

Incentivizing Live Kidney Donations:  
Economic Models for Policy Enhancements

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### ***Abstract***

*The kidney market is not currently at equilibrium: demand from sick patients far exceeds available kidneys for donation. This paper examines treatment from dialysis and treatment from live kidney donation. The model incorporates these options and includes incentive programs that aim to increase numbers of live donors. With public health demand side interventions and monetary supply side interventions, the market can reach equilibrium.*

### **Introduction**

The organs in our bodies cohesively work together to maintain internal homeostasis. Often referred to as the “filters” of the body, kidneys do just that—they filter around 150 quarts of blood daily to remove waste products and extra water, regulating the concentration and volume of bodily fluids on a microscopic level. Every human is born with two kidneys and can function normally with only one.

An otherwise healthy individual faces risks of end stage renal disease (ESRD), most commonly occurring from diabetes and high blood pressure. With diabetes, the body cannot break down sugars properly and high levels remain in the bloodstream causing permanent damage to the kidneys. High blood pressure forces blood through the tiny vessels in the kidneys, causing the vessels to stretch and scar. This leads to more fluid being excreted by the vessels, creating a dangerous cycle (Kidney Failure, 2014). Once diagnosed with ESRD, patients can be treated with dialysis, wait on the transplant list, or simply make lifestyle choices until the end of life.

As of February 26, 2016 100,434 patients were on the kidney transplant waiting list. Of those, only 14,879 kidney transplants took place. This leaves a gap of about 85,000 patients who are still waiting for a kidney. These transplants can be either live or cadaveric kidneys, that is,

kidneys that come from deceased donors or living donors. As no payment mechanism for donation exists, kidney donors in the US often are completely altruistic, including “non-directed donors” who donate kidneys without a specific recipient in mind. Donors can be related or unrelated to the recipient, but must undergo an extensive health screening process. A new system of “ongoing donor chains” involves a donor and patient pair who are not compatible, and matches them up with another donor patient pair where the first donor donates to the second patient (United Network for Organ Sharing, 2016).

Evidence has shown that kidneys from live donors have a significantly higher success rate after transplantation (Mjøen & Holdaas, 2015). Nevertheless, live donation rates remain far lower than cadaveric donations. This can be explained by inadequate donor compensation, lack of medical knowledge, and inability to donate because of previous medical issues (Tumin et. al., 2014). The current process to become a living donor in the US is fairly rigorous, involving a medical history review, financial consultation, immunological tests, laboratory tests, an EKG, a chest x-ray, psychological evaluation, urine samples, and gynecological exams (National Kidney Foundation, 2016). Lack of medical knowledge also plays a role in the donation number: many potential donors may be unaware that they can survive without one kidney. As for donor compensation, the only country in the world with free sale of organs is Iran; however, this paper focuses on the US system, which outlaws direct payment.

The National Organ Transplant Act of 1984 banned the sale of human organs from living sources (Public Law 98–507). This arose from the previous confusion of the property rights of cadavers.

The Act has been under scrutiny by certain groups and individuals that advocate for monetary compensation for donors or for a completely free market in organs (Roff, 2011; Major, 2008). In contrast, other individuals and groups claim that a legal market in organs would exploit the poor and the act of turning the human body into a commodity would lead to ethically dubious situations (Board, 2002; Ivanovski, 1997). These individuals and groups that argue an “intrinsic wrongness” to direct donor payment assert that if we view organs as commodities, we go against Kant’s assertion that humanity should never be merely a means<sup>1</sup>. Gill and Sade (2002) proposed a compelling argument against prohibiting kidney payment. However, this paper assumes the NOTA will not be revoked anytime soon. Although direct donor payment is legal in America, some states have introduced payment systems for live donors that circumvent the law to legally incentivize donations.

The model in this paper incorporates supply and demand elasticity, price discussion, and an introduction of incentives in the market. With the NOTA, the market is currently operating inefficiently. The equilibrium lies where quantity demanded meets quantity supplied by live kidney donors. Because of the NOTA, equilibrium efficiency is not reached. The incentive programs by states mentioned above help move the market closer to equilibrium. With a combination of tax incentives and programs to reduce disincentives, the kidney shortage can be eliminated and every patient in ESRD who needs a kidney can get one.

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<sup>1</sup> “Man, however, is not a thing and hence is not something to be used merely as a means; he must in all his actions always be regarded as an end in himself” (Kant, p. 36).

## **Literature Review**

### **Medical Outcomes**

Any discussion regarding live kidney donation assumes donors can live a healthy life with one kidney post-donation. The study by Fehrman-Ekholm et. al. (2001) followed all living kidney donors in a Swedish center for 31 years post-donation. They found that absolute renal function of donors was not significantly lower than the normal decrease in kidney function from ageing. They did find that 38% of their donors experienced an increase in blood pressure. A more recent study by Sommerer et. al. (2004) concluded that this increase in blood pressure could be accounted for by the natural ageing process. Follow-up visits post-donation were suggested, to help catch and treat any potential health risks that do not occur naturally.

Mjøen et. al. (2015) examined all previous reports of living kidney donation outcomes, focusing on the risks of mortality, high blood pressure, potential ESRD, and albuminuria. They concluded that there is significant evidence that living donors face an increased risk of developing ESRD, and selecting donors based on age and medical history would help to reduce this risk. The discrepancy between findings from 2001 to 2015 indicates that further research is necessary in conjunction with improved donor check-ups. Future research is also advised to choose control groups more selectively. There is little doubt, however, that regardless of increased blood pressure, live donation is still far more preferable than dialysis (Mjøen et. al., 2015).

## **Current Donation System**

Living kidney donors fall under several categories: related, non-related, non-directed, paired, blood type incompatible. Related donors are blood relatives to the ESRD patient, including parents or siblings. Non-related donors are not blood related, but have an emotional connection to the patient whether they be spouses, in-laws, co-workers, or other close friends. Non-directed donors are also known as altruistic donors and are completely motivated by selflessness. Paired donation involves two or more donor/patient pairs who are not blood type compatible, and they trade donors so that each patient gets a kidney from the other donor (National Kidney Foundation, 2016). This method has recently gained publicity through Al Roth's idea of paired donor chains—these chains can extend all across the country and have potential to help reduce the shortage (Roth et. al., 2006).

The bottom line of kidney donation lies in the necessity of blood type compatibility. At a very basic biological level, antibodies exist in the bloodstream and are specific for each blood type. If a patient receives a transplant from someone without a compatible blood type, the antibodies will reject the kidney. For as long as kidney transplantation has existed, blood type matching has been a major barrier to patients receiving kidneys. A recent method called *desensitization* can work around this barrier. Patients undergo plasmapheresis, which filters antibodies out of the blood, and other antibodies are pumped in while the body begins to regenerate the old antibodies. This combination of new and old antibodies are “less likely to attack the new organ” and if that is still a concern, drugs are available to kill white blood cells. The researchers involved with this new study calculated that the process, including transplantation, costs around \$130,000 and

concluded this method is ultimately cheaper than dialysis in the long run (Rostaing & Malvezzi, 2016).

### **Donor Psychology**

A Malaysian study (Tumin et. al., 2013) analyzed reasons potential unrelated living kidney donors were not willing to donate. All subjects had post-secondary education, and were asked to be living kidney donors; the majority chose not to donate. The study found that most subjects did not believe it was possible to live with just one kidney, which ended up being a major barrier to donating. More educational programs could assist with this, targeting the “psychosocial issues” mentioned in the study (Tumin et. al., 2013). However, it may not be reasonable to translate these Malaysian results into the U.S. programs. The essential conclusion then is that knowledge of the human body, surgical process, and past medical history all influence a donor’s decision regardless of country of origin. With the recent studies on desensitization, medical barriers and history are less likely to impact a donor’s decision.

Cacioppo and Gardner (1993) assessed previous studies of blood, tissue, and organ donor psychology. Organ donors were found to make decisions based on positive and negative aspects. The positive aspects included personal satisfaction, humanitarian benefits, and pride; negative aspects included fears of “organ mutilation” and inadequate medical attention post-op. Public health programs targeted towards both the positive and negative aspects of donation were recommended (Cacioppo & Gardner, 1993).

Previous research on organ donor attitudes and behavior has not focused on live kidney donation. Most research focuses on donor cards for cadaveric donation. Results from these studies can still be extrapolated to live donation. While global attitudes regarding organ donation are positive, observed donation behavior does not follow this pattern. The Morgan and Miller (2002) study discovered that donors consider costs to family and availability of black market organs as considerations for donation. In the kidney market, black market organs function as substitutes, but are often unsafe and costly. This study also concluded that policies to target misconceptions would be useful to increase the amount of donors (Morgan & Miller, 2002).

### **Dialysis vs. Transplant**

The Matas and Schnitzler study (2004) estimated the amount society saved when transplants rather than dialysis is used. With a Markov model, this study determined that living donation saved \$94,579 (2002 USD) and gained 3.5 quality adjusted life years (QALYs) per patient, equalling a total of \$269,319 (2002 USD) saved per patient per year (PPPY). The authors propose that a payment system would include some combination of a life insurance and health insurance policy (Matas et. al., 2004). Because this would not be a direct payment to donors, it would not violate NOTA.

Costs to society have been analyzed by the United States Renal Data System. Societal costs are measured by Medicare expenditures, because all kidney donations are covered by Medicare. Figure 1 shows the upward trend in costs from ESRD patients, with a clear distinction between costs from transplant patients and those still on dialysis. Although data is from 2013 and the



numbers may not be the same in 2016, it is clear that a large gap between dialysis and transplant costs exists. Figure 1 shows that in 2013, hemodialysis cost roughly \$85,000 per patient per year, peritoneal dialysis cost roughly \$70,000 per patient per year, and transplants cost roughly \$30,000 per patient per year.

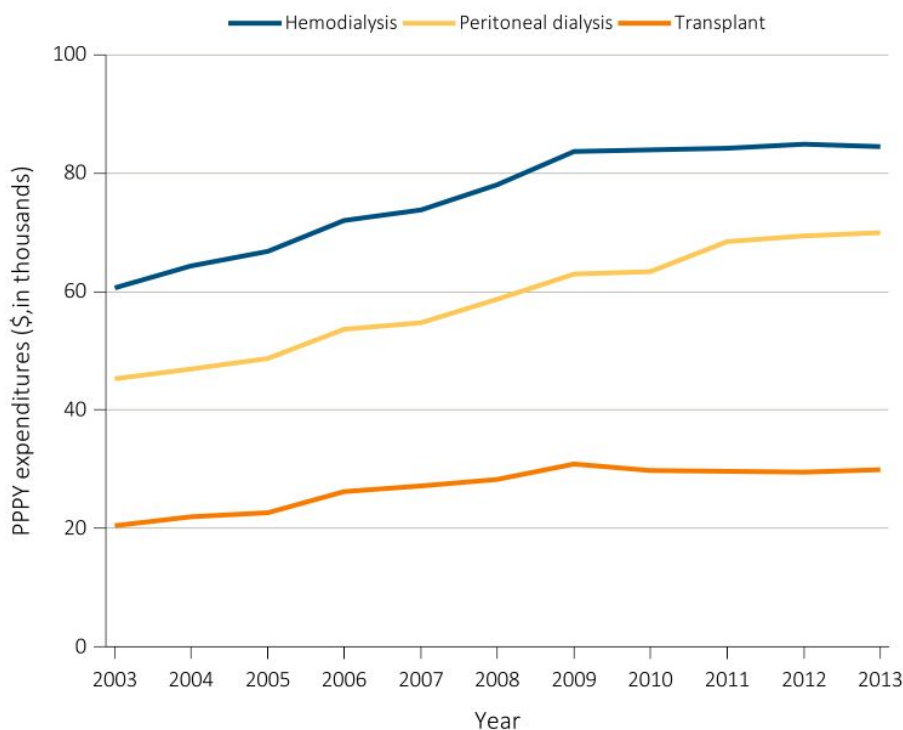


Figure 1. Total Medicare Expenditures PPPY. *Data Source: USRDS ESRD Database, 2013*

Steps have been made recently to reduce the cost of dialysis by creating bundled payments and a pay for performance system (Swaminathan et. al., 2012). Bundled payments involve grouping medical and surgical procedures, including all care leading up to the treatment, together for the insurance company. Pay for performance systems pay doctors based on patient outcomes, which encourages them to work with other professionals to deliver high quality care. However, the cost of this still far exceeds the cost of a one-time surgical fix of ESRD. Surgical costs include 30

days pre-op pre-transplant, procurement, hospital admission, physician costs, 180 post-transplant admission, and immunosuppressive drugs and other prescriptions, according to UNOS.

According to the Milliman Research Report in 2014, the total average billed charges for a kidney transplant was \$334,300. The largest cost came from hospital transplant admission, at \$119,600. Kidney transplants are shown to have a 85% survival rate after five years, surpassing all other organ transplant result statistics. However, kidney transplant patients lose their Medicare coverage for immunosuppressive drugs three years after surgery. Extended coverage would increase post-op survival rates and would increase cost-effectiveness (Knauf and Aronson, 2009).

### **Constraint: Insurance Coverage**

With the new laws associated with the Affordable Care Act, discrimination based on pre-existing conditions is illegal as of 2014. However, this only affects health insurance not life insurance. Although kidney donors have as a group lower death rates, those that sought life insurance after donation sometimes met difficulty (Boyarsky et. al., 2014). In fact, the Boyarsky study found about 25% of their sample that sought insurance faced difficulty in terms of being denied, being charged a higher premium, or being told they had a pre-existing condition (Boyarsky et. al., 2014). Although the ACA prevents these difficulties arising for those seeking health insurance, there is no such stipulation for life insurance. This then becomes a fairly significant constraint a potential donor may face.

## Economic Model

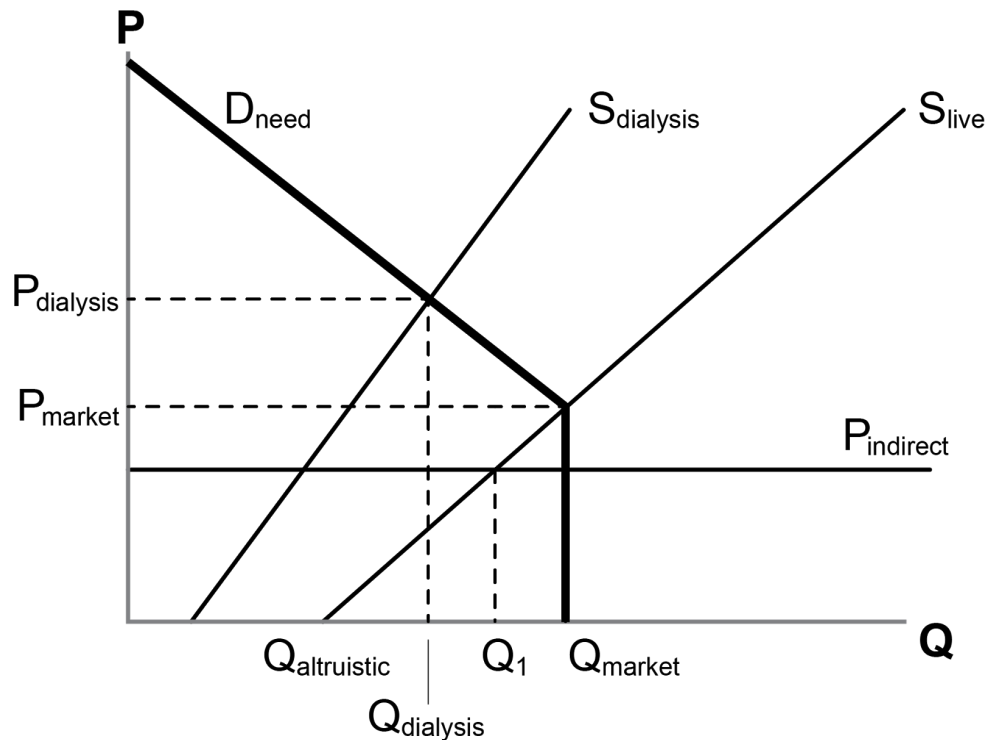


Figure 2. ESRD treatment model.

## Demand

On the demand side, the demand curve is derived from all patients with ESRD who need some sort of treatment. Demand begins by sloping downward up to the point  $Q_{\text{market}}$ , where it becomes vertical. The downward slope of demand for ESRD treatment can be attributed to the law of demand. As price for ESRD treatment decreases, quantity demanded will increase. In the kidney market, price includes the price for both society and individuals. Price for treatment can be absorbed by the government or paid through private insurance. The patient's insurance pays for the donor's expenses, such as the evaluation, surgery, limited follow-up tests, and medical

appointments. Price for the individuals includes opportunity cost and quality of life adjustments for ESRD.

The fixed number of ESRD patients creates a vertical demand curve at the point where quantity is equal to the amount of ESRD patients. Beyond this point, there are no more patients waiting to be treated. If  $Q_{\text{market}}$  is reached, the kidney shortage is eliminated. The point where  $P_{\text{market}}$  intersects with  $Q_{\text{market}}$  is the ideal equilibrium, with no shortage and a low price. Iran's free kidney market is at this equilibrium, because everyone who needs a kidney gets one at a certain price.

## **Supply**

The model uses two different supply curves: one derived from medical networks that provide dialysis, and one from networks of live kidney donors. If, in the case of adding substitutes, artificial kidneys became a feasible treatment option, another supply curve would be added. In this case, there are only two because dialysis and live donation are discussed in terms of cost effectiveness and utility.

## **Dialysis Supply**

Costs contained within the dialysis supply curve are the direct cost for dialysis treatment centers, including equipment, medical personnel, and administrative costs. Costs are borne by the government and individual, in the form of opportunity costs. The dialysis curve,  $S_{\text{dialysis}}$  lies farther behind the live donor supply curve. From the Matas et. al. study (2004), it is known that

dialysis costs individuals and society more than live donation. At  $P_{\text{dialysis}}$ , a horizontal line would intersect  $S_{\text{live}}$  at a higher quantity than it intersects  $S_{\text{dialysis}}$ . This indicates that for the same price and cost to society, live donation can be a treatment for far more patients.

### **Live Donor Supply**

The intersection between the live donor supply curve and the x-axis shows the number of kidneys donated on a purely altruistic basis ( $Q_{\text{altruistic}}$ ). As price for donating increases, more kidneys will be available because donors are influenced by some incentive and change in price. Cost contained within the live donor supply curve is the direct cost of transplant surgery borne by the government or private insurance. Also within that curve are other costs borne by the living donor, such as lost earnings, travel and incidental costs, quality of life adjustments, and potential future health risks.

### **Elasticity**

Price elasticity of demand is primarily influenced by the presence of substitutes in the kidney market. The substitutes to kidney transplant surgery include dialysis, end of life care, in-vitro kidneys from stem cell research, and new artificial kidneys. As more of these substitutes become viable options, demand will become more elastic and patients with ESRD will find it easier to obtain effective treatment options.

## Total Expenditures Model

As the Matas et. al. study (2004) calculated, the cost of treatment through dialysis is far greater than the cost of treatment through live donation. Figure 3 below shows the total expenditure on dialysis in solid pink, and the total expenditure on live donation in striped pink. This model is not absolutely mathematically specific—it simply depicts the large gap in spending on dialysis versus transplant surgery. It is important to note that the cost from  $S_{live}$  includes surgical costs for both the patient and the donor, and the increased quality of life of the patient. However, it does not include (because no data exists on this topic) the quality of life adjustments made for the kidney donor, in the case of potential future health complications.

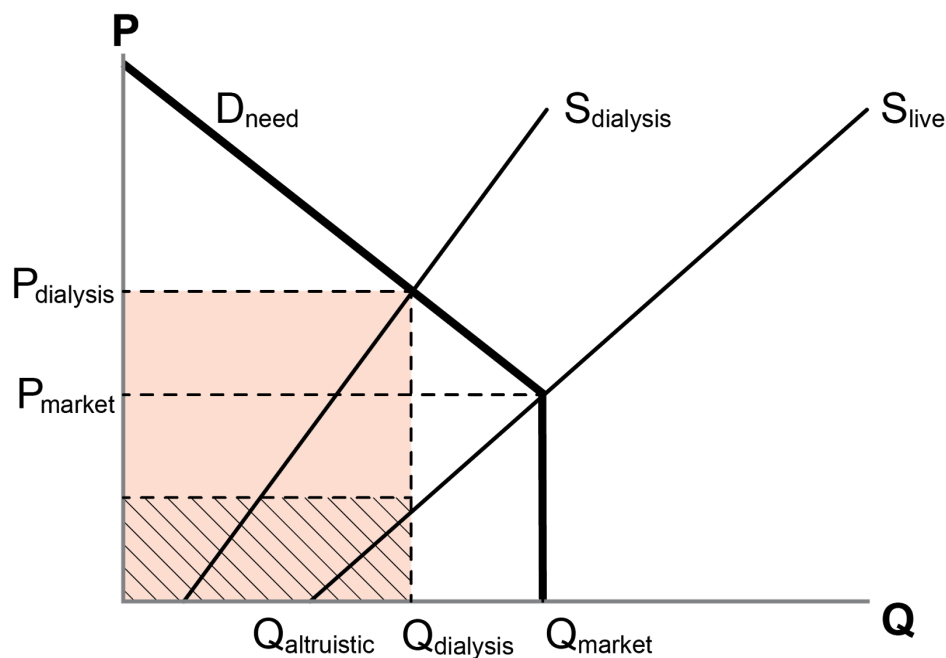


Figure 3. Total Expenditures Model.

## **Incentive Programs**

As stated in the introduction, the NOTA bans the sale of human organs. Looking at Iran's legal free market shows that they have successfully eliminated their kidney shortage. In that country, the incentive to donate is by a majority monetary, with some altruism involved (Zargooshi, 2001). Because it is illegal in the U.S. and incentives are still needed for donors because  $Q_{\text{altruistic}}$  creates an even greater shortage, some states have implemented donation laws. These laws can be seen as incentive programs, that try to persuade potential healthy donors to donate, while still remaining in the legal boundaries.

## **Donor Leave Laws**

Donor leave laws are designed to compensate for time and lost wages. Federal employees are guaranteed 30 days of paid leave for organ donation, separate from sick and annual leave (Public Law 106-56). Following the federal program, many states also offer state employees up to 30 days leave, but it may be paid or unpaid.

## **Tax Deductions**

As of February 1, 2016, there are 17 states that offer \$10,000 state income tax deductions for live kidney donors: Arkansas, Georgia, Idaho, Iowa, Louisiana, Maryland, Massachusetts, Minnesota, Mississippi, New Mexico, New York, North Dakota, Ohio, Oklahoma, South Carolina, Utah, Virginia, and Wisconsin. This \$10,000 is meant to assist with the lost wages, housing, and medical costs (Venkataramani et. al., 2012). Although this tax break could be

considered a significant incentive to low-income potential donors, the Venkataramani study found that these policies had no statistically significant effect on donation rates. They presumed this could be attributed to the low cash value of the tax, lack of public awareness of the benefits, and the conditions in the specific states. Tax incentives are a “compromise between the status quo and a commercial market for organs”; the question then becomes whether or not credits or deductions are more useful (Joshi et. al., 2016).

Higher tax credits over a span of multiple years, rather than tax deductions, is another incentive solution proposed by Joshi et. al. (2016). This appeals to both low and high income earners; low income groups won't be exploited because the credits are non-transferrable and they have a low tax burden to begin with. High earners will be incentivized because they represent the lowest rates of live donations, and will gain more credit (Wellington and Sayre, 2011). Appropriate risk compensation would involve a yearly tax credit for 10 years, which would minimize exploitation and risk of impulsive decisions (Becker and Elias, 2007).

The current proposal for a federal tax credit has the potential to increase donors. As of February 1, 2016, there is a pending federal legislation that would ensure a federal tax credit of \$5,000 for “unreimbursed expenses”. This legislation has not passed yet, and could significantly impact the amount of living donors because it would be a federal law, rather than state law. Most state employees are also guaranteed 30 days of paid leave for organ donation.



### **National Living Donor Assistance Center**

Financial disincentives to donating include paying for travel and living expenses and the opportunity cost of lost wages during the operation process. In 2007, the National Living Donor Assistance Center (NLDAC) was formed and assisted their first donor by contributing more than \$2,000 to donation costs. About 76% of donors are predicted to spend one month's income on donor-related expenses, and the development of the NLDAC has significantly increased the number of donors and is predicted to increase these numbers in the future (Warren et. al., 2014).

### **American Kidney Fund Safety Net Grants**

American Kidney Fund safety net grants of \$100 are available to donors to compensate for out-of-pocket expenses. This is only meant to partially subsidize travel expenses and other incidental costs and regards expenses not covered by health insurance or governmental programs, such as Medicare (Information for Patients, 2016).

### **Conclusion**

All these programs, whether they're at the state or federal level, provide monetary incentives for people to donate. As more incentives are introduced, donors will move up along the supply curve away from the altruistic donation intercept. The horizontal line at  $P_{\text{indirect}}$  captures these incentive programs. As more incentives are introduced, the line moves up vertically until it hits the price at  $P_{\text{market}}$  shown in the blue line on figure 3 on the next page. The current shortage can be seen as

the quantity difference between  $Q_1$  and  $Q_{\text{market}}$ . As incentives to donate live kidneys increase, the shortage can be reduced.

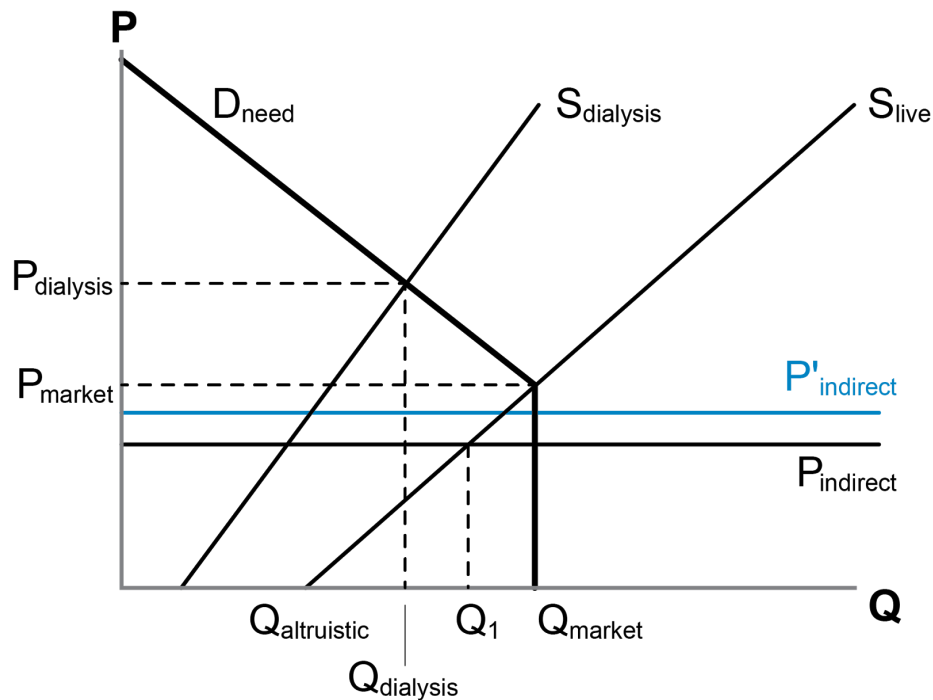


Figure 3. ESRD Treatment Model with Incentives

The poor patient outcomes and high cost to society from dialysis treatment provides a clear reasoning as to why live donation should be encouraged. Although this research is clear, policies must work around NOTA through indirect financial incentive systems, such as tax credits.

Our system also has a few disincentives, which should be addressed to reduce the shortage. Most prominent are the intensive tests potential donors must go through and the worry of insurance coverage they face. By creating policies that increase tax credits and decrease disincentives, the kidney shortage can be reduced until every patient living with ESRD gets treatment.

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