

# **Your New Liver Is Only a Learjet Away**

**By Peter Ubel**

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### **Your New Liver is Only a Learjet Away: Part 1 of 3**

The forty million dollar Gulfstream jet landed at Memphis International airport in the early morning hours, its schedule hastily arranged earlier that day from Northern California, where the flight originated. Waiting on the tarmac was Dr. James Eason, head of transplant surgery at Methodist University Hospital, who planned on whisking the passenger to the operating room for a liver transplant. The passenger rushed to Memphis not because he lived in Memphis and happened to be out of town when an organ became available, but rather because he knew that flying from his home in Northern California to Tennessee would give him his best chance of receiving a life-saving organ.

You see, the demand for transplantable livers in Northern California far outstrips the supply, meaning there is a decent chance a patient with end-stage liver disease will die before a replacement organ becomes available. But in Tennessee, the number of people waiting for a liver transplant is significantly smaller, per capita, than California, and as a result the supply of transplanted livers is much better matched to the demand for such organs. As a result of these geographic variations in supply and demand, patients in Northern California wait more than six years, on average, for a liver transplant, whereas the majority of patients in Tennessee receive new livers in less than three months.

That's right: six years versus three months!

The passenger on the Gulfstream that morning was Apple co-founder and CEO, Steve Jobs. After being told he needed a liver transplant, Jobs had learned about the huge disparity in waiting time between California and Tennessee, and arranged to get placed on the transplant waiting list in both locales, knowing he could fly to whichever location came up with the first available organ. So when

he got a call from Memphis explaining that a 20 year old man with a compatible blood type had died in a car crash earlier that day, he summoned his flight crew and made his way to Tennessee.

Steve Jobs walked out of the plane that morning a frail shadow of his former self. Pancreatic cancer had spread to his liver and, without a transplant, he had only weeks or months to live. Thanks to that early morning flight and the talents of his surgeon, Jobs received a transplant later that day and would survive two and a half more years, a time in which he introduced the world to the iPad and to a talking phone assistant named Siri.

It was wonderful for Jobs and his loved ones that he was able to receive a transplant that day. But was it fair that Jobs could afford to charter a jet from California to Tennessee to undergo a transplant, while thousands of equally sick Californians waited at home for livers that didn't always come in time?

Currently, less than 6% of transplant candidates are listed at multiple transplant centers. And less than 2% get listed at transplant centers a long-distance from where they live, like Jobs did. After all, there's not much reason for Northern Californians to get waitlisted in Tennessee if they cannot afford to rent a Gulfstream on short notice to get them to the transplant center on time. This Gulfstream deficiency may end soon, however, if a start-up company called OrganJet succeeds in its goal of "democratizing Steve Jobs' transplant experience." According to the vision of its founder, Sridhar Tayur, OrganJet will make sure that distant transplants are no longer available to only the wealthiest of patients. In fact, if insurance companies agree to pay for OrganJet's services, as Tayur hopes, virtually everyone with healthcare coverage (be it Medicare or BlueCross/BlueShield) will be able to afford to fly to whatever location gives them the best chance of a life-saving transplant.

Would such democratization be a good idea? The answer to that question is more complicated than it appears at first glance, and raises questions about healthcare equity and regional variation in healthcare quality that are relevant well beyond the world of solid organ transplantation. The OrganJets of the world may finally force us, as a society, to talk more explicitly about just how fair we want our healthcare system to be.

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In the US, hearts, kidneys and livers are distributed in a manner that strives to give every patient fair access to these life-saving organs. When a deceased donor's liver becomes available, the local organ procurement organization (or OPO) offers the liver to the sickest transplant candidate, as long as that person's blood type is compatible with the donor. Sickest-first is the rule. A rich investment banker with moderate liver disease won't jump ahead of a bricklayer with severe disease. A white person won't get priority over an African American, nor a man over a woman, nor a Christian over a Muslim, nor even a Protestant over (God forbid?) an atheist. In short, the liver transplant allocation system in the US is an astonishingly explicit and fair way to dole out life-saving resources.

For all its ethical wonders, however, the liver transplant system is far from perfect. For starters, people without health insurance often have a difficult time accessing the transplant waiting list. Critics quip that the first test physicians order when evaluating patients for transplant is a "wallet biopsy."

There is another major problem, as Steve Jobs' experience made so apparent. Barring the kind of wealth that enables people to rent out private jets, a person's chance of receiving a life-saving transplant depends very much on where that person lives.

Sridhar Tayur first learned about geographic inequities in organ transplantation when he was an invited speaker at Northwestern's Kellogg School of Management in October 2010. Out for dinner that night with colleagues, Tayur asked one of the Northwestern faculty members what research he did for a living. The professor, Baris Ata, said he was studying fairness in kidney transplant allocation, trying to determine, for example, whether patients who have been waiting longest for their kidney should receive priority over those more likely to benefit from available organs. Such a research topic is not out of the norm for a business school professor to study. Business schools are loaded with faculty who use advanced mathematical models to solve challenging real world problems. Just a few years ago, in fact, Alvin Roth won the Nobel Prize in Economic Sciences<sup>1</sup> for developing methods that have helped create kidney exchange programs that match chains of living donors to needy patients.

Tayur realized he had the perfect skill set to solve the problem of geographic inequity in organ transplant allocation, and that his solution would not require any policy changes. He had made an academic reputation for himself figuring out the mathematics of “inventory and supply chain optimization,”—in other words, for helping companies figure out how to allocate scarce resources to maintain the right amount of product on store shelves vs. warehouses. Tayur had even founded and run a software company, SmartOps Corporation, that helped companies make these decisions. That company had left him, if not Steve-Jobs-wealthy, then at least financially secure: “When you do well in software,” he told me, “you do very well.”

Tayur realized he had an opportunity to give something back to society, as a social entrepreneur: “When I was running my software company,” he told me, “I started using private jets, because I wanted more time with my family while flying out to meet customers at difficult to reach locations.

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<sup>1</sup> [http://www.nobelprize.org/nobel\\_prizes/economic-sciences/laureates/2012/popular-economicsciences2012.pdf](http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2012/popular-economicsciences2012.pdf)

I noticed that there were lots of underutilized private jets lying around the country. I recognized this as a classic optimization problem.” Earlier in his academic career, serendipitously, he had written an academic paper on how to optimize the use of fractional jets, akin to the model used by Share-cars. “I understood private jets, and I understood optimization algorithms, so I knew I could figure out how to get people access to organ transplants, by finding them affordable flights to transplant centers that have shorter waitlists.”

OrganJet was born.

Tayur’s initial business model for OrganJet was quite simple. OrganJet would charge a modest fee to help clients figure out which transplant programs would be likely to shorten their waiting time for an organ. Clients could then sign up to have access to an on-demand flight, in case one of those transplant programs called up with an available donor. Having a flight at ready disposal is critical because many transplant programs require patients to arrive within six hours after an organ becomes available, or they pass the organ on to the next person on the list. The six hour requirement exists because in organ transplantation, donor organs need to be placed into recipients in a timely manner or the organs accumulate irreversible damage. Thus, if a patient on the transplant waiting list in, say, Pittsburgh cannot make it there in time, the transplant team will call another candidate until it finds one that can make use of the organ.

Excited about his chance to address an important social problem, Tayur began working through the details of his business plan, issues such as how many jet companies he would need to contract with and how much money he would need to charge customers for a given flight. “I envisioned OrganJet as an opportunity to make some money and save some lives at the same time,” Tayur told me, words not that different from what honest medical school applicants would tell interviewers about their career choice. The fees he charged customers for these flights would not only cover the charge

of paying for the pilots and the fuel, but would include a surcharge that would be the source of OrganJet's profits.

Tayur was excited about his idea, but the more people he bounced his business plan off, the more pushback he received. In particular, many people told Tayur his idea would only promote greater unfairness in the transplant system, by further disadvantaging people who lacked the financial resources to pay for OrganJet's services. Tayur thought he could minimize this problem by convincing health insurance companies to pay for the flights, but his critics pointed out that many low-income patients wouldn't be able to afford such generous insurance.

Tayur realized his new company needed to become *two* new companies. He had already incorporated OrganJet as a nonprofit entity in May 2011. So in July of 2012 he started a second company, GuardianWings, a tax-exempt nonprofit that raises funds to cover flight costs for low-income patients. His vision was now clear – he would work to overcome geographic inequities in transplantation one patient at a time, giving everyone a fair shake at life-saving treatments even if they were not wealthy CEOs.

OrganJet exists because of the dramatic geographic disparities in organ transplant wait times, disparities that exist, in part, because of the chronic shortage of donor organs. Ever since the advent of powerful immunosuppressive drugs in the 1970s - drugs like cyclosporine which mute the body's efforts to reject foreign organs - the number of patients who could potentially benefit from transplantation has far outstripped the supply of transplantable organs. Transplant specialists work tirelessly to find new sources of organs—from living related donors and from unrelated donors; from previously healthy brain dead donors and from brain dead donors who haven't necessarily been so healthy—but each expansion of the donor pool has been met by an even greater expansion of the potential recipient pool. Formerly untreatable patients—elderly people with kidney failure,

HIV infected patients with liver failure—are now recognized by medical experts as viable transplant candidates.

This mismatch between supply and demand guarantees that there will be a long waitlist for transplantable organs. But the mismatch does not necessitate a geographic disparity in transplant waiting times. Instead, those geographic disparities exist for a host of other reasons, some medical and others political. Medically speaking, the geographic disparities exist in part because some well-known transplant programs draw a disproportionate share of transplant candidates. At the University of Pennsylvania, for example, 436 patients were waiting<sup>2</sup> for liver transplants at the end of 2013, a number that reflects the strong reputation of the program and the size of the regional population. By contrast, at Methodist University Hospital in Memphis, where Steve Jobs received his transplant, only 79 patients were waiting for livers at the same time. According to Dr. David Axelrod, a transplant surgeon at Dartmouth who conducts research on transplant allocation, “even more important than the size of any program’s transplant list is how quickly programs churn through their list. Both Penn and Methodist transplant around 125 patients per year, meaning it takes years for Penn to make it through its list versus mere months for Methodist.” With famous transplant programs drawing candidates from far afield, the system becomes imbalanced, with disproportionately large numbers of people waiting for transplants in some parts of the country.

So far we have seen two ingredients that combine to create geographical disparities in transplant access: an under supply of transplantable organs, and an uneven distribution of transplant candidates across the country. But even together, these ingredients would not have been sufficient to create geographical disparities in transplant access. One more ingredient has been crucial to this recipe—transplant allocation systems distribute organs largely to transplant programs in the same area of the

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<sup>2</sup> <http://www.srtr.org/>

country where the organs are recovered. For example, when a patient at Temple University Hospital in Philadelphia suffers fatal brain damage, her liver will typically be offered first to a patient within the same local transplant area. Thus, patients at Temple University will have no priority over those at the Hospital of the University of Pennsylvania, which resides in the same transplant area. But both groups of patients will have priority over those in Pittsburgh, which lies outside the area.

If no suitable patient resides within the area, the liver will be made available to patients within the same transplant region. The US is divided into 11 such regions, with Philadelphia in region number 2, which includes all of Pennsylvania, West Virginia, Maryland, Delaware and Washington D.C. If no center within the region accepts the liver for a patient on their list, it is then offered nationally.

This local-priority system explains why there is no single liver transplant waiting list in the US but, instead, dozens of such lists. And it explains why OrganJet has a market niche: any patient who manages to be placed on multiple waiting lists, in different areas or regions, is more likely to receive a transplant. If OrganJet can make multiple listing more common, it will have succeeded in reducing geographic disparity in transplant survival. If enough people from California and Massachusetts receive transplants in places like Tennessee, then those remaining behind in California and Massachusetts will benefit too, as the wait lists in those locations shrink. If Medicare and Medicaid decide to pay for OrganJet's services; if private payers follow suit; if, if, if, . . .

We are a long way from turning these "ifs" into "whens". Neither Medicare nor Medicaid currently pays for OrganJet's services, and it is too early to tell whether private insurers will embrace OrganJet's prices. Tayur, the CEO of OrganJet, is still negotiating with insurance companies on a case-by-case basis. He is also negotiating with large companies that self-insure their employees, presenting them with results of statistical analyses he has conducted which demonstrate that OrganJet's services could save them money: "It would get their employees off dialysis sooner, not

only improving their quality of life in the process, but also allowing them to return to work sooner, with greater productivity.”

Tayur is pleading his case and trying to build his business, but his success is far from foregone.

Which means we have time, as a society, to decide whether we want transplant jetting to become the norm. It is now, while OrganJet’s business remains nascent, that we need to do the careful work of thinking through the implications of its services. Should we strive for a world in which all transplant candidates have affordable access to Learjets?

## **Your New Liver Is Only a Learjet Away: Part 2 of 3**

Irena Bucci was receiving follow-up care after delivering her second baby when the obstetrician discovered a problem with her kidneys. “My creatinine was rising,” creatinine being a waste product normally cleared out of the bloodstream by healthy kidneys, “and my doctor didn’t know why. I didn’t have high blood pressure or diabetes,” two diseases that are common causes of kidney failure. Bucci met with a number of kidney specialists, in hopes of uncovering the cause of her kidney failure. “But the tests didn’t discover one. And without a diagnosis, they couldn’t figure out how to treat my illness. They told me it was just a matter of time before my kidneys failed.”

In the absence of a transplant, kidney failure is usually treated by dialysis. With this treatment, patients no longer face imminent death. Prior to the emergence of dialysis, people with irreversible kidney failure usually died in a matter of weeks. On dialysis, many patients live for years. But they do not necessarily live in great health. The medical literature estimates that patients on dialysis face annual mortality rates close to 20%.<sup>3</sup> Bucci desperately wanted to avoid that fate. “My doctor urged me to find a living donor, and get transplanted before I needed dialysis. A few even told me that since I am from Russia, I should go abroad and find someone willing to ‘donate’ a kidney.”

But Bucci was not comfortable receiving a kidney from a stranger—that struck her as both unethical and as medically dangerous: “Who knows what kind of organ you would get that way.” She also didn’t have any relatives who could serve as living donors. So she settled in for the long wait to receive a transplant from a deceased donor. At Georgetown University Medical Center, near where

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<sup>3</sup> [http://www.ajkd.org/article/S0272-6386\(05\)00777-8/abstract](http://www.ajkd.org/article/S0272-6386(05)00777-8/abstract)

she lived, less than a quarter<sup>4</sup> of their kidney transplant candidates receive a transplant in a typical year. Bucci knew that each one of those years she spent waiting for a transplant could be her last.

And then she read Walter Isaacson's biography of Steve Jobs, and learned that he had flown to Tennessee to receive a liver transplant, and thought to herself: "Why don't I do something like that?" She decided to get herself listed at as many transplant centers as possible, and travel to which ever one could find her a suitable organ.

Bucci began undergoing transplant evaluations at hospitals located relatively close to Washington D.C., but that operated in different transplant areas than Georgetown. In the process of undergoing those evaluations, she received some bad news that made it even more important for her to get listed at multiple centers – she had a PRA of 90. The PRA, or Panel Reactive Antibody test, estimates the percent of potential donor kidneys that a person's immune system will reject. Probably as a result of her pregnancies, Bucci's immune system was highly reactive; her body was choosy about what kind of foreign antigens it would tolerate. Whatever the reason for her high PRA, Bucci would be unable to accept 90% of eligible donors. As an IT expert with a Master's degree in mathematics, it was not difficult for Bucci to figure out that her long wait for a kidney had just gotten longer.

That's when Bucci began spending her free time getting herself onto as many transplant waitlists as possible. She researched hospitals in the Northeastern United States and made appointments at transplant centers with relatively short wait times. She stretched beyond the Northeast, even getting herself listed at two programs in Florida. And not surprisingly, she connected with Sridhar Tayur, the CEO of OrganJet, a company that helps patients receive distant transplants to reduce their waiting time for an organ. (See Part 1 for the origins of this company.) Tayur convinced her to add

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<sup>4</sup> <http://www.srtr.org/csr/current/Centers/201206/pdf/DCGUTX1KI201206NEW.pdf>

the University of Pittsburgh to her list of centers. She travelled to all those programs outside of work hours, because she did not want her employer to realize she had kidney failure. She was already noticing that her illness affected her concentration, and she did not want to give her boss a reason to relieve her of her job: “I didn’t want to hit them over the head with my illness,” she told me. “They weren’t going to learn about my kidney problems until I left work to get a transplant.”

If you wonder what it takes to get yourself listed at multiple transplant centers—Bucci maxed out at 6 programs—it requires a great deal of persistence. Applying to transplant programs is not like applying to college, where you check a few boxes and your SAT scores travel to any program in the country. Instead, you need to haul your ill body over to whatever program you hope to apply to, and go through a slew of evaluations you have already gone through at other programs. In fact, each transplant center that Bucci applied to put her through a head to toe physical exam as well as a round of blood tests. In addition, she had to deal with her insurance company and what seemed like a bevy of clinical coordinators at each center. “Some of the evaluations took three to six months,” she told me, “and I needed to keep on top of the process to make sure that things weren’t getting stalled because somebody didn’t fax documents to the correct number.”

Nevertheless, her insurance company paid for all these evaluations. “At six centers?” I asked. “Well, at one point my insurance company pushed back. But I told them I was going to a sixth center, and they eventually relented.” “What about the transplant centers?” I asked. “Why would they go through all the work of evaluating you for a transplant when they knew you were being listed at so many other centers?” I was thinking about a landscaping company I had spoken with that refused to come to my house and provide an estimate on my yard work if I had already asked two or more competitors to bid on the same job, explaining that it wasn’t worth their time to go

through the effort of providing an estimate if they had less than a 50-50 chance of getting my business.

Bucci quickly explained the difference between landscaping and kidney transplant evaluations:

“Sometimes transplant centers make more money evaluating patients than transplanting them.”

Most of her evaluations cost several thousand dollars and one cost as much as \$10,000, paid for almost entirely by her insurance company. “No center hesitated to evaluate me. Once they knew I had insurance that would pay for the work-up, they welcomed me with open arms.” I am not suggesting that transplant programs specifically evaluate patients just to pad their coffers. But they certainly have little incentive *not* to evaluate candidates. The more candidates on their waiting lists, the better chance one of their patients will match an organ when it becomes available.

Welcome to the strange world of the transplant marketplace. Transplant centers make hefty sums of money regardless of whether they transplant even a minority of patients on their waitlists.

Meanwhile, patients are forced to either wait in line at the transplant center close to where they live, or travel around the country getting placed on multiple lists, or finding a transplant center with a shorter waitlist than the local hospital. And now Sridhar Tayur wants OrganJet to make multiple listing *more* common? Why are we addressing geographic inequities in transplant access by flying patients to transplant centers far from home? Wouldn't it be better to simply fly the organs to the patients?

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In 1998, I stood before an audience of health professionals at the University of Alabama at Birmingham, an elite medical center that typically ranks among the top ten in the nation in NIH research funding. I was invited to UAB to discuss an article I had recently written with Art Caplan in the *New England Journal of Medicine*, in which we argued for national sharing of transplantable

organs like livers. As a physician trained in bioethics, I explained to the audience why I thought a person's chance of living or dying should not depend on the arbitrariness of geography. Moreover, I informed the audience that livers could be flown across transplant regions with little decline in organ function. I saw no moral justification for local-priority allocation policies, saying something like: "When a donor organ becomes available in Tennessee or Alabama, it makes no sense to transplant it into a relatively healthy person nearby if someone in Pennsylvania or New York is in more urgent need."

I have rarely encountered a more hostile audience in my lengthy academic career. The audience muttered and hissed while I spoke. At one point a transplant surgeon leaped to his feet to interrupt: "You want to ship Alabama organs up north?!" The question was adamantly rhetorical, not too different from that 1980s TV commercial when the old coots from Texas reject a salsa because it was made "in New York City?!"

My experience in Alabama uncovered one of the primary barriers to sharing organs across the country: transplant surgeons in places like Alabama and Tennessee don't want to send precious organs out of state. Lose an organ, and they lose business.

When I finally chose a local landscaping company to remodel my yard, the other companies which provided me with estimates lost out on my business, business they would never be able to make up. By contrast, when Steve Jobs flew to Tennessee for his transplant, the Northern California hospital industry lost his business, but it didn't lose business more generally. The number of transplants performed in Northern California was unaffected by Jobs' decision to go to Tennessee. That's because the number of transplants performed in any area of the country depends on the supply of organs—the number of local people who experience fatal brain injuries—and not on the length of their transplant waiting list. With hundreds of other liver transplant candidates waiting in Northern

California, Steve Jobs' departure had no impact on the local hospital industry. The next time a liver became available in the San Francisco area, there were plenty of paying customers ready to receive it.

Our current transplant system creates perverse incentives, in which transplant centers benefit when patients (and their insurance companies) spend money getting themselves listed at multiple centers, and where the departure of one of their patients to receive a transplant in a distant part of the country has no impact on the volume of their business. If OrganJet succeeds in its mission, the practice of multiple listing will expand, further enriching transplant centers.

But will it succeed? And should we hope it succeeds?

### **Your New Liver Is Only a Learjet Away: Part 3 of 3**

As I have described in two earlier posts, here and here, the transplant system in the US suffers from terrible geographic disparities. People needing liver transplants in Northern California wait more than six years on average for an organ to become available, versus only three months in places like Memphis Tennessee. The solution to the geographic problem seems straightforward: stop giving priority to local transplant candidates over needier candidates in other locations. And the only barrier to fixing the problem appears to be the recalcitrance of transplant centers who are benefiting from the current system. Indeed, in 1999, the Institute of Medicine called upon the transplant community to reduce geographic disparities in transplant access by sharing organs more widely. By that time, the science of organ preservation had already advanced to the point where organs like livers and kidneys could be transported successfully from New York to Tennessee and still be healthy enough to thrive after transplantation. Yet a decade and a half later, the system remains unchanged. Bruce Vladek, former director of Medicare and Medicaid, laments<sup>5</sup> that “the transplant community has largely ignored the [IOM’s] recommendation.” Sharing transplantable organs would give patients a more equal chance of receiving transplants, regardless of where they live, and would also eliminate the unfair advantage patients receive when they list themselves at multiple transplant centers.

But this solution is not as straightforward as it seems. If the transplant system begins flying organs across transplant regions, those centers with the longest waiting lists, typically filled with the sickest patients, would become net importers of transportable organs. Huge programs like the University of Pennsylvania would become even bigger. And some, perhaps most, small transplant programs would go out of business, unable to compete for scarce organs when they become available. With

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<sup>5</sup> <http://virtualmentor.ama-assn.org/2012/03/pfor2-1203.html>

much shorter waiting lists, the chances that one of their patients would be the top candidate for an available organ would be relatively slim, like competing in a lottery where everyone else has five times as many tickets as you do. Moreover, if small transplant programs collapse, that could doom the hospitals and medical centers housing those programs. The money the centers lose on, for instance, treating Medicaid patients with pneumonia would no longer be balanced by the money they make transplanting people with liver disease. Finally, the loss of the smaller programs could make it harder for patients in rural communities to undergo transplantation evaluations.

In trying to make our transplant system fairer, we are forced to decide whether we are willing to drive small transplant programs out of business. Indeed, questions about whether to protect small medical centers from the business of medical practice are becoming increasingly relevant across American healthcare, even beyond the boundaries of transplantation medicine. Small medical centers are under intense pressure to compete for patients, in part because they have a difficult time matching the price of high-volume centers<sup>6</sup>. Consider a medical center like the Mayo Clinic. Because of its size and experience, the Clinic has become more efficient than many smaller medical centers, the result being a growth in market share, as patients fly across the country to Rochester Minnesota for their artificial hips and their pacemaker implants, their healthcare savings more than making up for the cost of the trip. Such market-share dominance is already becoming an issue in organ transplantation. Wal-Mart has contracted with the Mayo Clinic to perform transplants on any of its employees who develop organ failure. Wal-Mart even pays to house these employees near one of Mayo's hospitals, so they can wait for organs to become available and recover from their subsequent transplant.

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<sup>6</sup> <http://hbr.org/2013/10/the-strategy-that-will-fix-health-care/ar/1>

Contracting with the Mayo Clinic makes sense for Wal-Mart, because the company can obtain relatively low price transplants for its employees. Mayo's size offers it efficiencies of scale not available to smaller transplant programs, and Wal-Mart's size no doubt enabled it to negotiate discounted rates for the care its employees receive.

Large medical centers not only have efficiencies of scale, that allow them to charge lower prices, but often provide higher quality of care for complex conditions, because they gain more experience treating such conditions. Research has shown that, all else equal, experienced healthcare providers often provide better care than less experienced ones. For instance, among patients with pancreas tumors, 14% die shortly after surgical removal of the tumor at hospitals where such procedures occur one or two times per year. In hospitals where such procedures are more common, postoperative mortality is less than 4%.

Debates about organ allocation must consider this relationship between the volume and quality of healthcare. David Axelrod, a Dartmouth transplant surgeon, conducted a study of liver transplant outcomes at small and large transplant programs, comparing the smallest third of programs (which transplanted a median of 21 patients per year) to the largest third of programs (which transplanted more than 90). He found, all else equal, that patients transplanted at the smaller programs were 30% more likely to die in the first year after their transplant. "The differences were striking," notes Axelrod, "but that does not mean all patients should head to large transplant centers, not with the way our current system is set up. After all, some of those large programs, like ones in San Francisco where Steve Jobs lived, also have long waiting times. If you have a large center with great post-transplant outcomes, but most patients die before they ever get transplanted," he asked me, "is that the best option for the patients?"

I interpreted that as a rhetorical question.

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In February of 2013, physicians at the Albert Einstein Medical Center in Pennsylvania called Irena Bucci to tell her they had identified a kidney donor who was a perfect 6 out of 6 antigen match for her. In fact, because the match was 6 out of 6, the healthcare team would fly the kidney to the Georgetown hospital in D.C, rather than require Bucci to come travel to Pennsylvania. In kidney transplantation, these 6 out of 6 matches are the main exception to the local first allocation rule. Whenever such matches occur among patients with high PRAs, they take priority over providing the organs to local patients who are not perfect matches.

Thrilled about finding a donor, Bucci made her way to Georgetown. She remembers lying in a pre-operative bed, IVs already in place, thinking: “It’s coming!” Meanwhile, a surgeon in Pennsylvania was scrubbed and gowned, and carefully making incisions in the donor’s body to retrieve the kidneys. But when he peered inside the donor’s body, the kidneys didn’t look healthy. The transplant was off.

“You must have been devastated,” I said to Bucci when she told me the story. “Not really,” she said. “I still wasn’t on dialysis and I didn’t see the world coming to an end.”

Besides, she had more plans. She had learned about the National Kidney Registry, an organization that helps living donors find each other to initiate chain reaction transplants. Bucci’s husband, for example, wanted to give her one of his kidneys, but he was not a compatible donor. The National Kidney Registry worked to find another couple in a similar situation who could initiate a donor exchange. Bucci’s husband would donate a kidney to the other couple while one member from that couple would donate a kidney to Bucci. The first couple that the Registry identified was not up to snuff in Bucci’s mind, however. The donor was 55-years-old, and only a 2 out of 6 antigen match.

At the ripe young age of 41, Bucci did not want anything but the best possible kidney. Then the Registry found a better suited couple from Denver. They set a date for the transplantation. On August 15<sup>th</sup>, Bucci's husband would be rolled into the operating room and part ways with one of his kidneys. "It was very hard for me," Bucci said. "I didn't want to harm my loved one."

That's when Bucci got a call from the University of Pittsburgh. They had a kidney for her. "Can you get here by 11 p.m.?" they asked. It was 5 p.m. She had no choice. Time to go to Pittsburgh!

Her first thought was that she could drive to Pittsburgh in less than five hours, but she knew that would be calling it close. So she contacted Tayur at OrganJet and told him about her situation, and he began looking for a private jet in case she needed one.

OrganJet's business model depends upon the transplant system maintaining the status quo – continuing to give priority to local transplant centers over regional and national ones. If the officials regulating the transplant system changed their policies, and required programs to share organs when feasible, then the long wait times in Northern California will decline, leaving much less incentive for people like Steve Jobs to get waitlisted in Tennessee, and for people like Irena Bucci to consider using OrganJet's services. One rule change could doom Tayur's business even before it, literally and figuratively, gets off the ground. "I am not worried about that," Tayur told me. "I didn't start OrganJet only to make money. I also started it to solve an important social problem." Tayur would be delighted, in fact, if broader sharing of organs eliminated the need for his business. "The important thing is to make the system fairer."

Meanwhile, Tayur continues to field calls from potential customers, people like Irena Bucci who are willing to get waitlisted at transplant centers far from home because they know a jet will be available if they need one. When the University of Pittsburgh gave Bucci five hours to get to town, she knew

she could count on OrganJet. As it turned out, Bucci was able to find a commercial flight that arrived in Pittsburgh with 30 minutes to spare, and received her transplant later that night. “Before the transplant,” she told me, “I felt like I was always walking around in a smoky bar.” The air is now clearer, and she does not have to spend her spare time traveling around the East coast undergoing transplant evaluations.

Bucci never needed to pay OrganJet for its services. Yet Tayur still considers Bucci’s transplant to be a business success for OrganJet — “She got a kidney!” Making a second fortune does not appear to be on the immediate horizon. In fact, while he still hopes eventually to make money on OrganJet, his main financial goal now is not to lose too much of his own money building his new company: “I promised my wife I wouldn’t spend more than \$300,000 of my own money in order to establish the company.”

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Any effort to improve the US healthcare system must strike a balance between promoting low-cost, high-quality care and the desire to promote local healthcare systems that are easily accessible to patients, wherever they live. In the case of rare and complex illnesses, it makes sense to encourage patients to travel to regional, or even national, centers of excellence. We should not expect local children’s hospitals to be able to separate conjoined twins, or community medical centers to be able to perform bone marrow transplants on adults with leukemia. People with these kinds of problems are best off finding care at the kind of large, advanced medical institutions experienced in treating these illnesses.

But where do we draw the line when promoting centers of excellence in medical care? Should we encourage local hospitals to perform heart bypass procedures? How many such procedures should we expect hospitals, or surgeons, to perform each year? Should we prop up community hospitals,

and their cardiovascular treatment programs, when local insurance companies negotiate with the Mayo Clinic to perform such procedures on people living near those committee hospitals?

Solving geographic disparities in transplantation forces us to ask these same questions. We have to decide whether we want to address geographic disparities within the current system, while paying for companies like OrganJet to fly patients to local transplant centers with shorter waiting lists, or instead whether we want to scrap the current “local priority” system, and fly organs across UNOS regions to better match patient need.

Because lives are at stake, I think we need to promote the highest quality of care for patients who need solid organ transplants, which means the transplant community ought to share organs more widely, even if such sharing destabilizes smaller transplant programs. The goal of organ transplantation, after all, is to improve patients’ lives. The transplant system should therefore be designed in a way that maximizes patient benefit. I am by no means suggesting that we should ignore the impact that such a policy shift would have on smaller hospitals that currently provide transplant services. Our health care system needs strong rural and community hospitals if we want to serve people’s basic health care needs. Indeed, we should make sure that such institutions are paid generously for the work they do best. Medicare already recognizes the importance of such subsidies, by boosting payments to rural providers. We should explore other ways to promote high quality primary and secondary care at smaller hospitals.

But we should not prop up smaller healthcare institutions by giving them an advantage in securing lucrative and scarce transplantable organs, an advantage that then hurts patients who are served by larger hospitals. When people need tertiary or quaternary medical care, we should encourage them to go to institutions that specialize in providing such care. In the case of organ transplantation, that means creating a system that does not punish patients for seeking care at large, experienced

transplant centers.

If the transplant community continues to insist on giving priority to local transplant centers when organs become available, we have to hope that companies like OrganJet thrive. One way or another, the US organ transplantation system needs to change. The benefits of organ transplantation should neither depend on a person's ability to charter a private jet, nor on whether that person is lucky enough to live near a hospital that, thanks to our local first system, has a relatively short wait list. There is no excuse for maintaining the status quo. When it comes to lifesaving transplant organs, where you live shouldn't determine whether you live.