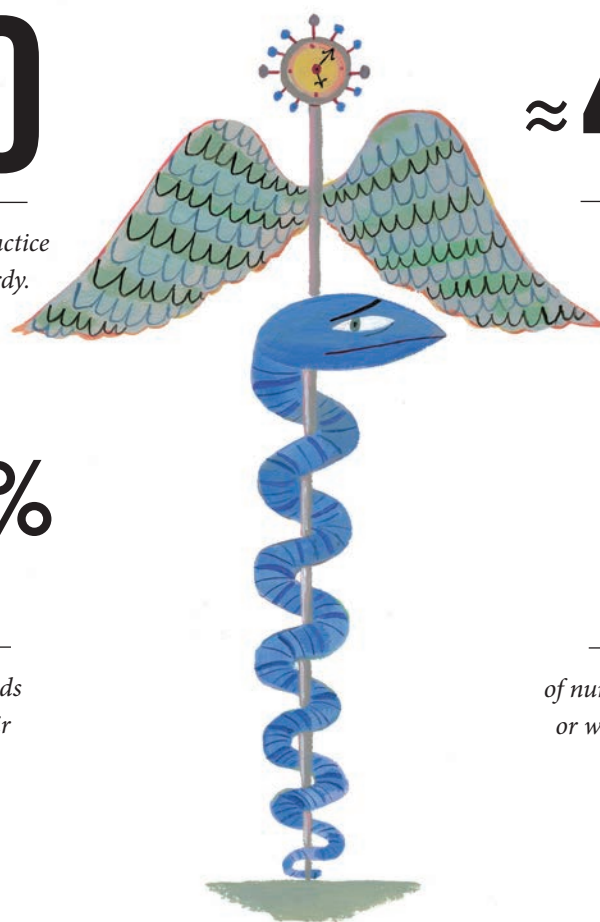
physicians commit suicide each year.

48%

of women in STEM fields are unhappy with their work-life integration.

98%

of nurses say they've experienced or witnessed rude and abusive behavior on the job.



PREACHING THE GOOD NEWS

A Baptist preacher. That's what Robert Pendleton, M.D., felt like when he first took the job of chief medical quality officer two years ago. He'd make the rounds trying to inspire 8,000 faculty and staff members to see past the stormy waters of health care reform and seize the opportunity to create a better system for patients. He realized the hospital had been too busy telling people what to do, instead of asking them to think. "The frontline staff knows best where the waste is, where there are inefficiencies and where the opportunities for improvement lie," says Pendleton. He believes that providers have two choices — either sit on the sidelines and be a victim of change, or embrace the opportunity to be unshackled from the fee-for-service environment and create a system they believe in. It's clear which path he thinks leads to career satisfaction. Today, Pendleton has stepped off the pulpit and instead looks for ways to support a "tidal wave of providers who are leading the way forward." It's been a sea change in culture, with hundreds of quality improvement projects successfully launched and continuous, real-time improvement happening daily. "What an exhilarating profession it is to be in right now," says Pendleton.



LEARN MORE ABOUT PENDLETON'S APPROACH TO CHANGE:
ALGORITHMSFORINNOVATION.ORG/FLOWSTATE

“WE ATTRACT SUPERB PEOPLE AND THEN HOOK THEM TO A PLOW.”

— WILLIAM T. COULDWELL, M.D., PH.D.
Chair, Department of Neurosurgery

constantly. "Sometimes it can feel like we're rafting down a river with constant rapids," says Michael Magill, M.D., chair of family and preventive medicine. "We keep waiting for the flat water, but it never comes. It's all white water."

Continuous uncertainty and change hurts morale in any situation. "But health care transformation isn't just change," says cognitive psychologist Charlene Weir, Ph.D., R.N. "It feels like a vise grip over people's time and decisions." To be motivated, Weir says, people need to feel a sense of control — the one thing physicians feel is missing now. Almost universally, University of Utah providers would like more input, with only 58 percent reporting they feel like they have the ability to influence things that affect their practice.

This loss of autonomy and lack of influence, pressure to work more efficiently and generate more revenue — not to mention the transition to the simultaneously celebrated and maligned EHR — leaves many providers feeling like mere cogs in the assembly line of medicine.

Paradoxically, those who perform the best financially often end up feeling the most pressure. "If you're a big rainmaker in the system, there's a huge incentive to keep you busy clinically," says William Couldwell, M.D., Ph.D., chair of neurosurgery. "We attract superb people and then hook them to a plow." The emphasis on minute-by-minute productivity, Couldwell notes, leaves little time for big-picture thinking and transformative research projects, which is what attracted many to choose academic medicine over private practice.

Sam Finlayson, M.D., M.P.H., chair of surgery, agrees. "We really can't run any faster or work any harder. We need to get people off the hamster wheel and engage them in creating a system that allows them to practice at the top of their license."

Moreover, a stressful, frustrating environment naturally breeds angry and disrespectful behavior, which almost always flows downhill. Ninety-eight percent of nurses say they've experienced or witnessed rude and abusive behavior on the job, according to an ACHE survey. No one can blame someone for avoiding a testy manager or a difficult attending, but silence comes at a price. Lack of communication is the No. 1 cause for medication errors, delays in treatment and surgeries at the wrong site, and it's the second-leading cause of operative mishaps, postoperative events and fatal falls.

"Our profession has traditionally done a really poor job of supporting all faculty members as they balance the multiple missions of the academic health center with their personal lives. This is especially true for women faculty members," says Carrie Byington, M.D., associate vice president for faculty and academic affairs. Only half

“
WHEN YOU THINK OF ACADEMIC HEALTH CARE, THERE ARE SO MANY REASONS NOT TO BE IN IT. WE WORK HARDER, GET PAID LESS AND OUR FOCUS IS ALWAYS DIVIDED... AND YET WE STAY, BECAUSE OUR CONTRIBUTIONS HAVE THE POWER TO MAKE A DIFFERENCE.
”

— **CARRIE BYINGTON, M.D.**
Associate Vice President for Faculty and Academic Affairs

of women are happy with their work-life integration, according to a survey by the Association for Women in Science, and many are reconsidering their professional choices or dropping out altogether. “Faced with the prospect of 15-20 years of training and relatively poor payment, it’s no surprise that so few women are entering academic health care,” says Byington, who has spent much of her career creating a mentoring program that helps support junior faculty. “There’s a lot of talk about value in health care right now, but value has many meanings,” says Byington. “One of the things we need to learn to do better is to *value people*.”

HEALING OURSELVES AND SAVING THE SYSTEM

But really, aren’t all Americans a little unhappy with their jobs and, by the way, getting paid a lot less than most in science and medicine? The answer is yes. But we’re also not relying on them to make life-saving discoveries and treatments that can maintain and restore our health. Creating a fully engaged and satisfied workforce may prove to be more important – and more challenging – than bending the cost curve. But what’s the solution? How do we keep people in academic health care motivated, focused and happy at work?

For starters, we need to reconsider our thinking about motivation. While conventional wisdom tells us that money is a key motivator, research on the subject overwhelmingly points to much deeper human needs: a desire to feel in control of our lives, to continually learn and grow and to find a larger sense of purpose in what we do. “Human beings have an innate inner drive to be autonomous, self-determined and connected to one another,” says author Daniel Pink. “When that drive is liberated, people achieve more.”

Duke University behavioral economist Dan Ariely puts it this way: “We tend to think that people are

like rats in a maze, that if we give them money we can direct how they work.” But, he explains, people are really more like mountaineers. We care about reaching the peak – and the challenge of the journey. We care about creating those moments when we’re in the zone, when other worries disappear, when we’re able to find our flow state.

“Creating a thriving workplace is going to require institutional culture change,” says Senior Vice President Vivian S. Lee, M.D., Ph.D., M.B.A. She acknowledges that the pressure health organizations feel to act quickly in the face of reform means leaders often don’t slow down enough to talk about changes with their teams. “We’re not always communicating our view from 10,000 feet,” she explains. “When we mandate change without providing meaning or context, it’s dispiriting rather than inspiring.”

To create more flow and satisfaction within a large academic medical setting, aligning around a central mission is key. “If we can get it right, our culture will be structured, yet it will also feel intuitive,” says Lee.

A change in mission can signal a subtle but important shift. “Our mission in medicine has been

TEACHING ACADEMIC SURVIVAL SKILLS

Seven years. That’s about how long new research scholars in basic science have to “sink or swim.” Institutions measure their value by the number of articles published and grants received, but rarely throw them any sort of flotation device. “When I needed data about our health system to write an NIH grant, the attitude was basically, we don’t have time for your science fair project,” says Carrie Byington, M.D., associate vice president for faculty and academic affairs. Byington watched her peers drop out, one by one. “I didn’t want to see talent wasted like that ever again.”

Byington set out to change the culture and find a better way for the research and clinical missions to work together. Today she’s created faculty-mentoring programs for clinical and translational scientists, educators, and health care providers across the health sciences. These programs support junior faculty members as they develop their careers, helping guide them to the resources that can propel their career forward.

These programs offer a one-stop shop to help assistant professors build successful clinical, education and research programs and translate their work into successful applications for promotion and tenure. Seminars, new faculty orientation, grant writing expertise, access to experts in statistical methods and data analysis, and intensive one-on-one mentoring all work together to ensure that excellent faculty members don’t fall through the academic cracks. Most importantly, the programs help faculty members see that the institution is committed to investing in them and in their futures.

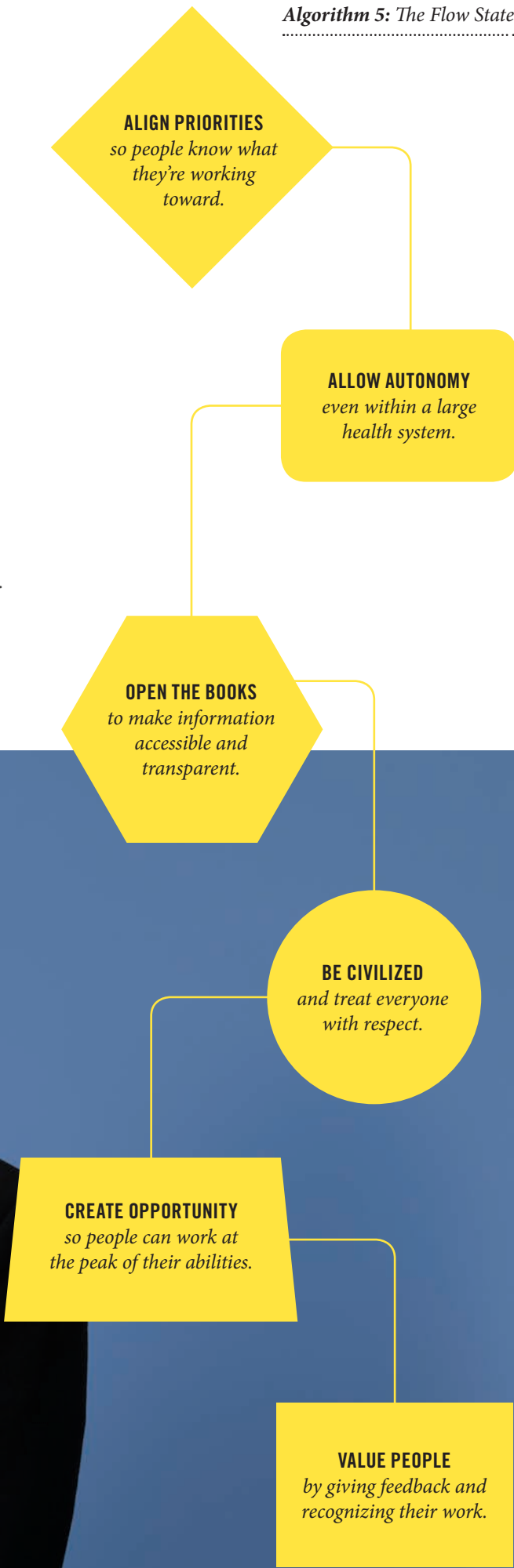
“When you think of academic health care, there are so many reasons not to be in it. We work harder, get paid less, and our focus is always divided between clinical care, education and research. And yet we stay, because our contributions have the power to make a difference.”

to treat disease,” says Finlayson. “But if we shift that mission to advancing health, then our perspective, our priorities and how we engage completely changes.” Our job is to create circumstances around change that are attractive. “When physicians begin to see how improvements don’t get in the way of taking care of patients, but rather make their professional lives flow more easily, they’ll be on board.”

One thing is certain: the dominant culture of medicine does not respond well to command and control. “Change can’t be top down,” says Sean Mulvihill, M.D., CEO of the University of Utah Medical Group and associate vice president for clinical affairs. Mulvihill’s non-prescriptive approach has focused on traveling around to division and department meetings, outlining the challenges, suggesting different approaches for addressing them, and then listening. “Physicians are in the best position to really direct meaningful change in the system,” says Mulvihill. “They just need to let go of the fear that they will somehow come out worse.”

Monica Vetter, Ph.D., chair of neurobiology and anatomy, believes we need to present changes as opportunities, not mandates. Vetter was recently asked to uproot her entire department from their recently remodeled lab space as part of a campus expansion plan. The move would be disruptive and the new lab space would be more densely populated, but the opportunity she presented was that researchers would be co-located more thematically. Instead of announcing the move

Algorithm 5: The Flow State



via an email, Vetter met with each faculty member (she went to their offices), listened to their concerns and explained how she thought the new space would create a central hub for collaboration with better access to shared resources, graduate students and colleagues. “It took us several months to work through the process, but I was surprised at the sense of optimism,” she says. “People really appreciate the opportunity to be a part of creating something larger.”

Feedback helps everybody work with a shared sense of purpose and, ultimately, it’s this sense of purpose that drives lasting career satisfaction. The feedback needs to be based on metrics and data that people trust. “When you create metrics you feel are valuable and then have data that shows you’ve moved the needle, that’s gratifying and a morale boost,” says Finlayson, whose faculty are working on more than 50 quality improvement projects. “Without data it’s just cheerleading. And if the feedback comes three months later, it’s not helpful.”

Allowing people to define how they want to measure patient care can be powerful. When an interdisciplinary group in orthopedic surgery created a care pathway for joint replacement, they identified their own version of “Perfect Care,” based on the best practices and metrics they felt were most important. “We crave opportunities to think creatively and strategically,” says Chrissy Daniels, M.S., director of strategic initiatives at University of Utah Hospitals and Clinics. “People are happiest when they can influence decisions, function as a team, are treated with respect and know they matter.”

BRINGING HAPPY BACK

It’s hard to argue that many of the changes in medicine aren’t for the better. Outspoken health care reformer Eric Topol, M.D., believes the patriarchal “priesthood of medicine” has far outlived its usefulness. A new

“**PEOPLE ARE HAPPIEST WHEN THEY CAN INFLUENCE DECISIONS, FUNCTION AS A TEAM, ARE TREATED WITH RESPECT AND KNOW THEY MATTER.**”

— **CHRISSY DANIELS, M.S.**
Director of Strategic Initiatives

generation of doctors are starting their careers with eyes wide open, excited by the prospect of creating a Platinum Age of Medicine propelled by health care reform. “I’m optimistic because I see so much enthusiasm among students, residents and fellows,” says Brad Poss, M.D., associate dean of Graduate Medical Education. “They think about the system, population management, and team-based care, and they have all kinds of ideas about how they’d like to improve them.”

The goal, as Lee sees it, is to create an environment that balances independent thought and creative discovery with system-based thinking and team science, so that everyone feels inspired to engage. While we’re far from reaching our institutional flow state, we believe we’re starting to ask the right questions. “We’re all facing these issues, and my hope is that we can work together to find solutions that transcend our individual organizations,” says Lee. “The only way our patients are going to receive the exceptional care they deserve is if we figure out how to create the kind of meaningful work environment that the people providing the care deserve.”

FIVE WAYS WE’RE FINDING OUR FLOW

1 **EMPOWERING TRAINEES**
Monthly quality improvement program for family practice residents provides an opportunity during training to make meaningful differences for safe, effective, patient-centered health care.

2 **MENTORING FACULTY**
Comprehensive mentoring programs for clinical and translational researchers, health science educators and providers focused on quality improvement help faculty achieve career goals and make meaningful contributions.

3 **PROVIDING GRANT SUPPORT**
Our biostatisticians and grant submission specialists provide faculty the resources they need to design appropriate studies, collect pilot data, prepare extramural grant applications and submit competitive proposals.

4 **REPAYING FACULTY DEBT**
The Educational Loan Reduction Assistance Program helps new faculty pay down their educational debt so they can spend less time worrying about money and more time building careers.

5 **BALANCING WORK AND LIFE**
New family-friendly policies, including six weeks of paid parental leave and a part-time tenure program, support faculty who want to “Lean In” to their careers and their families.

Your Brain on Flow

You know how it feels to be in the zone at work. Fully focused, the external world fades away, and existence itself is temporarily suspended. In this state, hours seem to pass in minutes, and every action you take flows effortlessly into the next one.

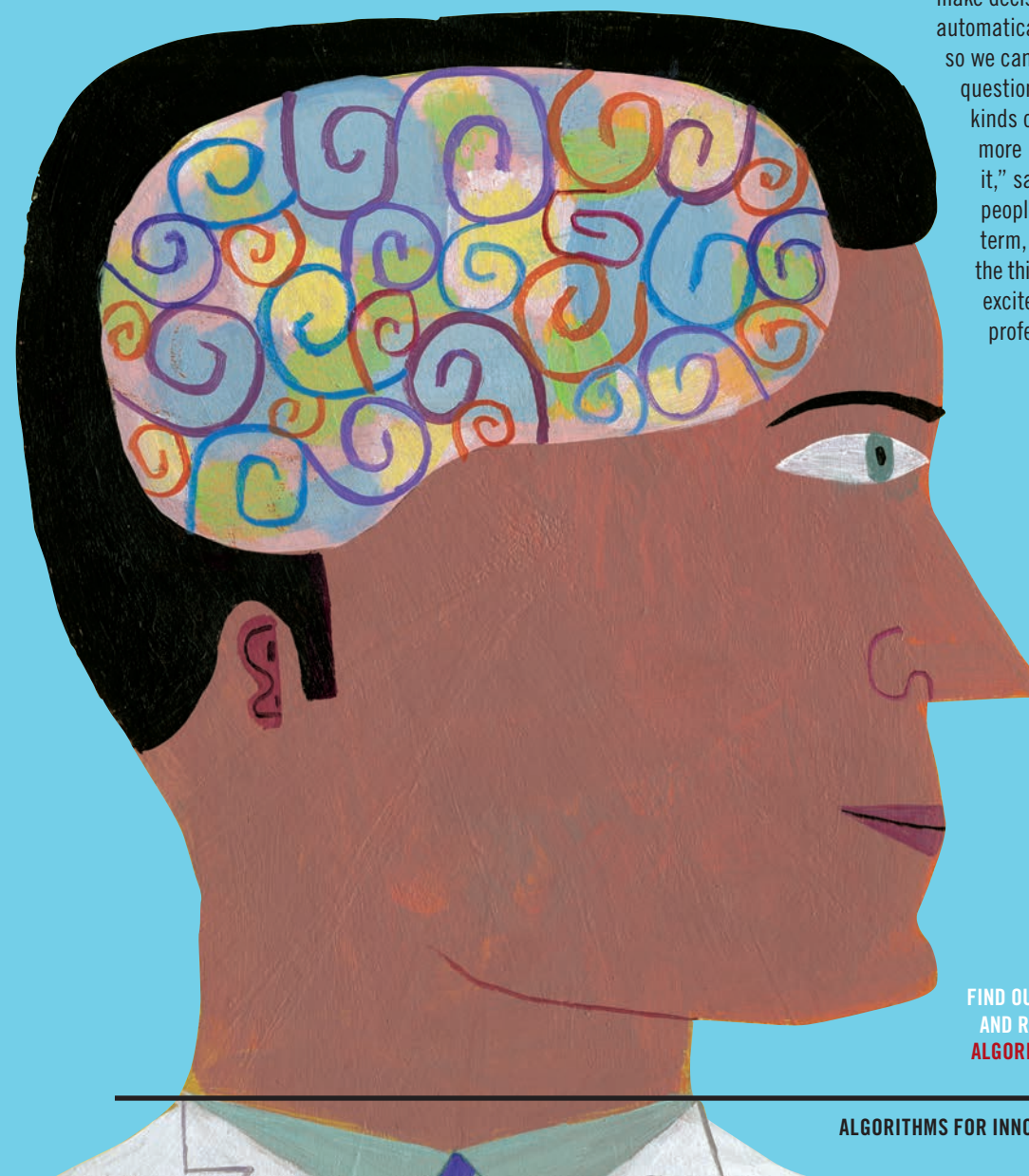
Psychologist Mihaly Csikszentmihalyi, known for his research on happiness and motivation, calls this the flow state. We’ve all experienced it when we’re pushed to the peak of our capabilities, working on a challenge that’s intrinsically rewarding. These are the times when we’re the most confident – even ecstatic – about what we do.

There’s a neurological explanation for this feeling. Our nervous systems are only capable of processing 110 bits of information per second. In a state of flow, when you’re completely immersed in a challenging task, you’re using all 110 bits of your processing capabilities. And that means you don’t have attention for anything else, like how your body feels, what time your next meeting starts or how you’re going to solve a thorny personal problem. In this flow state, when your neurologic processing capabilities are maxed out, everything else disappears from consciousness.

But can workplaces actually induce this flow state for their employees? Yes and no, says Carol Sansone, Ph.D., chair of psychology. While flow is a uniquely internal experience, it can only happen when certain external factors are in place. “Organizations must recognize the factors that make flow possible and avoid creating policies that interfere with it,” she explains.

And it entails providing the opportunity for variety in daily tasks, even if that means sacrificing a little short-term efficiency. “Although standardized procedures can be necessary for some tasks because of safety and health concerns, when organizations tell us how to do everything, we get frustrated and disengaged, even if it’s a job we like to do,” she says. “That’s just how our brains function.”

The sweet spot for a flow-friendly workplace is to create an environment that supports both “fast thinking,” so we can make decisions quickly, accurately and automatically, and “slow thinking,” so we can fulfill our need to ask big questions and play around with all kinds of answers. “When a task is more interesting, we’ll stick with it,” says Sansone. “To keep talented people motivated over the long term, we must never lose sight of the things that got them interested, excited and involved in their professions in the first place.”



FIND OUT WHO’S HAPPY IN OUR HEALTH SYSTEM
AND RATE YOUR OWN CAREER SATISFACTION:
ALGORITHMSFORINNOVATION.ORG/FLOWSTATE

HOW TO FIND THE FLOW STATE

INSIGHTS FROM THE FRONT LINE

Happy employees don't just happen. Sure, there are those rare people who seem to find joy wherever they go. But the rest of us require a workplace that helps us become the very best version of ourselves. Here, six of our faculty weigh in on what makes them feel supported.



MEGHAN CANDEE, M.D., M.Sc.

Assistant Professor, Pediatric Neurology

Recipient of a debt repayment award through our Educational Loan Reduction Assistance Program

"Educational debt is a huge burden for many junior faculty. After all the years of training, it's yet another insurmountable mountain to climb. So for a university to acknowledge how worried we are about our loans – and to actually help some of us pay them down – that goes a long way toward helping me feel understood and appreciated."



DAVID YOUNG, Pharm.D.

Professor, Pharmacotherapy

Works as an embedded pharmacist in the pulmonology and adult cystic fibrosis clinics

"I look forward to coming to work every day. I not only know our patients' medications and treatment plans, I also know all about their families, vacations and pets. They come to clinic with questions specifically for me, and I collaborate with our multidisciplinary team to find solutions. It's incredibly rewarding to use my training at this level."



SARA SIMONSEN, PH.D., M.S.

Assistant Professor, Family and Preventive Medicine

First faculty member to take advantage of our part-time tenure track policy

"It's a real paradigm shift for part-time faculty like me to be respected at work and supported in spending time with my family. In academic medicine, you either work hard or you're out, and you're usually not perceived as working hard if you're at the zoo with your kids. People here trust that I'll get the work done, even if I'm not in the office every day."



HOWARD T. SHARP, M.D.

Chief, Division of General Obstetrics and Gynecology

Has led several quality improvement projects, including one that reduced C-section rates by 33 percent

"You can't put a price tag on happiness. Sure, I could make more money in private practice, but I get to mix it up here, from teaching residents to collaborating with researchers on the clinical problems I want to solve. Instead of being told by administrators, 'You have to do this,' I'm asked, 'What would you like to do to make a difference?'"



SKYLER JENNINGS, AU.D., PH.D.

Assistant Professor, College of Health

Participates in the Vice President's Clinical and Translational Research Scholar Program, a two-year mentoring program for junior faculty members

"As a new faculty member, you're suddenly the person in charge, which can be stressful and lonely. With the mentoring program here, it's been different. I've had people help me with everything from prepping a new course to choosing the best grant mechanism – so I get this view from 10,000 feet even though I'm still at the ground level."



KAREN MULITALO, M.P.A.S., PA-C

Associate Professor (Lecturer), Physician Assistant Program

Directs the Physician Assistant Program, ranked second in the nation by *U.S. News and World Report*

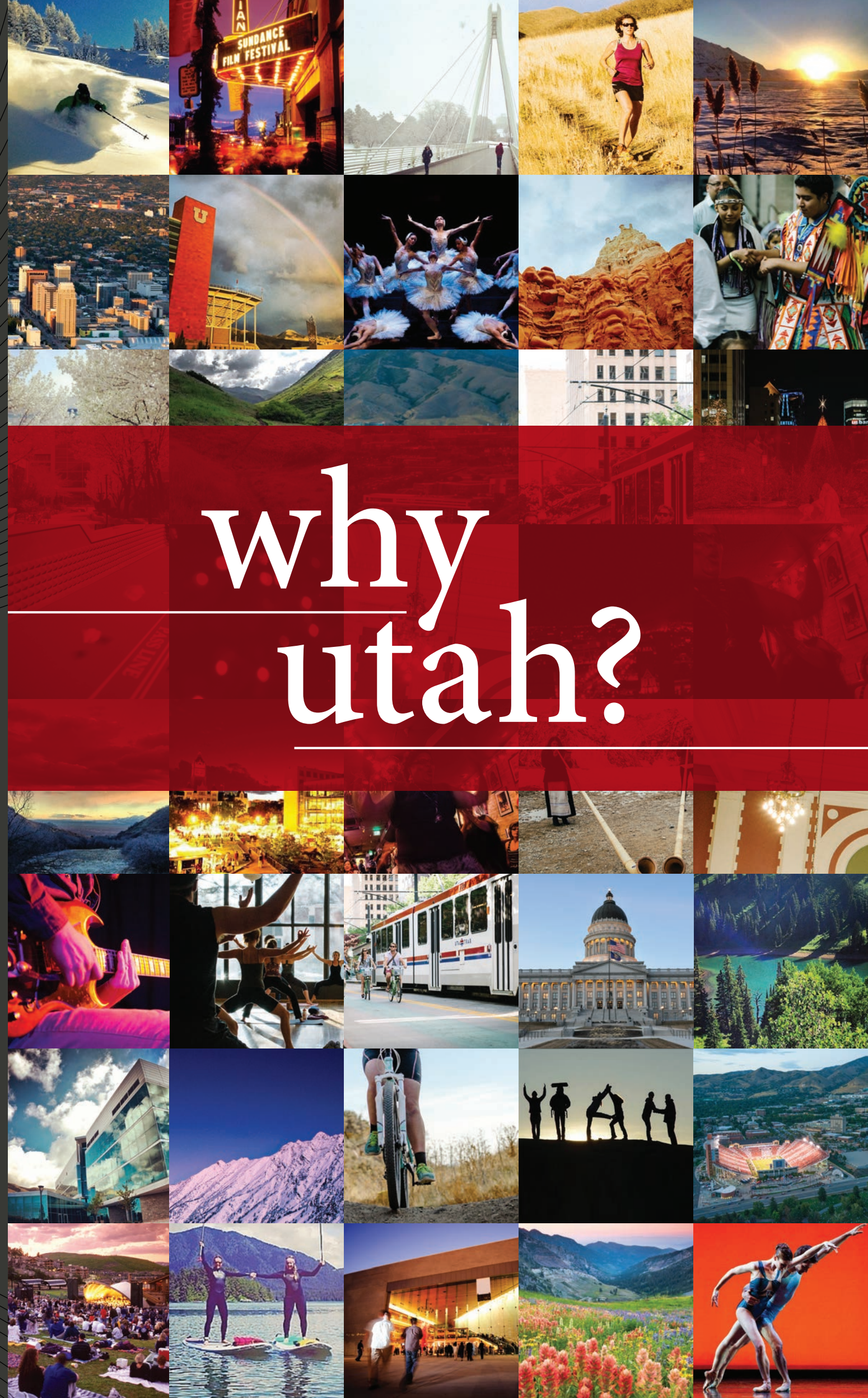
"It's the vision that inspires me – not just to teach students how to care for patients – but to inspire them to help underserved populations. I measure success by watching students become leaders in their field and giving back to the community. I've never seen another program provide top clinical education and execute that mission better than here."

Algorithms

**SEE THE PROGRESS
WE'RE MAKING**
ALGORITHMSFORINNOVATION.ORG
@UTAHINNOVATION

CAST YOUR VOTE
ALGORITHMSFORINNOVATION.ORG/
TENALGORITHMS

**A COMPLETE LIST OF SOURCES CITED IN
THIS REPORT CAN BE FOUND AT:
[ALGORITHMSFORINNOVATION.ORG/SOURCES](https://algorithmsforinnovation.org/sources)**



WHY UTAH?

Few places in the world boast landscapes as dramatic and diverse as Utah's. Our natural assets — ranging from 10,000-foot peaks to breathtaking desert scenes — are legendary. And you don't need to be an outdoor enthusiast to appreciate them. Wide-open spaces and expansive horizons beckon big ideas. Nature restores and refocuses the mind. Put simply, the world looks different from here. No less impressive are Salt Lake City's cultural riches. Minutes away from campus are an urban bounty of restaurants, theaters, museums and music halls.

sheer beauty

sheer beauty

WHY UTAH?



right sized

WHY UTAH?

In health care bigger is no longer better. Nimble and agile systems are poised to excel in the future. But what's the right size? How do we deliver care more efficiently without sacrificing quality? How do we align all the different stakeholders? Where's the Goldilocks zone for innovation? Perhaps by accident of our geographic location, we believe we've hit the sweet size — big enough to have outstanding resources and world-class talent but small enough to rely on each other to do our best work. To be right-sized is to encourage collaboration and creativity.

UNIVERSITY OF UTAH HEALTH SCIENCES

\$2.4 BILLION

Annual Budget

1,600

Faculty

5,700

Students

12,600

Staff

750

House Staff

CLINICAL CARE

\$1 BILLION

Net Patient Revenue

1.2+ MILLION

Hospital Visits

4

Hospitals

1,300

Physicians

10

Community Clinics

10%

Referral Area of Continental U.S.

RESEARCH

\$257.7 MILLION

677 GRANTS

EDUCATION

SCHOOL OF MEDICINE

50%

increase in annual enrolling class size –
from 82 to 122 students

COLLEGE OF HEALTH

3,200

students enrolled in 21 programs
in our largest college

COLLEGE OF NURSING

\$9.4M

from two new NIH grants support research
in end-of-life care and a new training
program for cancer and aging

COLLEGE OF PHARMACY

3RD

among pharmacy colleges for NIH funding
– the 39th consecutive year of being in the
top four in the nation

SCHOOL OF DENTISTRY

3.81

Admitted inaugural class of 20 students who had an average undergraduate GPA of 3.81, the highest of any dental school in the country. The new Ray and Tye Noorda Oral Health Sciences Building is scheduled to open at the end of 2014.

AWARDS

MOST WIRED

Two years in a row, University of Utah Health Care receives the Most Wired Innovator Award from H&HN magazine

TOP 10 IN QUALITY

Four years in a row, University of Utah Health Care receives prestigious University Health-System Consortium (UHC) Quality Leadership Award

LEADER IN PATIENT SATISFACTION

One in four of our providers scored in the top 10 percent nationwide; nearly half of them were in the top 1 percent.
Based on Press Ganey patient experience surveys

collaborative spirit

WHY UTAH?

Gone, at last, are the days of the scientific superhero. The new champion is collaboration. While we may have always believed in the merits of teamwork, the explosion of knowledge and tightening of funding has made it nonnegotiable. We value and reward brilliance, but don't play favorites. And we know that working in teams is, frankly, a lot more fun.

ANDREA H. BILD, PH.D.
Associate Professor, Pharmacology
and Toxicology

THERESA WERNER, M.D.
Assistant Professor, Internal
Medicine (Oncology)

ADAM COHEN, M.D.
Assistant Professor, Internal
Medicine (Oncology)

What if a treatment commonly given to breast cancer patients to prepare them for a chemo block actually blocked tumor growth? That's what pharmacologist Andrea Bild's research on valproic acid suggests. But to test her hypothesis, she must do a human trial and lean on a multitude of experts at Huntsman Cancer Institute: oncologists to dose and administer the drug and pathologists and radiologists to monitor tumor growth. "We've been working together on this for three years, practically for free," says Bild, one of the few basic scientists running a trial. "It's been the most gratifying experience for all of us, because we see the difference it's making for patients."



REBECCA UTZ, PH.D., M.S., M.A.
Associate Professor, Sociology

MICHAEL CASERTA, PH.D.
Professor, Nursing

The goal of hospice care is to provide a good death for the patient and the patient's family. But less attention is paid to the bereavement that follows, says gerontologist Michael Caserta, who, with Rebecca Utz, is exploring ways to affordably embed bereavement support within health organizations. "The key, we think, is moving away from a primary focus on emotional supports to helping with practical life challenges," Utz says. "Inheriting tasks from a spouse (cooking healthy meals or filling the car with gas) can be paralyzing. And those who have difficulty with these tasks tend to have a tougher time coping with the loss."

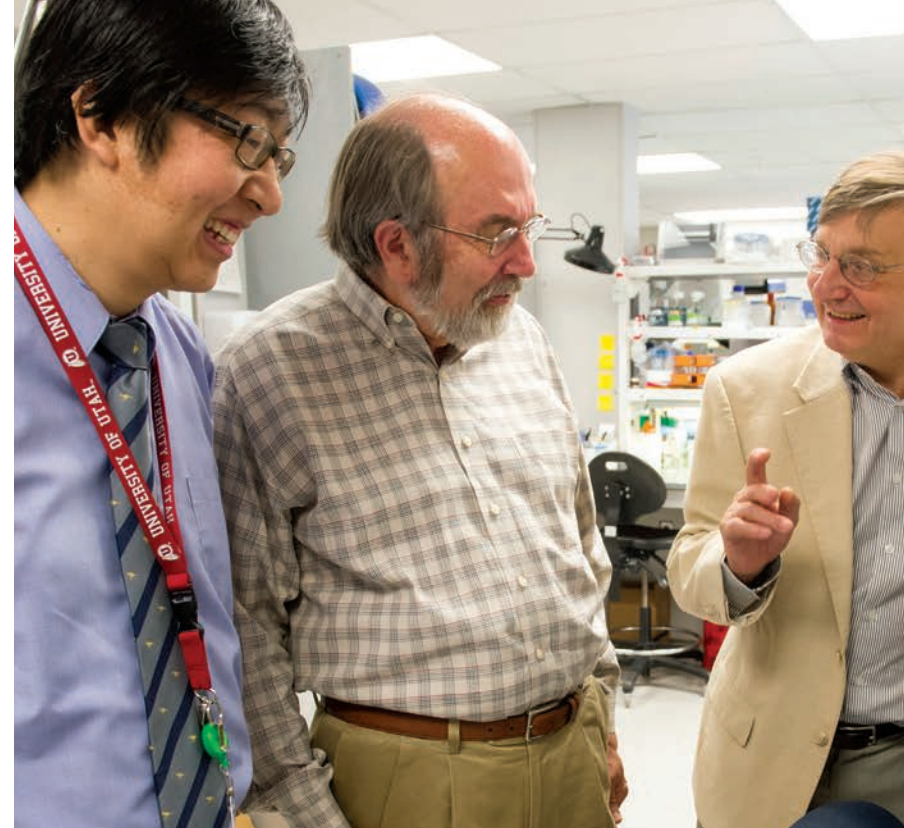


TSEWANG TASHI, M.D.
Hematology/Oncology Fellow

DONALD MCCLAIN, M.D., PH.D.
Professor, Internal Medicine

JOSEF PRCHAL, M.D.
Professor, Hematology/BMT

Hematologist Josef Prchal wanted to know if genetics explained why Tibetans thrive at altitudes averaging 14,800 feet without the medical complications that most of us suffer (a proliferation of red blood cells, which can lead to mountain sickness or heart failure). His recently published study identifying their mountain-living gene has implications for cancer, diabetes and high blood pressure. Like summiting the world's highest peaks, it took a team. Donald McClain monitored metabolic parameters, such as weight and diabetes status, in the volunteers. And native Tibetan Tsewang Tashi was critical for gaining the trust of study participants in this most secluded of countries.



STEPHEN L. LESSNICK, M.D., PH.D.
Professor, Pediatric Hematology/Oncology

MARY C. BECKERLE, PH.D.
CEO, Huntsman Cancer Institute,
Distinguished Professor of Biology

SUNIL SHARMA, M.D., M.B.A.
Professor, Internal Medicine (Oncology)

While juggling her duties as CEO of Huntsman Cancer Institute (HCI), Mary Beckerle still finds time for research. Her lab discovered a biological process that controls how cells stick, or remain attached in their normal environment — a process, they found, that goes awry in children with Ewing sarcoma, a common and hard-to-treat bone cancer. Their discovery may help explain the rapid spread of sarcoma cells and point the way to new treatments. With a \$1.7 million Grand Challenges Award from CureSearch for Children's Cancer, Beckerle and a multidisciplinary team at HCI, including Lessnick and Sharma, are pooling their expertise to develop therapies to improve the odds for children with this disease.



HEATHER HAYES, D.P.T., PH.D.
Assistant Professor (Clinical),
Physical Therapy

AMY POWELL-VERSTEEG, P.T.A.
Physical Therapy Assistant

D. JAMES BALLARD, D.P.T.
Assistant Professor (Clinical),
Physical Therapy

Insurance companies spare no expense covering complicated surgeries for patients with brain injuries and disorders, but they often skimp on rehab benefits. The University Rehabilitation and Wellness Clinic is a lifeline for patients who exhaust their rehabilitation coverage but require sophisticated, prolonged therapy. Using private gifts, grants and student labor, the clinic serves more than 200 Utahns with disorders such as stroke, Parkinson's disease and multiple sclerosis. It's been a 10-year labor of love for James Ballard, Heather Hayes and Amy Powell-Versteeg.

UTAH POPULATION DATABASE (UPDB)

UPDB is the world's largest genealogical and clinical database, linking family histories of more than 7.3 million people to medical and demographic information. For three decades, researchers have tapped into this invaluable database to make genetic, epidemiological, demographic and public health discoveries, including the genes responsible for breast and colon cancer and more than 30 diseases. The University of Utah stewards the database, which was founded and is supported by Huntsman Cancer Institute.

BIOINFORMATICS/GENOMICS/HIGH THROUGHPUT GENOMICS

From PCR setup to high-throughput sequencing and analysis of genotyping projects, these cores generate innovative new genomics data and also connect to the robust public genomics databases – enabling new discoveries in genomic medicine and research. For seamless data transition and analysis, these cores are integrated in the same IT system and Laboratory and Information Management Systems.

CENTRALIZED ZEBRAFISH ANIMAL RESOURCE (CZAR) FACILITY

Zebrafish have become increasingly valuable to researchers to model important aspects of human development and disease. This state-of-the-art system, which has 6,000 fish tanks and centralized circulating water systems, supports multi-lab collaborations doing large genetic screens as well as pilot experiments. CZAR is supported by an \$8 million NIH grant, which the University matched.

METABOLIC PHENOTYPING CORE

Investigators use this core to evaluate metabolic phenotypes in multiple model organisms to explore diabetes, obesity, exercise and nutrition. Experimental data produced by highly specialized technologies, such as mitochondrial bioenergetics, determination of whole animal energy, body composition by nuclear magnetic resonance, and determination of circulating metabolite and hormone concentrations provides researchers with the ability to elucidate multivariate parameters with the goal of mimicking human metabolic disorders.

RESEARCH EDUCATION, TRAINING AND CAREER DEVELOPMENT PROGRAM

As one of eight cores in the NIH-funded Center for Clinical and Translational Science, this program supports students pursuing graduate-level degrees in clinical investigation. It also offers career development programs for junior investigators, including grant writing, peer-review, management essentials and leadership development for principal investigators to foster careers in translational research.

ENTERPRISE DATA WAREHOUSE

More than 2.5 million patient records are securely stored in the data warehouse, providing access to the clinical and financial data from our EHR systems. Ninety percent of the data is received via real-time feeds and nightly batch loads and is accessible to authorized users on a real-time basis. Nearly 80 percent of the patient records have been matched to a personal record in the Utah Population Database to foster genetic discovery.

BIOREPOSITORY AND MOLECULAR PATHOLOGY

One of only a handful of repositories in the nation certified by the College of American Pathologists, our Biorepository provides high-quality, annotated biospecimens with appropriate controls. Molecular Pathology performs advanced testing serving as a bridge between new molecular discoveries in cancer research and clinical trials. Both sections are integrated directly into the electronic health record, as well as the Utah Population Database and the genomics IT systems.

ARUP LABORATORIES

A nonprofit, academic enterprise of the University of Utah's Department of Pathology, ARUP is a leading national reference laboratory that offers more than 3,000 tests and test combinations, including esoteric molecular and genetic assays. A leader in innovative laboratory research and development, ARUP educates and consults clients on how to improve diagnostics, streamline operations and reduce total cost of care.

WHY UTAH?

open access

Science works best when we put our resources in the hands of the many, not just the few. That's why our core research facilities offer unrestricted access to everyone on campus and beyond – from engineers, biologists and drug developers to students and venture capitalists. Run by experts, managed like a business – though still not-for-profit – and focused on collaboration. Here we highlight some of our 34 outstanding cores and facilities that support scientists who are transforming the future of medicine.

rockstar recruits

WHY UTAH?

Recruiting the right talent has never been more important. We want smart, motivated people, and we're willing to invest in them. This past year, we've welcomed 190 new faculty onto the Utah team. Here we feature just a few of our rising stars and asked them to tell us in their own words . . . Why Utah?



JIA-WEN GUO, PH.D., R.N.
Assistant Professor of Nursing

FROM NATIONAL TAIPEI UNIVERSITY OF NURSING AND HEALTH SCIENCES, TAIWAN



KATHERINE E. VARLEY, PH.D.
Assistant Professor of Oncological Sciences

FROM HUDSONALPHA INSTITUTE FOR BIOTECHNOLOGY



BENJAMIN S. BROOKE, M.D., PH.D.
Assistant Professor of Surgery
FROM DARTMOUTH-HITCHCOCK MEDICAL CENTER



"I came to Utah because there is incredible momentum in the institution towards stronger partnerships with communities, more patient-focused care and innovation."

WENDY CHAPMAN, PH.D.
Chair, Department of Biomedical Informatics
FROM UNIVERSITY OF CALIFORNIA, SAN DIEGO



FREDERICK G.P. WELT, M.D.
Professor of Cardiovascular Medicine
FROM BRIGHAM AND WOMEN'S HOSPITAL AND HARVARD MEDICAL SCHOOL



JAMES C. FANG, M.D.
Professor of Internal Medicine
Chief of Cardiovascular Medicine
FROM CASE WESTERN RESERVE UNIVERSITY SCHOOL OF MEDICINE



NANCY ALLEN, PH.D.
Assistant Professor of Nursing
FROM BOSTON COLLEGE

“The University of Utah’s Burn Center is one of the oldest and most prestigious in the country. The staff, my partners (Drs. Cochran and Morris), the support of the Department of Surgery and the legacy of Dr. Saffle made it difficult to see myself anywhere but Utah.”

GIAVONNI LEWIS, M.D.
Assistant Professor
of Surgery

FROM UNIVERSITY OF WASHINGTON
HARBORVIEW MEDICAL CENTER

JAMES H. BEKKER, D.M.D.
Associate Professor (Clinical)
of Dentistry

FROM PRIMARY CHILDREN’S
MEDICAL CENTER

“I’m excited to be part of building a dental program. The opportunities for research and training here are enhanced by the crossover with private industry.”

OLGA J. BAKER, PH.D., D.D.S.
Associate Professor
of Dentistry

FROM UNIVERSITY
AT BUFFALO – SUNY

KARA DASSEL, PH.D.
Associate Professor (Clinical)
of Nursing

FROM WESTERN KENTUCKY
UNIVERSITY

“Here, we’re poised to realize the possibility of the right care for every patient. There’s a commitment here to figuring out ‘how’ to make this happen, not ‘if’ we can make it happen.”

PAMELA MATHY, PH.D.
Associate Professor (Clinical)
and Director, Speech-Language-
Hearing Clinic Communication
Sciences and Disorders

FROM KENNEDY KRIEGER INSTITUTE

RACHEL HESS, M.D.
Professor of Internal Medicine
Director, Health System
Innovation and Research

FROM UNIVERSITY OF PITTSBURGH
SCHOOL OF MEDICINE

JASON GERTZ, PH.D.
Assistant Professor of
Oncological Sciences

FROM HUDSONALPHA INSTITUTE
FOR BIOTECHNOLOGY

“The University of Utah is a genuine health science center – that means it centralizes researchers, clinicians and patients both physically and ideologically. I believe it gives me the best chance to solve real problems.”

SHAWN C. OWEN, PH.D.
Assistant Professor of
Pharmaceutics and
Pharmaceutical Chemistry

FROM UNIVERSITY OF TORONTO



WHY UTAH?



global influence

The problems in health care transcend our borders, and so does our reach. Maybe it speaks to our confidence, commitment or desire to make a difference. Our faculty is inclined toward leadership. Here we highlight those people who have contributed to the larger conversation by serving as presidents of national and international societies. They represent a fraction of our faculty who serve in leadership roles that are transforming medicine, science and health care.

PRESIDENTS OF PROFESSIONAL ORGANIZATIONS

(CURRENT AND PAST)

DOMINIC ALBO, JR., M.D. <i>Southwest Surgical Association</i>	DAVID K. GAFFNEY, M.D., PH.D. <i>Brachytherapy Society</i>	GINETTE A. PEPPER, PH.D., R.N. <i>Western Institute of Nursing</i>
STEPHEN C. ALDER, PH.D. <i>Association of Accredited Public Health Programs</i>	CONSTANCE GOLDGAR, M.S., PA-C <i>Physician Assistant Education Association</i>	National Hartford Center of Gerontological Nursing Excellence
EDWARD R. ASHWOOD, M.D. <i>Academy of Clinical Laboratory Physicians and Scientists</i>	COLIN K. GRISSOM, M.D. <i>Wilderness Medical Society</i>	SHERRIE L. PERKINS, M.D., PH.D. <i>Society for Hematopathology</i>
MARY C. BECKERLE, PH.D. <i>The American Society for Cell Biology</i>	CHARLES D. HAWKER, PH.D. <i>Association of Clinical Scientists</i>	THEODORE J. PYSHER, M.D. <i>Society for Pediatric Pathology</i>
WILLIAM BRANT, M.D. <i>Trauma and Urologic Reconstructive Network of Surgeons</i>	KURT T. HEGMANN, M.D., M.P.H. <i>American Board of Preventive Medicine</i>	R. LOR RANDALL, M.D. <i>Connective Tissue Oncology Society</i>
ELIOT A. BRINTON, M.D. <i>American Board of Clinical Lipidology</i>	ELIZABETH F. HOWELL, M.D., M.S. <i>American Society of Addiction Medicine</i>	JEFFREY R. SAFFLE, M.D. <i>American Burn Association</i>
DIANA I. BRIXNER, PH.D. <i>International Society for Pharmacoeconomics and Outcomes Research</i>	WAYNE IMBRESCHIA, M.P.H. <i>University Administrators of Ophthalmology</i>	CHARLES L. SALTZMAN, M.D. <i>American Orthopaedic Foot and Ankle Society</i>
MARY P. BRONNER, M.D. <i>Rodger C. Haggitt M.D. Gastrointestinal Pathology Society</i>	PETER E. JENSEN, M.D. <i>Association of Pathology Chairs</i>	Association of Bone and Joint Surgeons
JOHN P. BURKE, M.D. <i>Society for Healthcare Epidemiology of America</i>	LYNN B. JORDE, PH.D. <i>American Society of Human Genetics</i>	International Federation of Foot and Ankle Societies
PATRICK C. CARTWRIGHT, M.D. <i>Society for Pediatric Urology</i>	WILLIAM KEYE, M.D. <i>American Society for Reproductive Medicine</i>	WADE S. SAMOWITZ, M.D. <i>Collaborative Group of the Americas on Inherited Colorectal Cancer</i>
THOMAS CHEATHAM III, PH.D. <i>International Society of Quantum Biology and Pharmacology</i>	VIVIAN S. LEE, M.D., PH.D., M.B.A. <i>Society of Reproductive Surgeons</i>	JAMES R. SCOTT, M.D. <i>American Gynecological and Obstetrical Society</i>
WILLIAM T. COULDWELL, M.D., PH.D. <i>American Association of Neurological Surgeons</i>	JANET E. LINDSLEY, PH.D. <i>International Society for Magnetic Resonance in Medicine</i>	American Society for the Immunology of Reproduction
International Meningioma Society	ELAINE LYON, PH.D. <i>Association for Molecular Pathology</i>	Council of University Chairs of Obstetrics and Gynecology
ALAN S. CRANDALL, M.D. <i>American Society of Cataract and Refractive Surgery</i>	BRUCE MACWILLIAMS, PH.D. <i>The North American Gait and Clinical Movement Analysis Society</i>	HOWARD T. SHARP, M.D. <i>International Pelvic Pain Society</i>
WILLIAM CROWLEY, PH.D. <i>Association of Medical School Pharmacology Chairs</i>	MICHAEL K. MAGILL, M.D. <i>Association of Departments of Family Medicine</i>	CLOUGH SHELTON, M.D. <i>American Otological Society</i>
RENA D'SOUZA, D.D.S., M.S., PH.D. <i>American Association for Dental Research</i>	JOYCE A. MITCHELL, PH.D. <i>American College of Medical Informatics</i>	American Neurotology Society
CHRISTOPHER B. DECHET, M.D. <i>International Society of Urologists</i>	KATHI MOONEY, PH.D., R.N. <i>Oncology Nursing Society</i>	DENNIS C. SHRIEVE, M.D., PH.D. <i>International Stereotactic Radiosurgery Society</i>
KARIN M. DENT, M.S., C.G.C. <i>National Society of Genetic Counselors</i>	ROYCE MOSER, JR., M.D., M.P.H. <i>Aerospace Medical Association</i>	JOHN SMITH, M.D. <i>Children's Spine Foundation</i>
CATHERINE DEVRIES, M.D., M.S. <i>IVUmed</i>	SEAN J. MULVIHILL, M.D. <i>American Hepato-Pancreato-Biliary Association</i>	RICHARD D. SONTHEIMER, M.D. <i>North American Rheumatologic Dermatology Society</i>
KATHLEEN B. DIGRE, M.D. <i>North American Neuro-ophthalmology Society</i>	EDWARD NELSON, M.D. <i>Southwest Surgical Association</i>	Medical Dermatology Society
C. PAUL ELEAZER, M.D. <i>Association of Directors of Geriatric Academic Programs</i>	PEGGY NORTON, M.D. <i>American Urogynecologic Society</i>	DAVID N. SUNDWALL, M.D. <i>American Clinical Laboratory Association</i>
MARK R. ELSTAD, M.D. <i>Association of VA Chiefs of Medicine</i>	SOCIETY OF GYNECOLOGIC SURGEONS	MARK A. SUPIANO, M.D. <i>Association of Directors of Geriatric Academic Programs</i>
ANNETTE FLECKENSTEIN, PH.D. <i>American Society for Pharmacology and Experimental Therapeutics</i>	INGRID NYGAARD, M.D. <i>American Urogynecologic Society</i>	Geriatric Research, Education, and Clinical Center Directors' Association
ROBERT S. FUJINAMI, PH.D. <i>Association of University Pathologists (Pluto Society)</i>	RANDALL J OLSON, M.D. <i>Association of University Professors of Ophthalmology</i>	LILLIAN TOM-ORME, PH.D. <i>National Alaska Native American Indian Nurses Association</i>
	BEVERLY PATCHELL, PH.D., A.P.R.N. <i>National Alaska Native American Indian Nurses Association</i>	KARL V. VOELKERDING, M.D. <i>Association for Molecular Pathology</i>



H.E. SMITH
Stem Cell Transplant Recipient
and Great-Grandfather



TAYTON WINWARD
7-Year-Old Burn Survivor
and AirMed Fan



MUFFY DAVIS
Disc Surgery Patient and
Paralympic Champion



KATE GRAGNOLATI
Sepsis Survivor and
Personal Trainer

inspirational patients

WHY UTAH?

We are not the measure of our academic achievements, our rigorous training or sophisticated research. We are defined by our patients and our ability to return them to wholeness and health. They're the source of our passion and greatest achievements.

READ THEIR INSPIRING STORIES AT:
[HEALTHCARE.UTAH.EDU/PATIENT-STORIES](https://healthcare.utah.edu/patient-stories)



BECKHAM FERSHTUT
2-Year-Old Kidney
Transplant Recipient



ANDY NISH
Detached Retina Patient and
Junior Karting Champion



BRIAN HULTMAN
Stroke Survivor and
Competitive Cyclist



STETSON LITTLE
3-Year-Old Asthmatic and
Superhero Aficionado



TERRI AND DANNY LEVATO
NICU Premie Twins and
Their Proud Parents

generous donors

WHY UTAH?

\$81.6M

Total Donations for 2013

10,600⁺

Total Number of Donors

Our donors are redefining philanthropy and trusting us to solve some of society's biggest problems. They expect results, not personal pay-off, and no challenge is too ambitious. We thank them for their vision, for fueling tomorrow's breakthroughs, for believing in us.

LIFETIME GIVING

GOLD (\$10,000,000+)

A. E.* and Rosemary* Benning
H. A.* and Edna* Benning
Ian and Annette Cumming
George S.* and Dolores Doré* Eccles
Richard A. Fay and Carol M. Fay
Ira and Mary Lou Fulton
Jon and Karen Huntsman
Mr.* and Mrs. Larry H. Miller
John A. Moran
Ray* and Tye* Noorda
L. S. "Sam"* and Aline W. Skaggs
Anonymous

CORPORATIONS AND FOUNDATIONS

The ALSAM Foundation
American Cancer Society
ARUP Laboratories
The Church of Jesus Christ of Latter-day Saints Foundation
Cumming Foundation
George S. and Dolores Doré Eccles Foundation
Huntsman Cancer Foundation
Jon and Karen Huntsman Foundation
Intermountain Healthcare
Emma Eccles Jones Foundation
The Ray and Tye Noorda Foundation
Primary Children's Hospital
Primary Children's Hospital Foundation
Skaggs Institute for Research
The Larry H. Miller Group
Nora Eccles Treadwell Foundation

SILVER (\$5,000,000 TO \$9,999,999)

Dr. Robert H.* and Dorothy Cannon* Ballard
Dr. Rodney H. and Carolyn Hansen Brady
William H. and Patricia W. Child
Edmund W. and Carol B. Dumke
Spencer F. and Cleone P.* Eccles
Dr. Claudius Y.* and Catherine B.* Gates
Robert C. Gay, Ph.D. and Lynette N. Gay
Martha Ann Dumke Healy*
Dr. Louis S.* and Janet B.* Peery
Bertram H. and Janet Marshall Schaap
Richard L. Stimson*
Arthur and Haru Toimoto
Anonymous

CORPORATIONS AND FOUNDATIONS

Beaumont Foundation of America
The Church of Jesus Christ of Latter-day Saints
Spencer F. and Cleone P. Eccles Family Foundation
Willard L. Eccles Charitable Foundation
Fidelity Charitable Gift Fund
Ben B. and Iris M. Margolis Foundation

(BENEFACTOR) \$1,000,000 TO \$4,999,999

Rex* and Linda Ahlstrom • Clarence H.* Albaugh, M.D. and Estelle Hardy* Albaugh • Margaret Allen Amundsen* • Elliott V. Anderson* • G. W.* and Lee Anderson • M. Russel and Barbara Ballard • D. Keith* Barnes, M.D. and Ida May "Dotty"* Barnes, R.N. • Dr. Grant H.* and Mildred Burrows* Beckstrand • B. Lue* and Hope S.* Bettilyon • Dr. Charles K. and Janice Beyer-Machule • Clarence* and Ruth N.* Birrer • Mary H. Boesche* • H. Roger and Sara F. Boyer • J. Gordon* and Betty* Browning • Fred W.* and Eveline Bruenger • Kenneth P.* Burbidge, Jr. and Sally R.* Burbidge • Robert S.* and Beth M.* Carter • The Dr. George Eastman* and Helene* Cartwright Family • Carmen M. Christensen* • Alfred "Chris"* and Trudi Christiansen • Helen Lowe Bamberger Colby* • David E. Cumming • John and Kristi Cumming • George* and Florence* Dauncey • Dr. Candace Cartwright Dee and Thomas D. Dee, III • The Thomas D. Dee, II* Family • William R.* and Shirley E.* Droschkey • Mr. and Mrs. Ezekiel R. Dumke, Jr. • Joe and Alexandra Dwek • The Spencer S. Eccles* Family • Valois Egbert* • Mr. and Mrs. Robert J. Eichenberg • William C. Fagergren* • Randall K. Fields • Val A.* and Edith D.* Green • Drs. George D.* and Esther S.* Gross • Richard A.* and Nora Eccles Treadwell* Harrison • John* and June Gale* Hartman • Calvin S.* and JeNeal N. Hatch • Dr. C. Charles* Hetzel, Jr. and Alice B.* Hetzel • Dr. C. Charles* Hetzel, Jr. and Dorothy B.* Hetzel • Dr. William I. and Setsuko* Higuchi • Dr. Aaron A. and Suzanne Hofmann • John T. and Anne. C. Hopkin • Alan E. and Drue B. Huish • Frank and Connie Hull • Donal B. Hutchison* • Dr. Webster S. S. and Alice L.* Jee • Thomas E.* and Rebecca D.* Jeremy • Joseph H.* and Esther J.* Kelley • Kirk Kerkorian • The Larry S. and Marilyn A. Larkin Family • Father Rick Q. Lawson • Edwin L.* and Grace C.* Madsen • T. G. "Bud" and Barbara* Mahas • Ralph E.* and Willia T.* Main • Jack* and Ann* Mark • Lucille P. Markey* • Gaye H. Marrash • Michael T.* and Taylor Miller • G. Mitchell* and June M. Morris • Dr. and Mrs. Charles A. Nugent, Jr. • Richard K.* and Maria A.* Obyn • Dr. Randall J. and Ruth Olson • James Packer • The Kerry Packer Family • George C. and Anne C. Pingree • Ronald E. Poelman* and Anne G. Osborn, M.D. • Sylvia E. Pahl • Drs. Glenn D. Prestwich and Barbara L. Bentley • Barbara B. Prince* • Dr. Thomas D.* and Natalie B.* Rees • Robert L.* and Joyce T. Rice • Debra J. Fields Rose • Dr. Leo T.* and Barbara K.* Samuels • Ida W.* Smith and Dee Glen* Smith • Julie and Richie Smith • Ryan, Scott and Nicholas Smith • Dr. Theodore and Mary Ann Stanley and Sons • Harold J.* and Eleanore Eccles* Steele • Harold J.* , Ardella T.* , and Helen T.* Stevenson • Grace E. Stillwell* • Keith A. and Amy Van Horn • C. Scott* and Dorothy E.* Watkins • Dr. Orson W.* and Dora D.* White • George* and Lorna* Winder • John Rex* and Alice C.* Winder • Dr.* and Mrs.* Maxwell M. Wintrobe • Joseph J. Yager* • Anonymous

CORPORATIONS AND FOUNDATIONS

Abbott Laboratories Fund • Archstone Foundation • Associated University Pathologists, Inc. • Ruth Eleanor Bamberger and John Ernest Bamberger Memorial Foundation • The Boston Foundation • Ciba-Geigy Corporation • David E. Cumming Family Foundation • In Memory of Terri Anna Perine • John D. Cumming Family Foundation • Dialysis Research Foundation • Dr. Ezekiel R. and Edna Wattis Dumke Foundation • Katherine W. and Ezekiel R. Dumke, Jr. Foundation • eCardio Diagnostics • The Marriner S. Eccles Foundation • Educational Resource Development Council (ERDC) • Eli Lilly and Company Foundation • Foster Charitable Foundation • The Fund for Charitable Giving • Fluor Enterprises, Inc. • General Instrument Corporation • Glaxo Wellcome, Inc. • Howard Hughes Medical Institute • Huntsman Corporation • W. M. Keck Foundation • Kohl's Department Stores • Larry H. Miller Subaru • The Lincy Foundation • Jack D. and Grace F. Madson Foundation • Majerus Family Foundation • J. Willard and Alice S. Marriott Foundation • G. Harold & Leila Y. Mathers Foundation • Thomas C. Mathews, Jr. Trust • Miche Bag • Muscular Dystrophy Association, Inc. • The Craig H. Nielsen Foundation • Ortho Pharmaceutical Corporation • Pfizer, Inc. • Research to Prevent Blindness, Inc. • Richards Memorial Medical Foundation • Skaggs Companies, Inc. • Skaggs Foundation for Research • Sigma Chi Chapters • Spencer F. Kirk Family Foundation • Stanley Research Foundation • Takeda Pharmaceuticals North America, Inc. • Thrasher Research Fund • The George and Sharee Paulson Unitrust • The Mathew B. Worton and LaDean R. Worton Memorial Fund • Vanguard Charitable Endowment Program • Workers Compensation Fund • Zions Management Services Company • Anonymous

*Deceased

endowed chairs

WHY UTAH?

The promise of enduring impact in research, education and clinical care is preserved through our 139 endowed and presidential endowed chairs. The commitment of stellar faculty and visionary donors is the bedrock of the University's excellence.

Sean J. Mulvihill, M.D. Ross R. Anderson, M.D. Presidential Endowed Chair in Surgery Established by Elliott V. Anderson in Honor of His Father **Meic H. Schmidt, M.D., M.B.A.** Ronald I. Apfelbaum, M.D. Endowed Chair in Spine Surgery Sponsored by Aesculap AG **Peter E. Jensen, M.D.** ARUP Presidential Endowed Chair **Kenward B. Johnson, M.D.** Carter M. Ballinger, M.D. Presidential Endowed Chair in Anesthesiology **Janice M. Morse, Ph.D.** Ida May “Dotty” Barnes, R.N. and D. Keith Barnes, M.D. Presidential Endowed Chair in the College of Nursing **Mark A. Supiano, M.D.** D. Keith Barnes, M.D. and Ida May “Dotty” Barnes, R.N. Presidential Endowed Chair in the School of Medicine **Scholar Search in Progress** Grant H. Beckstrand, M.D. and Mildred Burrows Beckstrand Presidential Endowed Chair in Surgical Oncology **Christopher P. Hill, D.Phil.** H. A. and Edna Benning Presidential Endowed Chair **Matthew P. Samore, M.D.** H. A. and Edna Benning Presidential Endowed Chair **Mark Yandell, Ph.D.** H. A. and Edna Benning Presidential Endowed Chair **Michael Varner, M.D.** H. A. and Edna Benning Presidential Endowed Chair **Carrie L. Byington, M.D.** H. A. and Edna Benning Presidential Endowed Chair **Brenda Bass, Ph.D.** H. A. and Edna Benning Presidential Endowed Chair **Lynn B. Jorde, Ph.D.** H. A. and Edna Benning Presidential Endowed Chair **Dean Yaw Li, M.D., Ph.D.** H. A. and Edna Benning Presidential Endowed Chair **Carl S. Thummel, Ph.D.** H. A. and Edna Benning Presidential Endowed Chair **J. Michael Dean, M.D., M.B.A.** H. A. and Edna Benning Presidential Endowed Chair **Gerald G. Krueger, M.D.** H. A. and Edna Benning Presidential Endowed Chair **Wesley I. Sundquist, Ph.D.** H. A. and Edna Benning Presidential Endowed Chair **Donald A. McClain, M.D., Ph.D.** B. Lue and Hope S. Bettilyon Presidential Endowed Chair in Internal Medicine for Diabetes Research **Vivian S. Lee, M.D., Ph.D., M.B.A.** A. Lorris Betz, M.D., Ph.D., Presidential Endowed Chair for the Senior Vice President for Health Sciences **John R. Hoidal, M.D.** Clarence M. and Ruth N. Birrer Presidential Endowed Chair in the School of Medicine in Memory of Dr. and Mrs. A. J. Nielson, Dr. Karl O. Nielson, Dr. Kenneth A. Nielson, Dr. Paul E. Nielson, and Mr. Douglas W. Nielson **Paula J. Woodward, M.D.** David G. Bragg, M.D. and Marcia P. Bragg Presidential Endowed Chair in Oncologic Imaging **Robert Paine III, M.D.** Kenneth P. Burbidge Presidential Endowed Chair for Pulmonary Medicine and Lung Transplantation **Nels C. Elde, Ph.D.** Mario R. Capecchi, Ph.D. Endowed Chair in Genetics established in honor of the University of Utah's first Nobel Laureate by the George S. and Dolores Doré Eccles Foundation **Nitin Phadnis, Ph.D.** Mario R. Capecchi, Ph.D. Endowed Chair in Genetics and Biology established in honor of the University of Utah's first Nobel Laureate by the George S. and Dolores Doré Eccles Foundation **Susan Beck, Ph.D., A.P.R.N., F.A.A.N.** Robert S. and Beth M. Carter Endowed Chair in the College of Nursing **Simon J. Fisher, M.D., Ph.D.** George E. Cartwright, M.D. Endowed Chair in the Department of Internal Medicine **Anne G. Osborn, M.D.** William H. and Patricia W. Child Presidential Endowed Chair Honoring Pioneering Utah Women in Medicine **Joshua D. Schiffman, M.D.** The Edward B. Clark, M.D. Endowed Chair in Pediatrics **Mario R. Capecchi, Ph.D.** Helen Lowe Bamberger Colby and John E. Bamberger Presidential Endowed Chair in the Health Sciences Center **David Grunwald, Ph.D.** Helen Lowe Bamberger Colby Presidential Endowed Chair in Human Genetics **Ginette A. Pepper, Ph.D., R.N., F.A.A.N.** Helen Lowe Bamberger Colby Presidential Endowed Chair in Nursing **Patricia A. Murphy, C.N.M., Dr.P.H., F.A.C.N.M.** Annette Poulson Cumming Presidential Endowed Chair in Women's and Reproductive Health **Scholar Search in Progress** Cumming Presidential Endowed Chair in Dermatology **Karen J. Salzman, M.D.** Leslie W. Davis Endowed Chair in Neuroradiology in the Department of Radiology **Mark Leppert, M.D.** Thomas D. Dee, II Presidential Endowed Chair in Genetics **Donald E. Kohan, M.D., Ph.D.** Dialysis Research Foundation Endowed Chair in the Department of Internal Medicine **C. Matthew Peterson, M.D.** John A. Dixon, M.D. Presidential Endowed Chair in the Health Sciences **Eric W. Schmidt, Ph.D.** William R. Droschkey Endowed Chair in the College of Pharmacy **David Kaplan, M.D.** E. R. Dumke, Jr. and Katherine W. Dumke Presidential Endowed Chair in Internal Medicine **David W. Grainger, Ph.D.** George S. and Dolores Doré Eccles Presidential Endowed Chair in Pharmaceuticals and Pharmaceutical Chemistry, College of Pharmacy **Christopher L. Peters, M.D.** George S. Eccles Endowed Chair in Orthopaedics established through the generosity of the George S. and Dolores Doré Eccles Foundation in honor of Arthur J. Swindle, J.D. **Scholar Search in Progress** Valois Egbert Presidential Endowed Chair in the Division of Rheumatology, Department of Internal Medicine **Samuel R. G. Finlayson, M.D., M.P.H.** Claudius Y. Gates, M.D. and Catherine B. Gates Dean's Presidential Endowed Chair in Surgery **Edward B. Clark, M.D.** Wilma T. Gibson Presidential Endowed Chair in Pediatrics **Alan Crandall, M.D.** Val A. and Edith D.

Green Presidential Endowed Chair in Ophthalmology **Joseph Stanford, M.D., M.P.H.** George D. Gross, M.D. and Esther S. Gross, M.D. Presidential Endowed Chair in the Department of Family and Preventive Medicine **Andrew T. Pavia, M.D.** Esther S. Gross and George D. Gross Presidential Endowed Chair in Pediatric Infectious Diseases **John M. Hoffman, M.D.** Willard Snow Hansen Presidential Endowed Chair in Cancer Research Established in Loving Memory by His Daughter, Mary Boesche **Michael C. Sanguinetti, Ph.D.** Nora Eccles Harrison Presidential Endowed Chair in Cardiology **Scholar Search in Progress** Nora Eccles Harrison Presidential Endowed Chair in Rheumatology **Scholar Search in Progress** Nora Eccles Harrison Presidential Endowed Chair in the Cardiovascular Research and Training Institute **James Fang, M.D.** John and June B. Hartman Presidential Endowed Chair in Cardiology **Robert E. Marc, Ph.D.** Calvin S. and JeNeal N. Hatch Endowed Chair in Ophthalmology **Daniel W. Fufts, M.D.** M. Peter and Robyn Heilbrun Endowed Chair in Neurosurgery **Clough Shelton, M.D.** C. Charles Hetzel, Jr., M.D. and Alice Barker Hetzel Presidential Endowed Chair in Otolaryngology **Michael K. Magill, M.D.** Dr. Nymphus Frederick Hicken, Alta Thomas Hicken, and Margarete Stahl Wilkin Hicken Endowed Chair in Family and Preventive Medicine **Roy D. Bloebaum, Ph.D.** Albert and Margaret Hofmann Endowed Chair in Orthopaedic Research, Department of Orthopaedics **Scholar Search in Progress** Aaron A. Hofmann, M.D. and Suzanne T. Hofmann Endowed Chair for Humanitarianism in Orthopaedics **Scholar Search in Progress** John Taggart Hopkin, M.D. Presidential Endowed Chair in Psychiatry **Dennis C. Shrieve, M.D., Ph.D.** Huntsman Cancer Institute Endowed Chair in Cancer Research **Scholar Search in Progress** Huntsman Cancer Institute Endowed Chair in Cancer Research **Robert A. Stephenson, M.D.** Jon M. Huntsman Presidential Endowed Chair in Urological Oncology in Honor of Robert A. Stephenson, M.D. **Dennis L. Parker, Ph.D.** Mark H. Huntsman Endowed Chair in Advanced Medical Technologies **Scholar Search in Progress** Dr. D. Rees and Eleanor T. Jensen Presidential Endowed Chair in Surgery **Grant W. Cannon, M.D.** Thomas E. and Rebecca D. Jeremy Presidential Endowed Chair for Arthritis Research **Scholar Search in Progress** Dale Johnson Endowed Chair in Surgery **Scholar Search in Progress** August L. (Larry) Jung, M.D. Presidential Endowed Chair in the Division of Neonatology, Department of Pediatrics, School of Medicine **Mary Bronner, M.D.** Carl R. Kjeldsberg Presidential Chair in the Department of Pathology **Mary C. Beckerle, Ph.D.** Ralph E. and Willia T. Main Presidential Endowed Chair in Cancer Research **Rachel Hess, M.D., M.S.** Ann G. and Jack Mark Presidential Endowed Chair in Internal Medicine in Honor of Thomas H. Caine, M.D. **Richard J. Sperry, M.D., Ph.D.** Governor Scott M. Matheson Presidential Endowed Chair in Health Care and Health Management **Scholar Search in Progress** The Dr. John M. Matsen Presidential Endowed Chair in Pathology **Robert T. Burks, M.D.** The Robert W. Metcalf, M.D. Presidential Endowed Chair in Orthopaedics **Gregory S. Hageman, Ph.D.** John A. Moran Presidential Endowed Chair in Ophthalmology in Honor of Randall J Olson, M.D. **Susan Cochella, M.D., M.P.H.** T. F. H. Morton, M.D. Presidential Endowed Chair in Family and Preventive Medicine **Jeffrey Rosenbluth, Ph.D.** Craig H. Neilsen Presidential Endowed Chair in Spinal Cord Injury Medicine **Jay Riva-Cambrin, M.D.** Max Noorda Endowed Chair Fund in the Department of Neurosurgery in Honor of Dr. John Kestle **Scholar Search in Progress** John Henry and Nancy Lenore Parker Endowed Chair in Medical Imaging Research **Patricia G. Morton, R.N., Ph.D.** Louis H. Peery Presidential Endowed Chair in Nursing Established in Loving Memory by His Son, Louis S. Peery, M.D. **Charles L. Saltzman, M.D.** Louis S. Peery, M.D. Presidential Endowed Chair in the Department of Orthopaedic Surgery **Darrel S. Brodke, M.D.** Louis S. Peery, M.D. and Janet B. Peery Presidential Endowed Chair in the Department of Orthopaedic Surgery **Kathleen H. Mooney, Ph.D., R.N.** Louis S. Peery, M.D. and Janet B. Peery Presidential Endowed Chair in Nursing Research **John T. Smith, M.D.** Mary Scowcroft Peery Presidential Endowed Chair Established by Louis S. Peery, M.D. in Loving Memory of His Mother **Scholar Search in Progress** Presidential Endowed Chair in Anesthesiology **Sankar Swaminathan, M.D.** Dr. Don Merrill Rees Presidential Endowed Chair in the Division of Infectious Diseases for the Investigation of Vector Borne Diseases **Scholar Search in Progress** Dr. Thomas D. and Natalie B. Rees Presidential Endowed Chair for Global Medicine **Andrew S. Weyrich, Ph.D.** Attilio D. Renzetti, Jr., M.D. Presidential Endowed Chair by the Division of Respiratory, Critical Care and Occupational Pulmonary Medicine **Scholar Search in Progress** Renzetti Endowed Chair, Division of Respiratory, Critical Care and Occupational Pulmonary Medicine **Michael Caserta, Ph.D.** Robert L. and Joyce T. Rice Presidential Endowed Chair in Healthy Aging **Kurt T. Hegmann, M.D.** Dr. Paul S. Richards Endowed Chair in Occupational and Environmental Health and Safety **Christopher P. Hill, D.Phil.** Dr. Leo T. Samuels and Barbara K. Samuels Presidential Endowed Chair in Biochemistry **Francis M. Filloux, M.D.** Glenn and Ben Schmidt/Edgar Endowed Chair in Pediatric Neurology **Chris Ireland, Ph.D.** L. S. Skaggs Presidential Chair for Pharmacy **Akiko Okifuji, Ph.D.** Scott M. Smith, M.D. Presidential Endowed Chair in Anesthesiology **Jared Rutter, Ph.D.** Dee Glen and Ida W. Smith Endowed Chair in Cancer Research **Scholar Search in Progress** Christi T. Smith Endowed Chair in Cardiology Research Established by Her Grandparents, Dee Glen and Ida W. Smith **Jean Pugh Shipman, M.S.L.S.** Clifford C. Snyder, M.D. Far Eastern Presidential Endowed Chair at the University of Utah Spencer S. Eccles Health Sciences Library **Scholar Search in Progress** Stanley Chair **Daniel O. Clegg, M.D.** Harold J. (Steve), Ardella T., and Helen T. Stevenson Presidential Endowed Chair in Rheumatology in Honor of Daniel O. Clegg, M.D. **John Fang, M.D.** Takeda Pharmaceuticals International Endowed Chair in Gastroenterology Honoring James W. Freston, M.D., Ph.D. **Wolfgang Baehr, Ph.D.** Ralph and Mary Tuck Endowed Chair in Ophthalmology **Lloyd Y. Tani, M.D.** L. George Veasy, M.D. Presidential Endowed Chair in Pediatric Cardiology **Douglas L. Brockmeyer, M.D.** Marion L. Walker, M.D. Chair in Pediatric Neurosurgery **Wade S. Samowitz, M.D.** C. Scott and Dorothy E. Watkins Endowed Chair in Pathology in Honor of Ernst J. Eichwald, M.D. **John H. Weis, Ph.D.** Reverend George J. Weber Presidential Endowed Chair in Immunology Established by Edith F. Weber in Honor of Her Husband **H. Ric Harnsberger, M.D.** R. C. Willey Endowed Chair in Neuroradiology **Monica Vetter, Ph.D.** George and Lorna Winder Presidential Endowed Chair in Neurosciences **Thomas H. Caine, M.D.** John Rex and Alice C. Winder Presidential Endowed Chair in Internal Medicine in Honor of Thomas H. Caine, M.D. **Michael W. Deininger, M.D., Ph.D.** Maxwell M. Wintrobe, M.D. Presidential Endowed Chair in Internal Medicine **Talmage D. Egan, M.D.** K. C. Wong, M.D., Ph.D. Presidential Endowed Chair in the Department of Anesthesiology, University of Utah **Scholar Search in Progress** Harry Wong, M.D. Presidential Endowed Chair in Anesthesiology **William T. Couldwell, M.D.** Joseph J. Yager Presidential Endowed Chair in the School of Medicine **R. Lor Randall, M.D.** L. B. and Olive S. Young Endowed Chair for Cancer Research

visionary leaders

WHY UTAH?

UNIVERSITY OF UTAH

David W. Pershing, Ph.D. President, University of Utah **Vivian S. Lee, M.D., Ph.D., M.B.A.** Senior Vice President, Health Sciences — Dean, School of Medicine — CEO, University of Utah Health Care **Ruth V. Watkins, Ph.D.** Senior Vice President for Academic Affairs **Michele Mattsson, J.D.** Chair, University of Utah Board of Trustees

UNIVERSITY OF UTAH HEALTH SCIENCES

Edward R. Ashwood, M.D. President and CEO, ARUP Laboratories **Jim Bardsley, Ph.D.** Associate Vice President for Planning and Capital Programs **Mary C. Beckerle, Ph.D.** CEO and Director, Huntsman Cancer Institute — Associate Vice President for Cancer Affairs **David H. Browdy, M.B.A.** Associate Vice President for Finance and Chief Financial Officer **Carrie L. Byington, M.D.** Associate Vice President for Faculty and Academic Affairs **Rena N. D'Souza, D.D.S., Ph.D., M.S.** Dean, School of Dentistry **Kristen A. Keefe, Ph.D.** Interim Dean, College of Pharmacy **Grant Lasson, M.B.A.** Associate Vice President for Strategy **Dean Y. Li, M.D., Ph.D.** Associate Vice President for Research — Chief Scientific Officer **John Mauger, Ph.D.** Associate Vice President for Special Projects **Robin L. Marcus, Ph.D., P.T.** Chief Wellness Officer **Don McClain, M.D., Ph.D.** Director, Center for Clinical and Translational Science — Associate Vice President for Clinical Research **Patricia G. Morton, Ph.D., R.N.** Dean, College of Nursing **Sean J. Mulvihill, M.D.** Associate Vice President for Clinical Affairs and CEO, University of Utah Medical Group **David H. Perrin, Ph.D.** Dean, College of Health **Jean P. Shipman, M.S.L.S.** Director, Spencer S. Eccles Health Sciences Library **Michael B. Strong, M.D.** Chief Medical Information Officer **Jay H. Vogelsang, CFRE** Associate Vice President and Chief Development Officer **Elizabeth D. Winter, J.D., B.S.N.** Chief Counsel

UNIVERSITY OF UTAH HEALTH CARE

David Entwistle, M.H.A. Chief Executive Officer, University of Utah Hospitals and Clinics **Gordon Crabtree, C.P.A., M.B.A.** Chief Financial Officer, University of Utah Hospitals and Clinics **Quinn L. McKenna, M.H.A.** Chief Operating Officer, University of Utah Hospitals and Clinics **Thomas L. Miller, M.D.** Chief Medical Officer, University of Utah Hospitals and Clinics **Margaret Pearce, Ph.D., M.B.A., R.N.** Chief Nursing Officer, University of Utah Hospitals and Clinics **Mark Miller** Chair, University of Utah Hospitals and Clinics Board of Trustees **Sean J. Mulvihill, M.D.** Chief Executive Officer, University of Utah Medical Group **Dayle Benson, M.H.A.** Executive Director, University of Utah Medical Group **John F. Bohnsack, M.D.** Executive Medical Officer, University of Utah Medical Group **Michael K. Magill, M.D.** Executive Medical Director, University of Utah Health Plans **Vicky Wilson, E.M.B.A.** Senior Director, University of Utah Health Plans **Robert C. Pendleton, M.D.** Chief Medical Quality Officer

SCHOOL OF MEDICINE

Dean Y. Li, M.D., Ph.D. Vice Dean for Research **Wayne M. Samuelson, M.D.** Vice Dean for Education **Carrie L. Byington, M.D.** Vice Dean for Academic Affairs and Faculty Development **CHAIRS Michael K. Cahalan, M.D.** Anesthesiology **Christopher P. Hill, D.Phil., Wesley I. Sundquist, Ph.D.** Biochemistry **Wendy W. Chapman, Ph.D.** Biomedical Informatics **John J. Zone, M.D.** Dermatology **Michael K. Magill, M.D.** Family and Preventive Medicine **Lynn B. Jorde, Ph.D.** Human Genetics **John Hoidal, M.D.** Medicine **Monica Vetter, Ph.D.** Neurobiology and Anatomy **Stefan M. Pulst, M.D., Dr. med.** Neurology **William T. Couldwell, M.D., Ph.D.** Neurosurgery **C. Matthew Peterson, M.D.** Obstetrics and Gynecology **Bradley R. Cairns, Ph.D.** Oncological Sciences **Randall J Olson, M.D.** Ophthalmology and Visual Sciences **Charles L. Saltzman, M.D.** Orthopaedics **Peter E. Jensen, M.D.** Pathology **Edward B. Clark, M.D.** Pediatrics **Richard W. Kendall, D.O.** Division of Physical Medicine and Rehabilitation **William M. McMahon, M.D.** Psychiatry **Dennis C. Shrieve, M.D., Ph.D.** Radiation Oncology **Edwin A. Stevens, M.D.** Radiology **Samuel R. G. Finlayson, M.D., M.P.H.** Surgery

ALGORITHMSFORINNOVATION.ORG
@UTAHINNOVATION

EXECUTIVE EDITOR

Amy Albo, M.A.
amy.albo@hsc.utah.edu

MANAGING EDITOR

Seth Bracken
seth.bracken@hsc.utah.edu

SENIOR WRITER

Kim Grob, M.F.A.
Write On Network

WRITERS

Julie Kiefer, Ph.D.
Kirsten Stewart, M.A.

DESIGN

Celery Design Collaborative
Rod DeWeese, Art Director
Stephanie Welter, Designer
Kelsey Lesko, Production
Assistant

YUMI

Wesley Thomas, Designer

ILLUSTRATOR

Calef Brown

PRINCIPAL PHOTOGRAPHY

Jesse Coss, Kristan Jacobson

LANDSCAPE PHOTOGRAPHY

Adam Barker, James Kay
Photography

WHY UTAH COLLAGE PHOTOGRAPHY

Austen Diamond, Bryce Garner,
Mark Maziarz, also courtesy of
Ballet West, Utah Symphony

COPY EDITOR

Lisa Anderson

PROJECT MANAGER

Suzanne Johansen
Celery Design Collaborative

WEB DESIGN

Celery Design Collaborative
Flybox Media

VIDEOGRAPHY

Charlie Ehlert

ASSISTANT VICE PRESIDENT FOR PUBLIC AFFAIRS

Christopher Nelson

PAPER AND PRINTING

Printed on New Leaf
Reincarnation Matte 100 paper,
which is FSC-certified, chlorine-
free, and is made from 100%
post-consumer recycled fiber
paper. Printer is FSC Certified,
a Certified Green Business, and
Climate Partner (certified in
climate neutral printing) and
uses zero VOC inks.

This publication is produced by the University of Utah Health Sciences
Office of Public Affairs

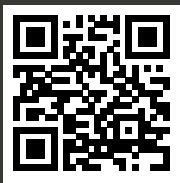
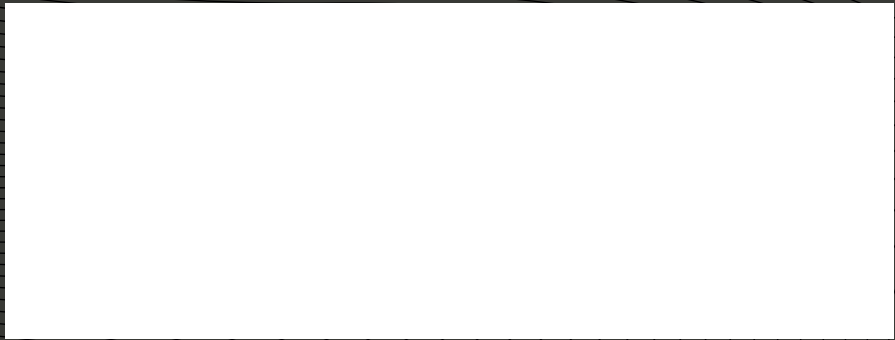
For additional copies contact: seth.bracken@hsc.utah.edu or 801-587-1142

If you have received two copies of this report, please pass one along to a colleague.
Thank you.



UNIVERSITY OF UTAH
HEALTH SCIENCES
INNOVATION REPORT 2014

University of Utah Health Sciences
Office of the Senior Vice President
50 North Medical Drive
Salt Lake City, Utah 84132



Join the conversation at
algorithmsforinnovation.org
and
@utahinnovation