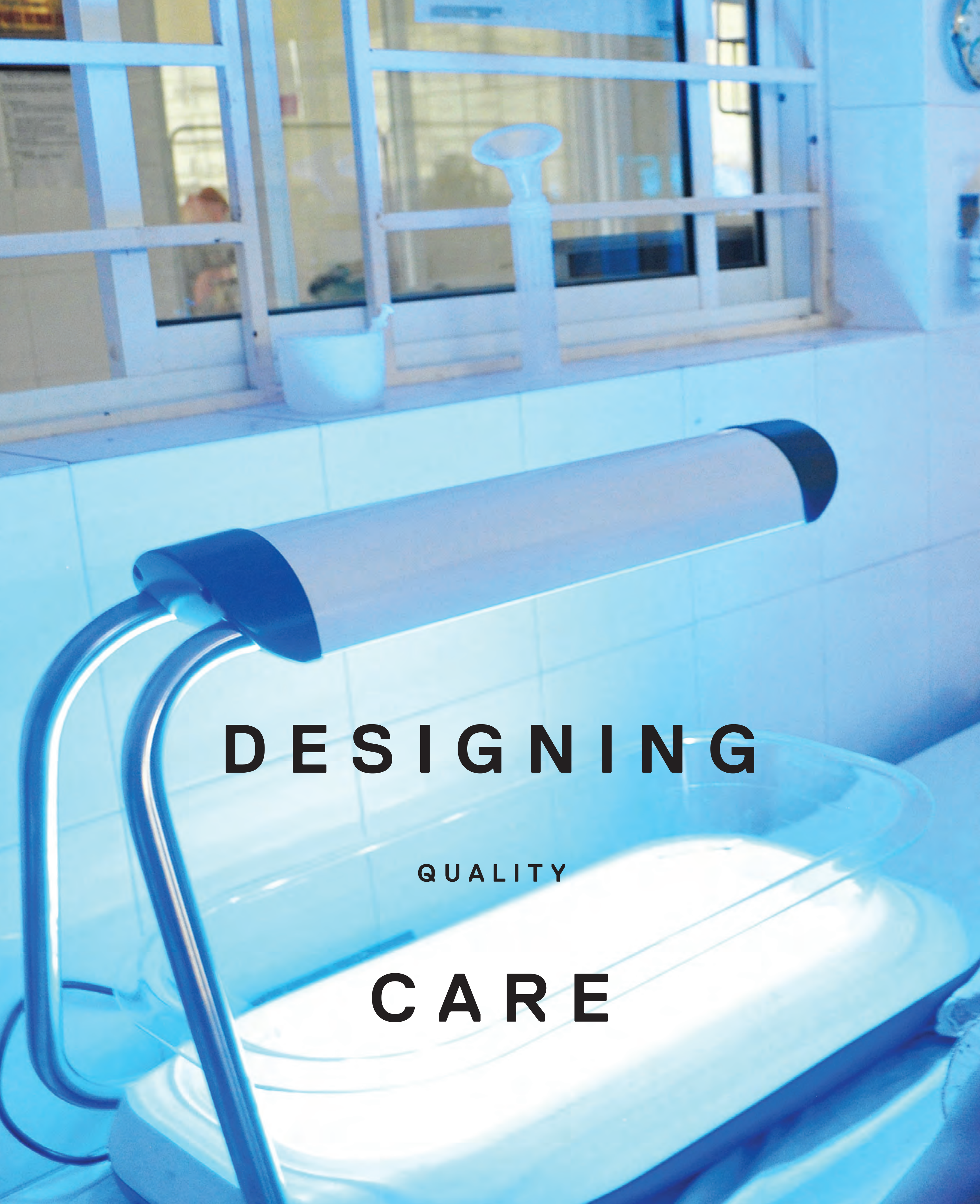
2014

Desiging Quality Care

Francie Latour
Rhode Island School of Design

RISD XYZ
Rhode Island School of Design, risdxyz@risd.edu



DESIGNING

QUALITY

CARE

by Francie Latour

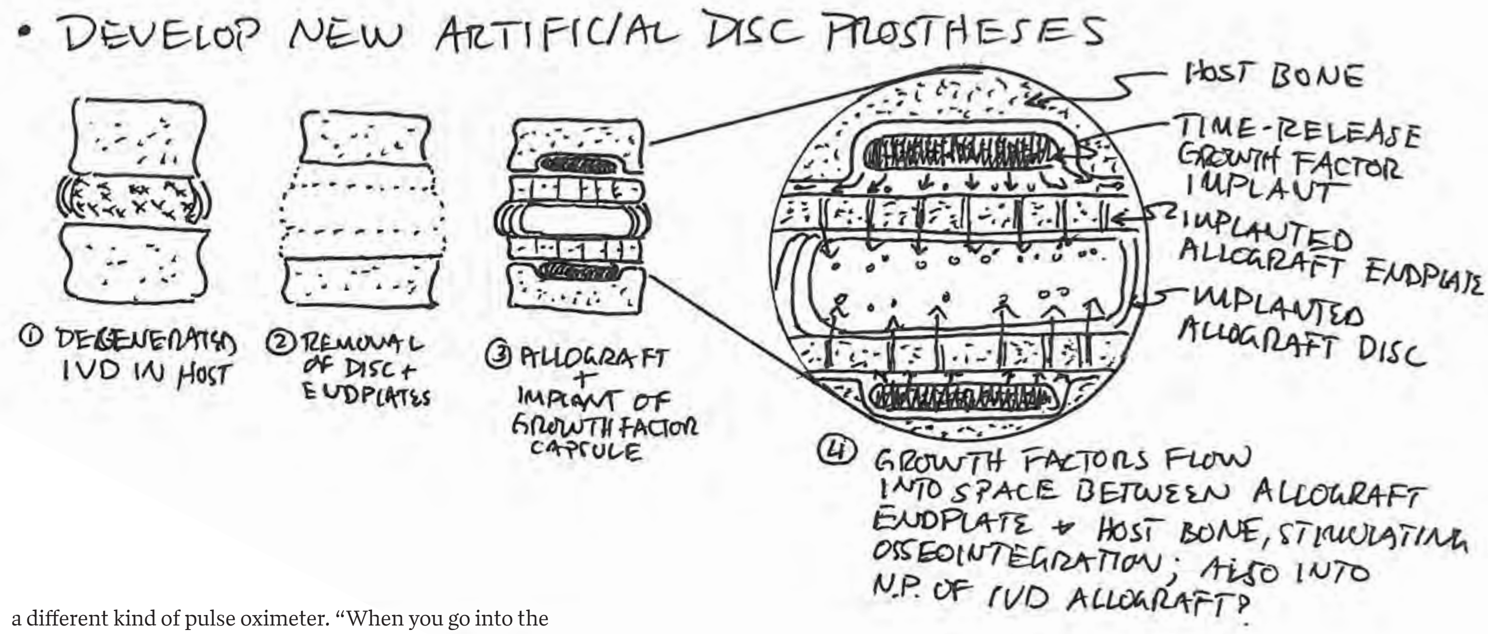
THERE IS A REASON WHY GLOBAL HEALTH EXPERTS CALL pneumonia “the forgotten killer.” Unlike AIDS, malaria or tuberculosis, it flies almost completely below the radar. But each year pneumonia kills more children than all of those diseases combined: more than one million kids under five die from the respiratory illness annually, making it the single biggest killer of children worldwide.

To call pneumonia a multidimensional problem is an understatement: it is a nutritional problem, a sanitation problem, an air-quality problem. It’s a problem of accessibility to vaccines, early diagnosis and international will.

For **Will Harris** 10 ID, pneumonia is also a problem of design. That’s because the fastest way to diagnose it in children is through a simple medical device called a pulse oximeter, which measures oxygen in the blood. For about $30, you can buy one at Target, clip it to your fingertip and monitor your oxygen levels during a mountain climb or a marathon. If you give birth in a US hospital, your baby has a tiny, disposable version of this unit wrapped around his or her big toe like a Band-Aid.

But despite the low cost and ready availability in the US, these units are not an option in the developing world. And that’s where design can save lives: one out of four childhood deaths from pneumonia are newborn babies.

“You’ve got these tiny, slippery, thrashing babies, and they need an intervention of some sort right after birth,” says Harris, a designer at the Cambridge, MA-based nonprofit Design that Matters. Earlier this fall he traveled to Haiti to test concepts for



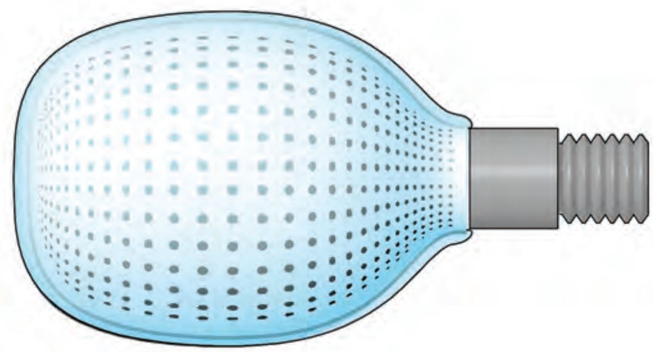
a different kind of pulse oximeter. "When you go into the developing world, people just can't afford tiny disposable devices for every single child," he says, "so you have to find a way around that."

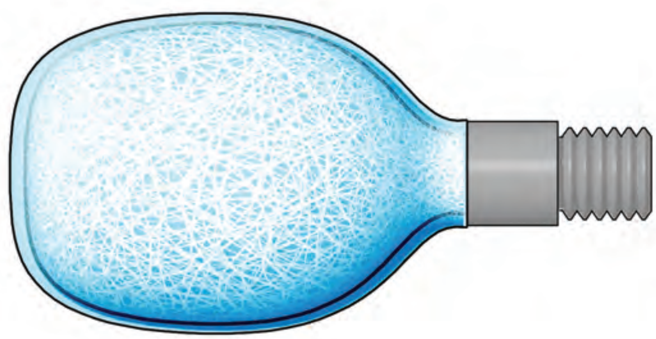
Finding a way around barriers to health care delivery in the parts of the world that need it most has long been the work of aid workers, research scientists and public policy makers. But increasingly, it's becoming the work—and passionate calling—of designers like Harris. Between 2010 and 2012, he helped lead a team of students, designers, engineers, manufacturers and clinicians in developing, testing and implementing *Firefly*, an award-winning device to treat newborn jaundice. Inspired by Bauhaus-era tubular steel furniture, the design is as sculptural as it is innovative—and it's already transforming the health of newborns in rural settings, helping more than 2,000 babies so far in Vietnam, Myanmar, Cambodia, East Timor, Thailand, Malaysia, the Philippines and Ghana.

Sloan Kulper MID 06, now a PhD candidate in medical engineering at the University of Hong Kong, is also working at the forefront of human-centered medical technology. Like Harris, he's passionate about design for social impact, creating accessible, sustainable devices that can treat disease and relieve suffering. But that's where the similarities end. Unlike Harris, the design challenges Kulper takes on lie entirely within the body: Working hand in hand with surgeons, radiologists and orthopedists, he's developing bone screw implants and bone cement injection systems. Where Harris' prototypes may find him manipulating steel tubing or plastics, the materials Kulper works with are manmade but entirely natural: cartilage, skin, muscle, blood and bone.

"In a lot of ways it really is still about engineering—solving these very structural problems that involve material fatigue, and lots of other structural issues," says Kulper, whose design process takes him from brainstorming sessions with mathematicians to scouring local Chinese markets in search of pig bones. "The big difference is that you're dealing with a living person who's made up of all this complex matter. And I guess I really do like the idea of there being something alive that you're working on, and having to actually design within the messiness of that."

> "The big difference is that you're dealing with a living person who's made up of all this complex matter. And I guess I really do like… having to actually design within the messiness of that."
>
> **Sloan Kulper** MID 06





Kulper's sketch of a vertebral implant concept (*above left*) and a rendering of a concept for a safer bone cement injection system for fractured vertebrae.

Previous spread: A field study of the *Firefly* prototype, which relies on the delivery of blue light (*above*) to heal infants with jaundice.

And while Harris' designs target babies' first weeks of life in the developing world—part of a global United Nations (UN) campaign to reduce child mortality by two-thirds before 2015—Kulper's work is focused on the opposite end of the lifespan: aging. According to the UN, by 2050 nearly four in five people over age 60 will live in the developing world.

"It's a big, looming issue," Kulper says. "Almost everything I am working on right now is in some way connected to aging—and the illness, pain and disability that come with it."

Of course, Harris and Kulper are far from the only alumni making a mark in the field of medical innovation and socially responsible design. In some ways, both are following in the footsteps of Marc Harrison, the pioneering industrial designer and legendary ID professor who had RISD students designing solutions for the Red Cross back in the 1960s. But these two young designers represent a growing wave of grads committed to making an impact on health care in the developing world—not just through the product itself, but through a design process that honors and integrates the knowledge of the local communities they are seeking to help.

TRANSLATING EMPATHY INTO ACTION

Growing up in Seattle in a family of architects, Harris had an understanding of industrial design by the age of 10. "As a kid I got very interested in trying to solve problems and create products," says Harris, who in middle school designed a magnetic sweeper for the dropped nails and screws that littered the floors during his family's DIY remodeling. "I had this addiction to duct tape, so originally I created this pole with a magnet duct-taped to it—which is now a very well-known thing you can just buy at Home Depot. But at the time, I didn't know any better. When my parents started telling me about this field called industrial design, I became very intrigued."

By high school, Harris says, he had his sights set on RISD, "not just because of the ranking it had, but because I was so interested in this idea of understanding how to do things by hand first, before getting involved with the digital world. I think RISD has to be one of the last schools to focus on that. I know as I've moved on professionally that foundation has been a very big part of my life."

Will Harris 10 ID (*right*) interacts with doctors, nurses and other practitioners in the process of developing viable life-saving devices like *Firefly*.

"I will never forget the feeling of seeing the first baby being treated by *Firefly*."

Will Harris 10 ID

But even before Harris began his formal art-school education, his trajectory as a designer would take an early and decisive turn toward medicine after his mother was diagnosed with cancer when he was in high school. As he watched her battle the disease over the course of four years, he was continually struck by how the medical devices used for delivering chemotherapy and radiation impact a patient's experience, mood—and even the willingness to fight for life.

"When my mother passed, I became very focused on medical design," Harris says. "I think that was the biggest push for me in terms of what I wanted to do in the world of design. Looking at the form of a medical device in terms of establishing trust—and the way changes in form could really strengthen that internal sense of trust—was incredibly important for me in wanting to keep going with this field and pursue it as a career path."

By the time Harris was majoring in ID, the idea of empathy through form was becoming a central design principle. But the actual process of taking a design from an initial idea to a real-world product remained a mystery. Then, in 2010, his final year at RISD, a pivotal advanced studio—taught jointly with MIT's Sloan School of Management and sponsored by Design that Matters—gave him the ideal laboratory for translating empathy into action. The *Product Design and Development* course taught by **Matt Kressy** 88 ID brought together a nine-person student team to address a condition that affects 60% of full-term babies and 80% of premature babies worldwide: jaundice.

A yellow discoloration of the skin caused by immature liver function, neonatal jaundice is totally curable with a simple treatment of phototherapy. In the developed world, the treatment is routine. But in resource-poor countries, phototherapy units and the electricity that powers them are often in short supply, making jaundice one of the leading causes of infant death and disability, primarily through permanent brain damage.

"Literally, all you have to do is shine a blue light on a baby to cure it," Harris says. It's a remedy so basic it has prompted the US to donate high-tech phototherapy machines to countries like Vietnam, where Design that Matters eventually tested Harris' prototype after hiring him as an intern and then as a designer. "The problem is, the US devices are very sophisticated and they look beautiful, but having them actually work in humid, rural environments is a whole different story. The fans that cool all these LEDs, they're going to break down. The bugs, dirt and dust are going to get into the devices."

Any solution would also have to address a common practice in developing countries: crowding multiple babies into a single conventional unit, which allows for the ready spread of infection and compromises treatment.

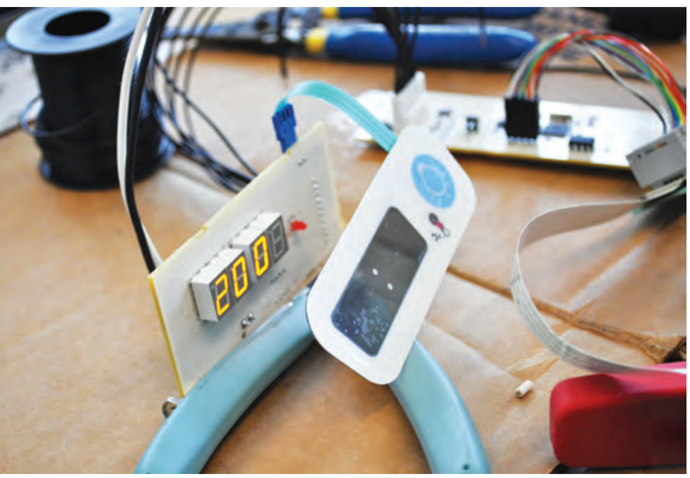
From concept to completion, the two-year collaboration with the team at Design that Matters put doctors, nurses and mothers in a rural clinic outside Hanoi front and center, with multiple visits, a month-long series of trials and a dynamic feedback system of bilingual visual cards rating features of the prototypes as "scary" or "comfortable," among other categories.

With *Firefly*, Harris arrived at solutions that both eliminated the crowding and addressed its root cause. The compact bassinet accommodates just one infant, but the double-sided light—on the top and bottom of the unit—envelops babies in a high-intensity blast of light, cutting normal treatment times almost in half.

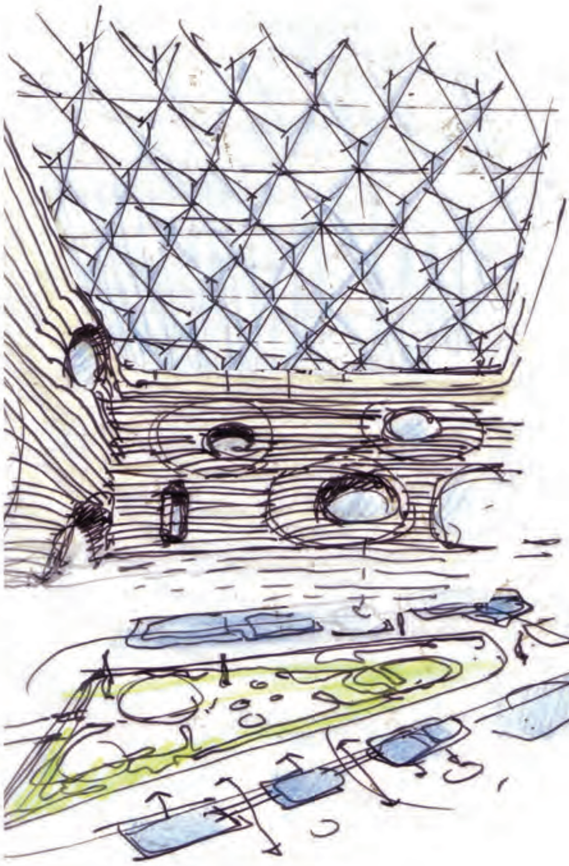
The device is also designed to fit on a mother's bed, a shift in scale with major implications for promoting breastfeeding, reducing workloads for clinicians responsible for hundreds of patients and easing the fears of new mothers routinely separated from their babies during phototherapy treatment.

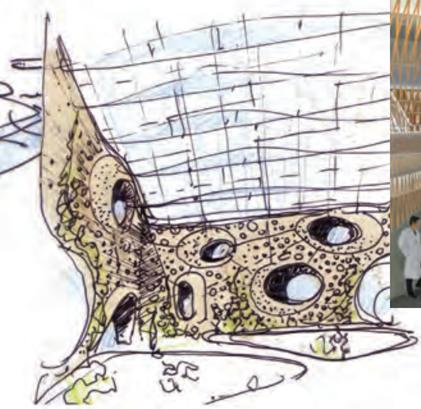
"I will never forget the feeling of seeing the first baby being treated by *Firefly*," Harris says of the device, which is largely assembled locally in Vietnam. "After living in Vietnam and helping to set up this trial and making sure we were following all of the regulatory issues and meeting with different manufacturers and everyone to make it all work out, seeing that first child treated was incredible."

Halfway around the world, *Firefly*'s reach now extends to Haiti, with one machine treating newborns at the same hospital where Harris and his team are testing concepts for a new pulse oximeter specially designed for use in the developing world. Dubbed the *Pelican*—due to its clamp mechanism—that device is still in the early stages of development, with 10 possible prototypes and no definitive partner yet identified to help bring the concept to market. But Harris already feels a sense of promise, fueled by a new collaboration with one of the most effective global health organizations in the world: the Boston-based Partners in Health.

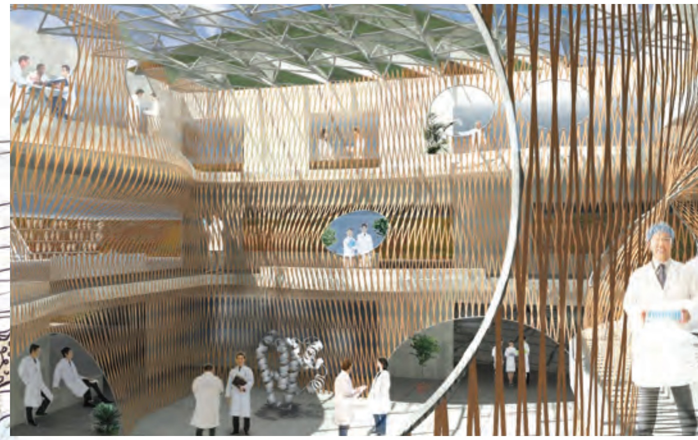


Harris travels to countries like Vietnam and Haiti to do field testing for products he's developing for Design that Matters.





> “I liked that kind of scientist’s approach to things. But at the same time, it’s a little mad-scientist in that the creative process isn’t super careful or clean.”
>
> **Sloan Kulper** MID 06



Kulper’s sketches and rendering of a proposed biotechnology research campus in southern China.

above: images courtesy of Ben Gramann, Sloan Kulper, Shaun Morris | Deco Design Collaborative, LLC

ART SCHOOL SEMINARY

Growing up in New Jersey, Kulper has vivid memories of his parents exposing him to the arts, with frequent trips to New York City museums “where I remember us walking until my feet hurt and feeling jealous of my sister riding in the stroller.”

But by the time he applied and got in to MIT, almost no one in his circles considered art school. “It was not on my radar at all, even though I already kind of liked design,” Kulper says. “To me art school felt almost like going to seminary. If you were going to do it, you had to feel this calling. And I didn’t feel that calling yet.”

Still, at MIT Kulper was almost immediately pulled toward design, gravitating towards MIT’s Media Lab, a mecca for research at the intersection of art, design, science and technology. Within a year, he had moved beyond his Computer Science major to embrace Architecture, where students could essentially design their own academic direction—giving him the latitude to pursue classes at MIT, Harvard and Massachusetts College of Art.

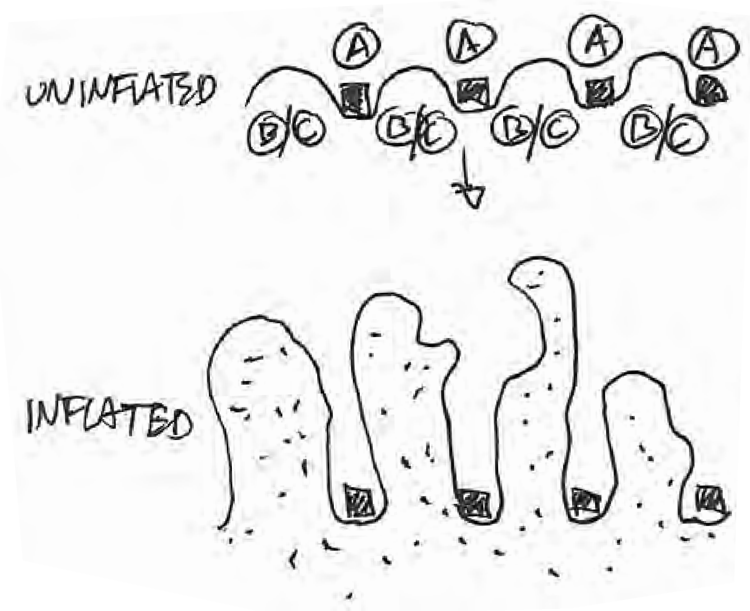
Architectural practice itself was never the draw. But with a safe haven in a design-centered department—and fueled by the boundary-breaking approach of the Media Lab—Kulper discovered the creative world that exists at the intersection of art and technology. His first exposure to books about ID was a revelation: along with the things he expected to see (like posters and typography) were images of trains, clothing irons and computers.

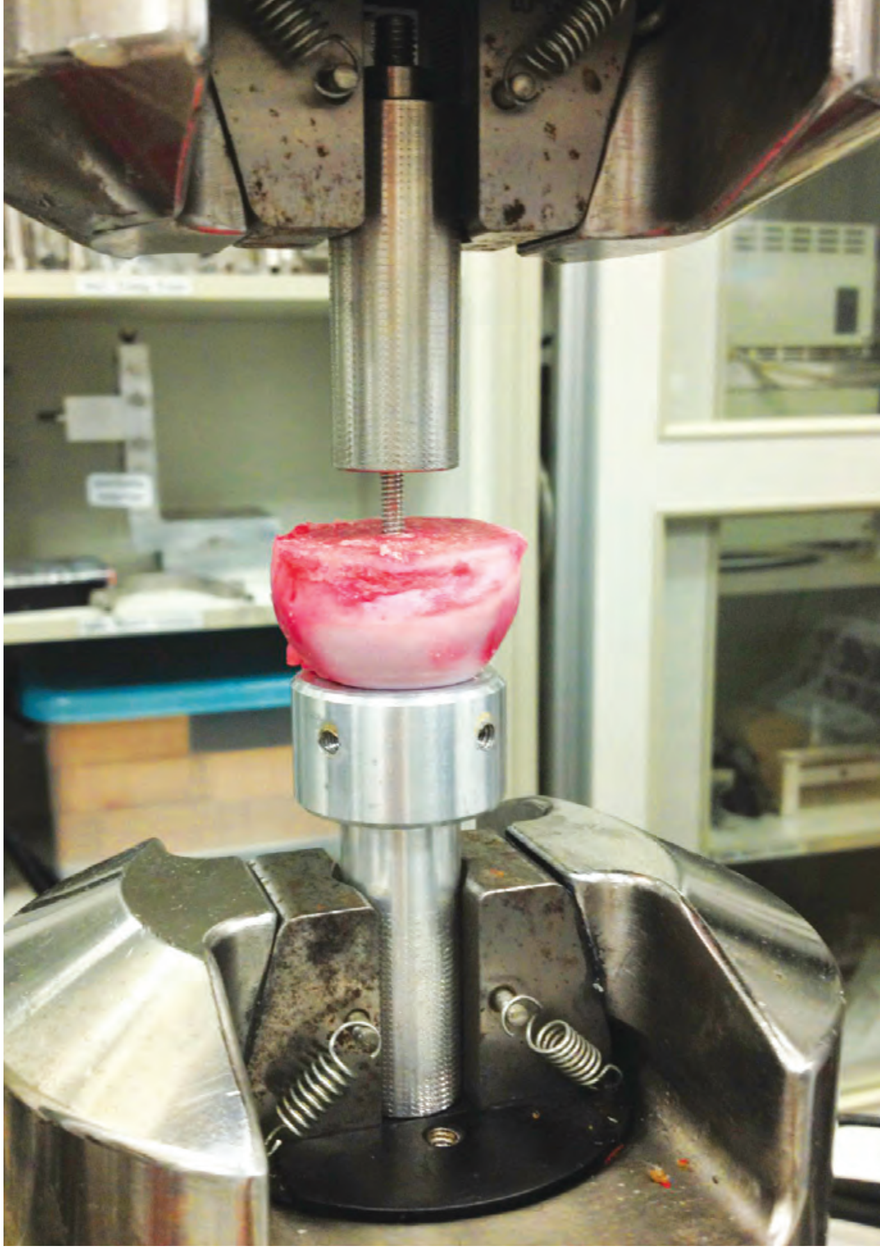
“I was like, what?” he says, recalling those early experiences. “That’s not design. What’s that doing there?”

By 2002 a part-time job doing electronics work for the cutting-edge interactive studio Small Design Firm blew the doors of what design could be wide open. “The idea that you could use your own technical knowledge to do something really interesting in design was cool,” Kulper says. “And I guess for me it was a great message, because I had always felt like an outsider in the design world.”

Ironically, as he shifted gears and started the MID program in 2004, Kulper was continually struck by the parallels between RISD and MIT, two institutions and cultures he had previously seen as worlds apart. “RISD is a place full of people who really care about the details of things—almost maniacally—which reminded me of what I loved about MIT,” he says. “And in ID, there was just a ton of experimentation. People were playing around with materials all the time, trying to force the materials to do different things. So I liked that kind of scientist’s approach to things. But at the same time, it’s a little mad-scientist in that the creative process isn’t super careful or clean. And that’s great. There’s so much to be learned from that.”

The summer between Kulper’s two years at RISD marked his first trip to China, where he helped to design a biotech research institute inspired by biological forms. The institute never got built, but the trip—and his increasing fluency as a maker in industrial design—positioned him well to return.





That came in 2009, when Kulper joined a collaborative team of students and young alumni from Wellesley and MIT working with villagers from Tibet to address the damage caused by the widespread practice of cooking indoors with highly polluting fuel. As a design director and founding member of One Earth Designs, he helped develop SolSource, a high-performance, sun-powered method of cooking with zero emissions.

With reflective mylar panels and a light bamboo frame, SolSource directly targets environmental and health threats to local residents, who have traditionally relied heavily on polluting fuels like wood and dung. After years of working as an industrial designer at Boston-based firm KVA matX, Kulper realized that to make SolSource a viable product he'd need to relocate to China.

"It sounds crazy, but these wonderful nomadic yak herders in Western China were suddenly our teammates in designing solar cookers to fit their needs," Kulper says. "And because one of the project founders was from the Harvard School of Public Health, there was a lot of methodology from medicine and public health research driving what we were doing—in addition to the social mission and the design mission. I think that experience really gave me the itch to do something medically related."

Not surprisingly, Kulper, like Harris, also fantasized about a career in medicine—a fantasy he now says didn't reflect a missed career opportunity so much as an increasingly sure sense of direction as a maker. "I did have this crisis, probably because I loved the idea of working with living things," he says. "But then one day I realized that if I become a doctor, I'll have to be a doctor all the time. I won't get to design things."

Through a series of connections, Kulper eventually stumbled on a mentor in a faculty member in biomedical engineering at the University of Hong Kong who was willing to take him on despite his lack of medical experience. Once he enrolled as a PhD student, the partnership was promising, with Kulper's manufacturing and product development experience from SolSource and design consulting proving to be an ideal fit with his mentor's engineering project.

"I did have this crisis…but then one day I realized that if I become a doctor, I'll have to be a doctor all the time. I won't get to design things."

Sloan Kulper MID 06

These sketches of an orthopedic implant concept led to this prototype for a machine that allows for biomechanical testing of the implant using a bone fragment from a pig's humerus.

The only problem: the project involved bones. "I have to tell you, I never cared about bones—ever," he says. "It's not something that even crossed my radar. If anything, I probably would rather work on something dealing with the brain. But I liked what he was doing, so I took a kind of a philosophical approach to it: Bones are mechanical things, and I work in a kind of mechanical way. So I just went for it. And what do you know? It turns out it's fantastic. It was a fantastic decision."

The medical device project at the center of Kulper's thesis work really got off the ground in earnest in June. But it is at a critical stage, with plans for animal testing of the prototype slated for later this year. As a result, Kulper is understandably cagey about discussing the details of the prototype, other than to say that it's a deceptively simple one, designed to address common complications of orthopedic implants.

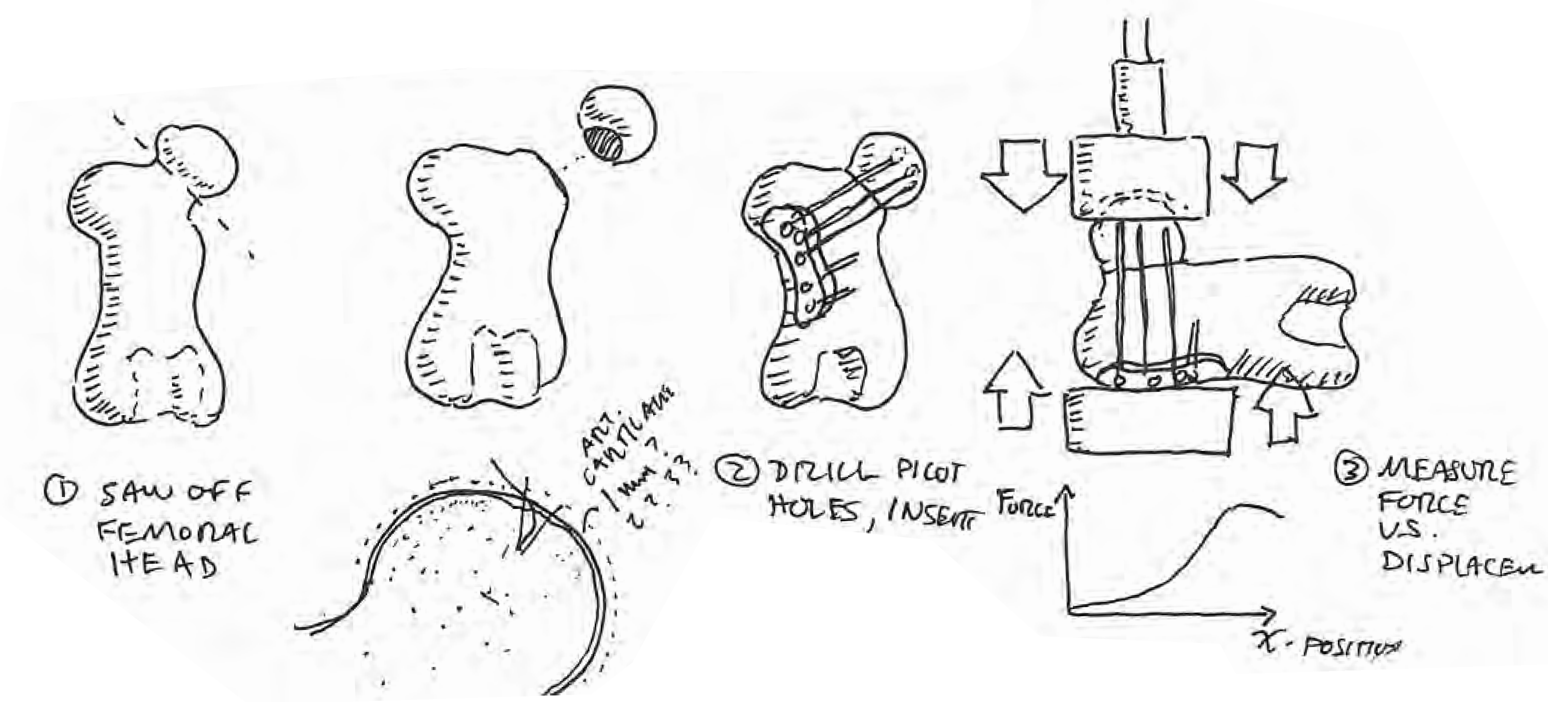
Another project focusing on bone cement injection—a procedure that stabilizes vertebrae in patients suffering from spinal fractures—is now in the hands of a polymer engineer working to develop a bio-material that does not yet exist. But Kulper hopes its properties may one day eliminate one of the biggest problems with such injections: cement leakage that can cause nerve pain and in rare cases, paralysis.

Kulper will say this much about his work: In the interplay between human tissue and manmade materials, he has found a sweet spot perfectly suited to the technical rigor, iterative approach and crit-style collaboration of his RISD education.

"You're working with this material and the mechanics of how these materials work together, and you're trying to develop a real intuition for it," he says. "For my latest project, the process started with me sitting down with a friend who does applied math and saying, 'OK, you have bones and you have a piece of metal that you're drilling into it. Seems obvious, right? But what's actually happening? What are all of the forces involved? Let's just think about that for a while. What happens when we put these two things together?' And it's so good to have that mathematical model because you're kind of constantly clarifying your thinking."

In the products he's developing now, Kulper says that one clear advantage he took from RISD is the absolute commitment to play as part of the design process. "There's a lot of vindication in seeing that you can have an actual, quantifiable improvement in the engineering design of something, but it didn't solely come from an exhaustive approach of expertly trying to control every variable," he says. "There's value to that, but it's also important to have patience for anomalies that come out, because the design that ended up being so interesting to us is kind of an anomaly. We wouldn't have expected it to occur, and if we were being careful and logical, we maybe would have missed it."

Harris agrees that there's something almost intangible about the way art school students learn to experiment and play in the studio that really helps in a medical research setting. "I think we're all driven by the experiences we've had, the emotions we've felt," he says. "It's just happenstance that I'm trying to do what I can in devices for medical care. I would have loved to have been a surgeon. But I can't deal with blood, so I do design." ■



images courtesy of Sloan Kulper MID 06 (University of Hong Kong)