OBJECTIVE:

The estimated values based on US Renal Data System data were used to model health state transitions: dialysis patients on the transplant wait list face a 5.6% annual risk of death; patients with a functioning graft face a 2.1% annual risk of death; patients with a functioning graft were assumed to face a 1.1% annual risk of graft failure.

The following estimates were assigned as treatment costs: Patients awaiting transplant and those with graft failure incur annual dialysis costs of $5,517.77. Data from the study centers supported the assumption that patients with functioning grafts were assigned average maintenance costs of $4,646 and patients experiencing graft failure were assigned costs of $6,293.

To calculate cost/quality-adjusted life year (Cost/QALY), a common health economic metric, utility scores were estimated from literature. Using a regression model, with 1 representing a year in perfect health, and 0 representing death. A utility score of 0.84 was assumed for patients with functioning grafts and a utility score of 0.64 was assigned for patients on dialysis. Costs and costs per QALY were estimated for year one of transplant and over the 10 year time horizon of the Markov model. A 5% annual discount rate for both costs and QALYs were assumed, consistent with German guidelines.

All site specific data were de-identified. No ethical approval record was required for this study.

RESULTS:

To further evaluate differences between the two regimens we projected costs and QALYs during the 12 month follow up period. Health economic modeling, including cost/QALY analysis were conducted a posteriori using the Markov model to project health outcomes over 10 years. The cost-effectiveness analysis was performed using a probabilistic sensitivity analysis (PSA) to take into account the variability in parameters. The PSA was conducted using 1,000 bootstrapped samples of the parameters used in the Markov model.

The objective of this study was to quantify the costs and health outcomes of cadaveric kidney transplantation using anti-thymocyte globulin versus basiliximab as induction therapy. Costs and health outcomes occurring within 12 months of transplant are estimated using the cost/QALY framework and supplemented with data from 3 German hospitals. Costs and health outcomes predicted to occur in the following decade are estimated using Markov models and literature based estimates for costs (QALY) and clinical outcomes.

Health economic modeling compared drug costs as well as costs associated with avoidance of acute post-transplant graft failure, reduction in use of dialysis and dialysis costs, improved quality of life, improved survival and cost-benefits.

METHODS: DATA COLLECTION, MODELING AND STATISTICAL ANALYSIS

The health economic model analyzed the Brennan-1st et al study database. The study population included patients aged ≥18 years diagnosed with end-stage renal failure who underwent cadaveric transplant and received either thymoglobulin or basiliximab induction regimens. The original SAS database from the Brennan study was used as source clinical information to estimate treatment costs during the 365 days following transplantation.

The total incidence of adverse events, serious adverse events, and cancer were also similar between the two groups. Patients receiving anti-thymoglobulin had a greater incidence of infection (85.8% vs 75.2%, P < 0.03) but a lower incidence of cytomegalovirus disease (7.8% vs. 17.9%, P = 0.02).

Table 3 lists treatment costs within 12 months of transplant. While induction costs associated with anti-thymoglobulin are $5,376 higher than those associated with basiliximab ($1,044) in the cost of treating rejection episodes (P=0.02). Costs of delayed graft function, nonfatal graft loss, and post-graft survival were significantly lower among anti-thymoglobulin patients (P=NS).

Infection treatment costs are nearly identical in the two groups (P=NS). Anti-thymoglobulin treated patients incurred higher graft maintenance costs and lower post graft failure costs, consistent with their longer graft survival (P=NS). At 1 year, total estimated treatment costs were 2.6% greater for anti-thymoglobulin- treated patients : $85,306 versus $83,144 (P=0.001).

Cumulative incremental costs and QALYs are presented in Figure 2. Since fewer anti-thymoglobulin patients return to dialysis within 12 months of transplant, long term costs are projected to be lower with anti-thymoglobulin versus basiliximab. By the end of year 2, costs are projected to be $51,446 less for each 100 patients in the anti-thymoglobulin cohort, with savings reaching $440,544 for each 100 patients by year 10.

Anti-thymoglobulin treated patients are projected to enjoy a modest gain in total QALYs compared to basiliximab-treated patients over the 10 year model time horizon (Figure 2). The initial utility difference of 0.007 QALYs per patient grows to 0.059 QALYs by year 10.

Discussion:

Based on data from Brennan-3rd and clinical care sites in Germany, this study found anti-thymoglobulin induction costs $5,178 more than basiliximab. However, reduced costs associated with delayed graft function, rejection episodes, nonfatal graft loss, and post-graft survival substantially reduced the cost advantage of basiliximab within 12 months.

To further evaluate differences between the two regimens we projected costs and QALYs within the subsequent decade. After 10 additional years, each anti-thymoglobulin-treated patient is projected to enjoy an additional 0.096 QALYs versus a basiliximab-treated patient. Also after 10 years, each 100 anti-thymoglobulin patients would cost $45,852 less than 100 basiliximab patients.

While substantial, the differences in costs and QALYs between anti-thymoglobulin and basiliximab were not significant with the overall savings achieved by substituting transplantation for a long-term dialysis regimen. According to our model, dialysis costs $124,293 per patient, gained transcription with anti-thymoglobulin vs $122,493 per patient gained, and transplantation with anti-thymoglobulin costs $25,142 per patient gained.

Comparing anti-thymoglobulin with basiliximab, the former is the dominant treatment choice-providing more QALYs and lower long term costs. The QALY advantage is evident within 12 months. Cost reduction occurs during year 2, and grows to approximately $440,000 for every 100 patients within a decade following transplantation.

Conclusion:

This analysis offers an important and increasingly relevant health economic perspective for patients undergoing cadaveric kidney transplant induction therapy receiving anti-thymoglobulin compared with those receiving basiliximab induction. Both models were validated using patient level cost data. Gains in QALYs are valuable to reflect the long term cost and consequences, including the patient benefit, that may be achieved with one induction therapy over another. For patients undergoing cadaveric kidneys, improved long term clinical outcomes may support healthcare institutions to reallocate more cost-effective care. Lastly, because funding for ESRD therapy is in the public domain, it is appropriate for healthcare institutions and others to consider the outcomes of this study before directing reimbursement changes might result in more cost-effective care.