Leading Practices for the Allocation of Organs for Combined Transplantation

March 22-23, 2012
Toronto, ON
Forum Report

Canadian Society of Transplantation
LEADERSHIP IN CANADIAN TRANSPLANTATION

Canadian Blood Services
Société canadienne du sang

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EXECUTIVE SUMMARY

In Canada in 2011, more than 4500 patients were awaiting an organ transplant. As organs are a scarce resource, there must be processes in place to ensure equitable and transparent allocation. Currently, there are inequities and inconsistent practices with regard to allocation, as well as, unequal access to services in various regions. As such, policies must be developed which are supported as much as possible by evidence-based information. From this basis, consensus-built recommendations can be developed that will subsequently inform the development of registries and a national system design. In addition the demand for transplantable organs is complicated by the additional needs of some patients who require more than one organ transplant such as those with end-stage heart, lung or liver disease who experience advanced chronic kidney disease. In some of these cases there is no clear consensus about the best strategy regarding the indication of heart, lung or liver transplant alone, or combined (either simultaneous or staged) heart, lung or liver and kidney transplant

In collaboration with the Canadian Society of Transplantation, the Canadian Blood Services conducted a consensus forum in order to evaluate the current evidence and practise, and to make recommendations on listing and allocation for combined transplant candidates, where they are not currently part of organ-specific allocation models. The purpose of this initiative was to develop eligibility (including listing) criteria and a decision-making model which could be applied to the allocation of organs for combined transplants that is acceptable, useful and adaptable within unique regions across the country. The consensus forum was the first step of a consultative process which is intended to aid programs with their task standardizing policies for combined transplant and interprovincial sharing. In in this report, the term “combined transplants” is defined as kidney/non-kidney combined transplant pairs and excluding kidney/pancreas as well as all other pairs.

Forum Objectives:

1. To understand, review and communicate current practice with regard to the needs of communities for organ allocation for combined transplants and the impact of combined transplants on single organ wait lists.
2. To develop Canadian eligibility criteria for combined transplants.
3. To develop leading practice recommendations that will support the integration of algorithms for eligibility (including listing) for combined and single organ allocation.
4. To initiate a discussion between the Canadian Blood Services and Canadian Society of Transplantation on balancing and the evidence these two groups require in order to collaborate on the development of recommendations for interprovincial sharing.
5. To initiate a discussion with stakeholders in order to facilitate data gathering in support of on-going policy development.
6. To enhance transparency for the organ donation and transplantation system and to thereby contribute to the public confidence of Canadians.

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THE FORUM PROCESS

Introduction

The forum for *Leading Practices for the Allocation of Organs for Combined Transplantation* was held in Toronto on March 22 -23, 2014. Prior to the meeting, a comprehensive background package was provided to participants and this included; a literature review, a forum participants' survey report, data and legal reviews, overviews of Canadian and international policies, as well as participant biographies.

Over the two days 42 participants with a range of expertise in kidney-related combined transplantation (heart, liver and lung) met to attend presentations and to discuss the agenda topics. In addition to the plenary presentations and discussions participants were organized into small groups for the purpose of addressing specific challenge questions that were created by the Forum Steering Committee. The plenary presentations, as well as the background information, informed the small group discussions so that the participants could formulate proposed guidelines for review by the larger group. The proposed guidelines were revised iteratively until consensus was reached.

Expert speakers

Speaker	**Topic**
Dr. Tom Blydt-Hansen	1. Challenge Address - International Scan Combined Kidney 2. Canadian/International Policies for Eligibility and Allocation
Dr. Jeffrey Schiff	Literature Review
Dr. John Gill	Combined Transplantation SRTR Analysis
Dr. Bryce Kiberd	Medical Decision Analysis
Dr. Marcelo Cantarovich	1. The Quebec Experience 2. CCTN Allocation Document
Dr. Vince Bain	Eligibility for Simultaneous Liver Kidney Transplantation
Dr. Sandra Cockfield	Liver-Kidney Allocation in Alberta

Assumptions

The forum discussions were predicated on previously agreed upon guidelines. These are referred to as *Core Assumptions* which were the agreed-upon "givens" that were used in order to provide a common starting point for reflection, discussion and decision-making. The *Core Assumptions* outlined the perspective within which the process was to unfold and also they helped to ensure that participants were focused on a common purpose and objectives.

Core Assumptions for this forum were as follows;

1. That the following principles guide optimal organ eligibility and allocation:
    - Medical Need - access to ensure health and life
    - Utility - optimal use of a limited resource
    - Justice - equitable access to a limited resource
    - Balance - for competing principles
    - Transparency
    - Accountability
2. That discussions at this forum to be based on the best evidence available.
3. That currently, the patient need for deceased donor organs outstrips supply and as such, result decisions must be made about which patient(s) (among the many waiting), will receive organs for transplantation.
4. That to in developing an organ allocation model medical practice is not dictated, but rather this model will serve a policy framework that is sufficiently flexible to adapt to regional applications.
5. That the proposed allocation model will focus on allocation of deceased donor organs only.
6. That this forum will focus on the most common and frequent challenges related to listing, eligibility and allocation for combined transplants and this agenda will not address "fringe" or unique situations.
7. That the discussion assumes already that the patients have already been deemed eligible for both requested organs.

Key Considerations

The discussions were also informed by the following considerations; the relevant and important circumstances, facts, data and concerns. The participants were instructed that these key considerations were to be taken into account when forming policy because they can potentially impact the success of the combined organ allocation initiative:

- The applicability of combined transplant allocation models utilized by other countries (e.g. UNOS, UK Transplant; Australia) will inform the project

- A combined transplant allocation model will require thoughtful implementation strategies, recognizing the unique needs of regions, programs and health care professionals

In Scope Topics

The following topics were accepted as within the scope of this forum;

- All current single organ allocation algorithms
- Existing combined transplant policies
- Kidney/non-kidney transplants
- Related CIHR research themes

Out of Scope Topics

The following topics were not considered to be within the scope of this forum;

- Bone marrow transplants
- Cellular transplant, particularly islets
- Double kidney transplant
- Double lung transplant
- Double vs. single kidney and double vs. single lung allocation decisions
- Heart-lung transplant
- Intestinal transplants including combined liver-intestinal transplant
- Kidney-pancreas transplant
- Living donors transplant

Definitions

The following definitions were applied to the context of the forum;

- **Simultaneous-Combined Transplant:**

  A patient receives a non-renal organ (heart, lung or liver) and a renal transplant from the same deceased donor within the same transplant procedure or operative time once recipient is stable (whenever the patient is stable and usually within 6 hours after the non-renal organ).

- **Staged-Combined Transplant:**

  A patient receives a non-renal organ (heart, lung or liver) from a deceased donor. Thereafter (the timing may vary), a renal transplant is performed from either a living or a deceased donor.

FORUM CHALLENGE QUESTIONS

The forum challenge questions were developed in advance by the forum steering committee and were informed by the following evidence; literature review, forum participants' survey, legal opinion, policy reports, as well as related background material.

Patient Eligibility Questions

1. What kidney-specific evaluation is required to determine etiology of kidney dysfunction?

2. How should the degree of non-reversible kidney injury be documented?

3. In the absence of other criteria, what duration and level of dysfunction is acceptable for eligibility consideration?

4. Under what circumstance(s) should a staged combined transplant (kidney, different donor) be considered versus a simultaneous combined transplant?

5. Are there any contra-indications specific to simultaneous combined transplantation that should preclude eligibility?

6. In a patient who has end-stage renal disease with dysfunction of a non-kidney organ, should the threshold for eligibility for heart/lung/liver transplants change in the face of need for a kidney transplant?

After the first set of group discussions on eligibility was completed, the Forum Steering Committee met to review results and develop consensus recommendations, which were later returned to plenary for further clarification and discussion.

Allocation Questions

7. Should the highest ranked priority for simultaneous combined transplants follow the non-kidney priority allocation system? (i.e., as interpreted during the forum: Does the kidney follow the extra-renal organ?)

8. Under which circumstances should the kidney priority allocation system take precedence over the non-kidney?

9. Should a simultaneous combined transplant have a higher status in the non-kidney priority allocation system? (Note: the word "status" refers to allocation priority.)

10. Assuming a patient has met the eligibility criteria for a simultaneous combined transplant, should the number of kidneys available be limited?

11. Non-kidney organs allocated to high status candidates are currently considered for inter-provincial sharing. In such a case, if the most suitable recipient is listed for a simultaneous combined transplant, should the kidney be shared inter-provincially as well?

12. Non-kidney organs are currently shared inter-provincially when there is no suitable local or provincial recipient. If the most suitable recipient is listed for a simultaneous combined transplant, should the kidney be automatically shared inter-provincially as well?

13. A patient is eligible and listed for a simultaneous combined transplant but receives the non-kidney transplant first. Should this patient get priority relative to others waiting for a kidney transplant?

14. A patient could have benefitted from a simultaneous combined transplant, but the decision was made to stage the transplant instead. The patient now needs a kidney. Should this patient get priority relative to others waiting for a kidney transplant?

15. A patient has received a non-kidney transplant and post-operatively, has developed non-recoverable Acute Kidney Injury (AKI) requiring renal replacement therapy. Should this patient, get priority relative to others waiting for a kidney transplant?

16. A patient has received a non-kidney transplant in the past and has now, over time, developed end-stage kidney disease and requires a kidney transplant. Should this patient get priority relative to others waiting for a kidney transplant?

After working through the majority of the questions, there remained several questions pertaining to the allocation of kidneys. It was decided to forward these questions to the CBS Kidney Allocation Committee for review and discussion.

Research Recommendations

Several potential areas for future research were noted and collected during the Forum. They were classified into four broad areas for future consideration by the Forum Steering Committee:

- Registry analyses we can do now
- Prospective data collection within the Canadian Registry e.g. CORR
- Interventional studies
- Prospective observational studies

Conclusion

At the adjournment of the forum, all challenge questions had been addressed. However, for some of the questions regarding eligibility, consensus was not reached due to time constraints. As such, the Steering Committee reconvened to consider all feedback expressed during the forum in order to reach a consensus on each of the remaining questions.

The active engagement of participants and their willingness to comment throughout this process demonstrated their commitment to their public accountability with respect to transplantation.

Feedback received from participants at the conclusion of the forum indicated that they were satisfied with the process and outcomes. They also indicated their support for additional research that could be used to gather credible evidence on which future decision-making would be based.

FORUM RECOMMENDATIONS

Overarching Recommendations

Developing an algorithm for combined transplantation requires ongoing review and adjustment as new information and research emerges. Canadian Blood Services is committed to supporting this report as a living document that will evolve as leading practice changes in response to new data and changes in the field.

Combined Transplant Recommendations

The recommendations related to eligibility and allocation presented in this report must be acceptable, useful and adaptable within unique regions across the country. Each jurisdiction is encouraged to adapt the algorithm to suit its particular needs and circumstances, and to implement recommendations in a way that maximizes the use of deceased organs for combined transplantation.

A. ELIGIBILITY RECOMMENDATIONS

A1. Investigate the Etiology and Severity of Kidney Dysfunction

We recommend that EVERY patient being considered for combined transplant should undergo the following:

1. Early nephrology consultation
2. Determination of GFR (measured or serum creatinine--based estimating equation)
3. Renal ultrasound
4. Proteinuria quantification (spot urine or 24 hour urine collection)
5. Urinalysis
6. Identification of known underlying kidney disease (all organs)

We recommend on a case-by-case basis:

1. Renal perfusion study (to assess for cortical necrosis)
2. Renal biopsy to assess chronicity of renal damage, if it can be performed safely
3. Measurement of tubular function (urine Na) for secondary assessment of hepatorenal syndrome or to identify a reversible pre-renal state.

A1. Key Considerations

- The initial kidney evaluation is not organ specific; the same initial kidney evaluation is recommended regardless of which non-kidney organ is being considered for combined transplant
- Eligibility may not require that we know the etiology of kidney disease.
- Qualification for eligibility should be based on the most accurate available measurement of GFR at the institution.

A1. Research Questions[1]

1. What is the most accurate method that can be used to assess the GFR (radionuclide GFR, creatinine-based formulas, cystatin C, etc)?

2. What is the correlation between biopsy findings and reversible kidney dysfunction? How does this correlate with post-transplant renal function of the native kidney such as in a staged transplant?

[1] Research questions noted throughout the report were mentioned during the forum Steering Committee meeting. Additional research questions are noted in the section "Research Listening Post".

A2. Duration and Level of Dysfunction

We recommend the following duration and level of dysfunction as acceptable for simultaneous combined kidney/non-kidney transplant eligibility consideration:

		On Dialysis	GFR <30 not on dialysis	GFR ≥30
Time	<1 month	Possibly eligible*	**Not currently eligible**	**Not currently eligible**
	1-<3 Month	Possibly eligible*	Possibly eligible*	**Not currently eligible**
	>=3 Months	**Eligible**	Possibly eligible*	**Not currently eligible**

** Possibly eligible requires additional criteria to rule-in eligibility for simultaneous combined listing (see Recommendation A3.).*

A3. Documenting the Degree of Non-reversible Kidney Injury

We recommend the following sequence of kidney function tests to determine eligibility for patients deemed "possibly eligible" by level and duration of renal dysfunction (Recommendation A2.):

1. Clinical optimization to see if the decline of the GFR is reversible. If not improved after optimization, then go to (2). *Note: clinical management may be organ specific.*
2. Ultrasound to identify chronically damaged kidneys.

   Kidney ultrasound criteria: Cortical thinning and small kidneys are deemed eligible for listing (i.e. don't need a biopsy). Use radiological criteria to determine small size[2]. If not meeting criteria, then proceed with (3) or (4).

A3. Key Considerations

- There is insufficient evidence to set conclusive criteria for biopsy adequacy toward prognostication of kidney failure.

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[2] Beland, D. Michael et al., August 2010. *Renal Cortical Thickness Measured at Ultrasound : Is it Better Than Renal Length as an Indicator of Renal Function in Chronic Kidney Disease?"* American Roentgen Ray Society. Vol 195, pp. 146-149.

3. Biopsy for evidence of permanent damage may be considered. The Biopsy criteria used to support eligibility is based on limited evidence and expert opinion of three Canadian pathologists and forum participants. Previous reports have considered >30% (glomerulosclerosis) cut-off, but without supporting data. Biopsy testing to determine eligibility has not been prospectively validated.

   Kidney biopsy criteria: Minimal sample adequacy – 20 glomeruli from at least 2 cores. Patients with ≥75% glomerulosclerosis AND ≥75% interstitial fibrosis are likely to have irreversible kidney damage.

   Patients with <50% glomerulosclerosis AND <50% interstitial fibrosis are likely to have potential for recovery of function, and may not immediately benefit from combined transplantation.

4. If biopsy not possible or if biopsy is inconclusive:

   History and duration of CKD criteria (adapted from the National Kidney Foundation Kidney Disease Outcome Quality Initiative [KDOQI] definition)

   a. Kidney damage for greater than or equal to 3 months as defined by structural or functional abnormalities of the kidney with or without decreased GFR, manifested by: pathologic abnormalities, or markers of kidney damage which include abnormalities in the composition of blood or urine or abnormalities in imaging tests; and

   b. CKD Stage 3-5 for at least 3 months prior to the onset of end-stage liver/heart/lung disease

   c. This establishes a history of chronic kidney disease and progression toward end-stage, sufficient for combined simultaneous organ transplant eligibility.

A3. Key Considerations (continued)

Greater than 20 glomeruli may be optimal for quantification of chronic injury and >-10 considered a minimum sample.

- A biopsy is not being done so much to identify etiology, rather to assess reversibility of kidney dysfunction.
- Frozen section is not supported by evidence, as adequate to assess for signs of chronic damage.

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A3. Research Questions

1. What is the role of the renal biopsy in determining the reversibility of renal dysfunction and eligibility for kidney transplantation?
2. What is the association of dialysis duration with regard to renal recovery, specifically after a liver-only transplant? The existing data, in particular for prospect studies, with regard to duration of dialysis exposure based on administrative data is inadequate.

A4. Staged Combined Transplants

We recommend considering a staged combined transplant (with a different donor) under the following circumstances when:

- uncertainty exists as to the irreversibility of kidney dysfunction
- physiological instability is expected as it relates to the non-kidney organ transplant procedure such that it may affect the recovery of kidney function after kidney transplantation. In this case, a planned staged procedure is preferred over a simultaneous procedure
- there is a medically approved living donor for one of the transplants
- no kidney is available at the time of the non-kidney transplant (at offer)

- there are donor-specific antibodies (DSA) detected against the proposed donor for the combined kidney transplant, notwithstanding that the DSA status is not a contraindication for the non-kidney transplant.

A4. Key Considerations

- There is insufficient data to determine whether staged combined transplantation may be preferred to simultaneous combined transplantation, or whether considering allocation priority for a staged kidney transplant would improve its favourability.

A4. Research Questions

1. What is the outcome assessment of patients who receive a staged non-kidney and kidney transplant within a short period of time (e.g., 3 months) vs. simultaneous combined transplants?

A5. Recommendations against Eligibility

We recommend that patients in the following situations not be considered eligible for simultaneous or staged combined transplants. This recommendation presumes no contraindication to either the single organ kidney or the non-kidney transplant on its own.

1. Expected 1-year mortality of > -20%
2. Expected 5-year mortality > -50%
3. Patients wait-listed for heart transplant as "status 4"[3]
4. Clinical trial for experimental criteria for extended eligibility of the non-kidney organ (i.e. don't meet current eligibility for single organ transplant).
5. High expected peri-operative mortality risk precludes consideration of simultaneous kidney after non-kidney (combined) transplant.

A5. Research Questions

1. What is the impact of hepatitis C on patient and allograft survival in the context of combined transplantation, in particular the impact of antiviral therapy on HCV recurrence?
2. What models would better predict short and long-term mortality for all solid organ transplants?

[3] Status 4 heart:

1. Mechanically ventilated patient on high-dose single or multiple inotropes ± mechanical support (eg. Intra-aortic balloon pump, extra-corporeal membrane oxygenation (ECMO), abiomed BVS5000, or biomedicus), excluding long-term ventricular assist devices (VAD).
2. Patient with VAD malfunction or complication, such as thromboembolism, systemic device-related infection, mechanical failure, or life-threatening arrhythmia
3. VAD in a patient <8 kg

A6. Early Eligibility for a Non-Kidney Organ Transplant in the Face of End-Stage Renal Disease

We recommend that patients with end-stage renal disease and non-kidney organ disease, but not yet meeting the criteria for non-kidney transplant alone, have their eligibility changed to allow a simultaneous combined transplant (to improve access). Specific criteria need to be determined by each organ group as follows:

1. Lung - cystic fibrosis and/or advanced COPD
2. Liver - primary oxalosis, atypical hemolytic uremic syndrome, and other primary enzyme replacement in rare hereditary metabolic diseases. These patients are indicated for liver transplant but do not accrue sufficient MELD points (Model for End Stage Liver Disease), thus affecting allocation priority (as addressed in the allocation section of this report).
3. Kidney - portal hypertension in compensated cirrhosis with risk of de-compensation at time of kidney transplant. Polycystic liver and kidney disease with severe mass effect in the face of acceptable synthetic function.
4. Heart - amyloidosis

A6. Key Considerations

- The proposed scenarios for early eligibility apply to circumstances where the kidney transplant would not be possible e.g. due to mortality attributable to the other failing organ without performing a combined transplant.

B. ALLOCATION RECOMMENDATIONS

The following principles have been tested in consultations across Canada and endorsed by the Canadian Blood Services' Organ Expert Group have been used to guide optimal organ eligibility and allocation:

- Medical need - access to ensure health and life
- Utility - optimal use of a limited resource
- Justice - equitable access to a limited resource
- Balance of competing principles
- Transparency
- Accountability

B7. Priority Ranking

We recommend that increased priority ranking be considered only for eligible patients who have been accepted for simultaneous combined transplant. For these patients, the non-kidney organ allocation priority dictates the kidney allocation.

B8. Kidney/Non-Kidney priority allocation

We recommend that in the rare circumstance where patients with end-stage kidney disease cannot be transplanted except by combined transplantation, that the kidney allocation priority dictates the non-kidney allocation under the following circumstances:

- Medical urgency (as defined by kidney listing status)
- Eligibility criteria listed under A6.

B8. Key Considerations

- Medical high priority (kidney status) is <1% of patients.

B9. Priority of Simultaneous Combined Transplant in the Non-Kidney Priority Allocation System

We recommend that a simultaneous combined transplant have a higher status in the non-kidney priority allocation system in specific situations. These are already incorporated into an existing allocation algorithm for non-kidney organs.

****Status 2 ADULT***:
In hospital patient on outpatient inotropic therapy not meeting above criteria.
1. Adult with cyanotic CHD: resting O^2 saturation 65-75% or prolonged desaturation to less than 60% with modest activity (ie. walking).
2. Adult with Fontan palliation with protein-losing enteropathy.
3. Patients listed for multiple organ transplantation (other than heart-lung).

Status 1 ADULT:
All other out of hospital patients.

Status 2 PAEDS:
1. At home with intermittent CPAP/BIPAP support for *HF management.*
2. In hospital for management of *heart disease/HF* not meeting above criteria.
3. Growth failure:<5^{th} percentile for weight and/or height OR loss of 1.5 SD of expected growth (weight or height).
4. Cyanotic congenital heart disease with resting saturation 65-75% OR prolonged desaturation to less than 60% with modest activity (ie. walking, feeding)
5. Fontan palliation with protein-losing enteropathy or plastic bronchitis.
6. Multiple organ transplant recipient candidates.

Status 1 PAEDS:
1. All other out of hospital patients.
2. In Utero (congenital heart disease or heart failure.

Status 4 S:
1. High PRA (>80%)

B9. Key Considerations

- Heart: Currently elevates status 1 to 2^*
- Liver: Patients sometimes get extra MELD points to support them qualifying for a simultaneous combined transplant and also to move them higher in the range of allocation eligibility. These patients will move higher due to renal disease on MELD. There is no specific priority over and above what is implicit in MELD.
- Lung: Patients do not become a higher priority unless they have high priority status for kidney.

B10. Kidney Availability for Simultaneous Combined Transplants

We recommend that at present there be no limit to the number of kidneys available for patients meeting the eligibility criteria for simultaneous combined transplants.

- No additional criteria given.

B10. Key Considerations

- The best interest of the patient is the first consideration.
- Simultaneous combined transplants will represent only a limited number of transplants; overall waiting times should not be significantly affected

B11. High Status Inter-Provincial Kidney Sharing

We recommend that in such a case, if the most suitable recipient is listed for a simultaneous combined transplant, the kidney should also be shared inter-provincially.

- High status non-kidney organs are currently shared inter-provincially.

B11. Key Considerations

- Organs currently being shared are limited to heart status 4 and 4S and liver status 3F/4F.[1] These will be rare situations.

B12. Inter-Provincial Organ Sharing

We recommend that if the most suitable recipient is listed for a simultaneous combined transplant, the kidney should automatically be shared inter-provincially as well.

- Non-kidney organs are currently shared inter-provincially when there is no suitable local or provincial recipient.

B12. Key considerations

- This sharing needs to be linked to a balancing system to ensure that programs that disproportionately export organs are not disadvantaged

B13. Priority for Kidney after Non-Renal Transplant

We recommend that a patient who is eligible and listed for a simultaneous combined transplant, but only receives the non-kidney transplant (the kidney is not transplanted), should be given priority for a staged kidney transplant.

Assuming there is a net survival benefit to combined transplantation, compared with those waiting on the kidney alone list, the priority given should be between 'b' and 'c' on the list below:

a. Medical urgency

b. Highly sensitized

c. Same as kidney/pancreas, pediatric, 0 mismatch HLA-A, B, DR

d. Wait time

B13. Key Considerations

- The allocation principle considered here is the increased medical need of these patients

B14. Priority for Kidney in Staged Combined Transplant

We recommend that a patient get priority relative to others waiting for a kidney transplant, (and that the priority be positioned between 'b' and 'c' on the list below), for the following situation: when a patient is eligible for a simultaneous combined transplant and the decision was made to stage the transplant. The patient receives a non-kidney transplant and now needs a kidney.

In this setting, we recommend that

a. Medical urgency

b. Highly sensitized

c. Same as kidney/pancreas, pediatric, 0 mismatch HLA-A, B, DR

d. Wait time

This is the same priority as recommended in B13.

B14. Key Considerations

- If increased priority remains available after the non-kidney transplant, this option may be preferred.
- There are circumstances where the benefit of combined transplant may be improved with a staged procedure or when there remains doubt about the likelihood of renal recovery (see Recommendation A4).
- Instability related to the non-kidney transplant may be deleterious to the kidney transplant if performed simultaneously, and a staged procedure may improve kidney outcome.
- Maintaining priority for a kidney in a staged procedure may reduce the number of kidney transplants required, since some native kidneys may recover.
- In the situation where an available living donor (for staged transplant) is no longer able to donate, similar priority should be available for a deceased donor kidney

B14. Research Questions

1. Can we quantify the number of planned staged transplants where the kidney transplants (living or deceased) was subsequently not required?

B15. Priority for Kidney after Post-Operative Irreversible Renal Failure

We recommend that a patient that has received a non-kidney transplant and post operatively has developed renal failure, is now dialysis dependant, get a priority relative to others waiting for a kidney transplant under the following conditions.

- In retrospect, the patient was "possibly eligible" by GFR/duration of dysfunction criteria but did not at the time meet criteria to document non-reversible kidney injury (see A3).
- Met eligibility criteria but was not recognized as eligible for combined transplant prior to the non-kidney transplant, then we recommend they receive priority similar to B14.

B16. Priority for Prior Non-Kidney Transplant Recipients

We recommend that a patient that has received a non-kidney transplant in the past and has now, over time, developed end-stage renal disease and requires a kidney transplant not get priority relative to others waiting a for a kidney transplant – the patient should follow the normal priority

- No additional criteria listed.

B16. Key Considerations

- Currently, increased priority is not considered for existing co-morbidities according to the current kidney allocation criteria. There is limited data to justify increased priority.

B16. Research Questions

1. What is the mortality experience of non-kidney transplant recipients waiting for a kidney transplant compared to other ESRD patients without prior non-kidney transplants?

Research Listening Post

Throughout this forum Drs. John Gill and Joseph Kim noted potential research topics that could be pursued in order to support further evidence-informed decision-making as related to combined transplantation.

1. Registry analyses that can be done now

a. Compare survival difference between kidney transplant recipients and wait-listed kidney only transplant candidates vs. survival difference between SLK and OLT (on dialysis/ who were WL for SLK)

b. Repeat (a) for heart transplants

c. While there are smaller total numbers of combined transplants in Canada, this allows for focus on the decision-making process around eligibility and allocation

d. Conduct HLA typing and HLA antibody/DSA assessment in greater detail in order to determine if combined transplant from same donor has immunologic privilege

e. Capture data on longitudinal experience of patients while on the waiting list

f. Collect data on indications for starting/ stopping dialysis/date of start

g. Assess survival as a function of duration of dialysis; number of patients coming off dialysis is important to ascertain but, at present, it is unclear if patient comes off dialysis unless they get kidney after liver transplant (but information may be available through linkage with USRDS)

h. Stratify analyses that assess the impact of duration of dialysis on OLT vs. SLK survival by acute vs. chronic liver decompensation (this may explain no survival difference for patients on dialysis for >6 months)

i. Study the time-dependent analysis of patients receiving kidney after liver transplants to ensure that time prior to kidney but after liver transplant is appropriately attributed

j. Capture data on the intent to do combined transplant where only a single organ transplant was completed and include reason(s) why combined transplant was not done.

k. Conduct a rigorous analysis of early mortalities after liver only transplantation as this may be helpful in deciding which patients would not likely benefit from adding a kidney

l. Develop clear relative risk measures of mortality in liver transplant recipients on chronic dialysis vs. non-transplant patients on dialysis; and in doing so, clearly distinguish between waitlisted vs. non-waitlisted patients in both groups

2. Prospective data collection within Canadian Registries (e.g., CORR)

a. Collect biopsy findings and determine the impact on decision-making and prognosis (specifically examine the role of degree of vascular disease). This could also fall under (4, below)

3. Interventional studies

a. Compare simultaneous vs. staged (with priority for kidney)

b. Compare staged (with priority for kidney) vs. staged without priority (this could be a sequential randomized single study)

4. Prospective observational studies

a. Estimation of kidney function radionuclide GFR vs. serum creatinine-based equations in decision-making about eligibility and prognosis

b. Determine subsequent survival of patients who received combined transplant and then developed end-stage renal disease

APPENDICES

APPENDIX A: LITERATURE REVIEW

Leading Practices for the Allocation of Organs for Combined Transplantation

March 22-23, 2012
Toronto, ON
Literature Review
Updated February 2014

Canadian Society of Transplantation
LEADERSHIP IN CANADIAN TRANSPLANTATION

Canadian Blood Services
Société canadienne du sang

INTRODUCTION

Organ transplantation is an established treatment for selected patients with end-stage organ disease. As the results of transplantation have improved, patients with more co-morbidities are being assessed for transplant. In some cases, this includes patients who would benefit for transplantation of more than one organ.

With respect to terminology, distinction should be made between simultaneous organ transplantation, when the organs are allocated and transplanted in a single operation versus sequential organ transplantation, where a patient receives one organ transplant, and then a second, different organ some time later.

Sequential transplants may occur over a matter of hours. For example, some centers have first performed a liver transplant in a patient requiring liver and kidney transplants but whose cross- match test is positive. After the liver transplant, the cross-match test is then repeated before deciding whether they should proceed with kidney transplantation. Sequential transplants can also be separated by weeks, months or years. An example of this is a patient who requires both a liver and kidney transplant, and receives a liver transplant first. After recovering from the liver transplant, they would then be waitlisted for a kidney transplant. Another example would be a patient who receives a heart transplant, progresses to end-stage renal disease several years later and is then listed for a kidney transplant.

Combined organ transplantation requires balancing the potential benefit to the patient who receives more than one transplant, with the fact that these organs could have been used to help two separate patients. In addition, since patients who require a combined organ transplant are generally sicker at the time of transplant, results of combined organ transplant may not be as good as for patients who only have one end-stage organ disease. Furthermore, allocation algorithms vary by organ as well as by geographic location. Therefore, there is uncertainty as to whether patients who require a combined organ transplant should receive priority ahead of those who require only a single-organ transplant, or treated in the same manner.

Another complicating factor is that the most common organ in a combined organ transplant is the kidney. However, in patients with end-stage organ disease, assessment of renal function is often complicated by a number of factors. One of these includes the loss of muscle mass, which results in a lower serum creatinine value and therefore can lead to an overestimation of renal function. Other conditions, such as hepatorenal syndrome and heart failure will also affect renal blood flow and lead to renal hypoperfusion. This will result in an underestimation of true renal function. Both of these problems exist with creatinine-based equations that are used to estimate renal function (such as the MDRD or CKD-Epi eGFR) and measure creatinine clearance by 24-hour urine collection.

The purpose of this paper is to review the literature on combined organ transplantation, in order to inform the decision-making process of this forum.

METHODS

A literature search was conducted to identify articles relevant to the topic of combined organ transplantation. Studies were limited to English language, and to the time period 1990 to August 2011. The search included articles regarding indications for multiple-organ transplants, comparisons to treatments other than transplant, and risk factors for death post-transplant. Other criteria included articles using results from registries, results of consensus conferences and cost-effectiveness studies. A comprehensive search strategy was created by a hospital librarian with experience designing such searches, and was conducted in both the MEDLINE and EMBASE databases. The full search strategy is presented in Figures 1 and 2.

The initial search yielded 2308 articles. An initial review of these articles and abstracts was performed with the following inclusion criteria:

- All articles had to refer to some type of combined organ transplant, such as liver-kidney, lung-kidney, heart-kidney, heart-liver or lung-liver transplant.
- Written in English

Articles that met those two criteria had to fulfill at least one of the following four criteria:

- Presented data regarding indications for listing for combined organ as opposed to single organ transplant
- Presented outcomes of combined organ transplantation
- Presented data regarding allocation of organs for combined organ transplant
- Presented data on the impact of pre-transplant renal function on the risk of developing end-stage renal disease post-transplant.

Exclusion criteria included the following:

- Articles which specifically excluded combined organ transplants
- Animal or experimental models
- Studies examining physiological parameters, pathophysiology or laboratory results without relation to outcome
- Kidney-pancreas transplantation or heart-lung transplantation, which are outside the scope of this conference
- Articles about donation or donor management

- Post-transplant complications, such as infections post-transplant
- Duplicate articles

After this initial review there was a full review conducted of the remaining 284 articles. In this step, the following types of articles were excluded: case reports, case series which incidentally included combined transplants (e.g. 1 heart-kidney patient in a series of 174 heart transplants), earlier papers which reported registry results when subsequent papers included the patients in the earlier papers, papers which described surgical techniques or modifications, non-English language of publication, editorials, letters to the editor, commentary, review articles, articles regarding intestinal transplantation, articles published only as a conference abstract or in Transplantation Proceedings, which had not undergone full peer review.

Of the 284 articles initially identified, 71 articles were selected for further review. Of these, two references have not been obtained as of this time. Also, additional articles were incorporated as found through hand-searching the references of these articles, or other articles previously identified that were relevant to this area.

After discussion by the Forum Steering Committee, it was decided that the forum would focus only on liver-kidney, heart-kidney and lung-kidney transplants. Therefore, 9 more papers were excluded, 5 of which relate to heart-liver transplantation and 4 to lung-liver transplantation.

Subsequent to the forum in March 2012, an updated literature review was conducted. The same search strategy was used, and expanded to include articles published between August 2011 and August 2013. A total of 867 articles were identified. Of these, 161 articles were selected for detailed review as well as the inclusion of 13 additional articles.

RESULTS

A. General

In total, 60 papers were found that were relevant to liver-kidney transplantation and 17 to heart-kidney transplant. Only a single paper was found for inclusion on combined lung-kidney transplant, although there are case reports and small case series on such transplants. Two papers were counted twice, one with data on liver-kidney and heart-kidney transplants, and the other presenting data on heart-kidney and lung-kidney transplants.

The results of the literature search are presented in Tables 3, 4, and 5 at the end of this Appendix.

Clinical practice guidelines have been previously published regarding the role of combined liver-kidney transplantation in patients with hemolytic-uremic syndrome. Not surprisingly, there were no

randomized controlled trials comparing a strategy of combined-organ transplantation to transplantation with a single organ. Also, apart from the papers mentioned below regarding liver-kidney transplant, there were no papers identified that laid out explicit criteria to help select patients for combined-organ as opposed to single-organ transplant. None of the papers found gave evidence to decide on how combined organ transplants should be allocated compared to single organ transplants.

The following six papers could not be categorized as above. One paper compared outcomes of kidney transplant following liver, lung or heart transplant to renal transplant alone. Two papers included only patients with hepatorenal syndrome who were referred for liver transplant. The papers used a group of patients who underwent liver transplant alone to predict risk factors for chronic kidney disease or end-stage renal disease post-transplant. Finally, one paper used the UNOS registry to compare the outcomes of a variety of combined organ transplants to that of single organ transplants.

B. Liver-kidney transplantation

Of the 60 articles selected, 14 papers were registry analyses, 13 of which were based on US data (UNOS, OPTN and SRTR); data from the Canadian Organ Replacement Registry (CORR) was used in one paper. Seven papers were case-control studies, six of which were single-center studies, and one of which was performed through the Collaborative Transplant Study registry. Two papers were paired-kidney studies, both of which used data from UNOS. One paper was a medical decision analysis based on UNOS data, and the remainder were almost all single center studies presenting a group of patients who received a liver-kidney transplant, and compared them to that center's cohort of liver or kidney transplants alone over that period.

A Canadian registry analysis showed that liver transplant patients on dialysis had worse outcomes than liver transplant patients without ESRD and a matched cohort of patients with ESRD alone. Survival after kidney transplant was similar for patients with and without a liver transplant (Al Riyami, 2007).

Most, but not all, registry studies showed that recipients of a combined liver-kidney transplant had worse outcomes than recipients of an isolated liver or kidney transplant. This difference appeared to be mainly due to early deaths which related to the increased morbidity of these patients at the time of transplant (Fong, 2003; Baccaro, 2010). However, at least one study showed improved survival of simultaneous liver-kidney transplants as compared to liver transplant alone after adjustment for demographics and other variables (Martin, 2012). In addition, studies that were restricted to patients with renal dysfunction at the time of transplant showed better outcomes with a simultaneous liver-kidney transplant than with liver transplant alone (Fong, 2012). Of note, many of these studies included patients from both the pre-MELD and MELD eras in the US.

Lower levels of renal function are a well-recognized risk factor for worse outcomes post-liver transplant, including ESRD post-transplant (Gonwa 2009, Fong 2012, Ruebner 2012). One study found that patients over the age of 65 who were on dialysis at the time of liver or liver-kidney transplant had significantly worse outcomes (Dellon, 2006). In one paper, the risk of ESRD post-liver transplant was particularly higher in diabetics with whose renal function fluctuated but on average had eGFR < 30 ml/min in the three months pre-liver transplant. This study mainly included patients from the pre-MELD era, and

therefore these patients may have been sicker at the time of transplant than such patients in the current era.

Several papers have suggested that recipients of a combined liver-kidney transplant have lower rates of acute rejection than a kidney transplant alone (e.g. Fong, 2003; Simpson 2006; Creput 2003; de la Cerda, 2010). However, many of these studies were based on registry records for acute rejection and older tissue typing methods. Whether these purported immunologic benefits are still valid in the current era of flow cross-matching and single-antigen testing is uncertain. One single-center cohort showed worse patient and renal allograft survival among liver-kidney transplant recipients with a positive cross-match (Saidman, 1994). One SRTR registry study showed worse outcomes following liver-kidney transplant among sensitized and positive T-cell cross-match patients (Askar, 2011). In addition, two case series showed a high rate of acute humoral rejection among liver-kidney transplant recipients transplanted who had donor-specific antibodies (DSA) at the time of transplant, particularly class II antibodies (Dar, 2011; O'Leary, 2013).

Determination of which patients should receive liver-kidney transplant as opposed to kidney transplant was assessed in few papers. One case series of 44 patients reported that renal biopsy was performed if patients were on renal replacement therapy for less than eight weeks; or, had an iothalamate or calculated GFR less than 40 ml/min and also where there was uncertainty by history and previous investigations about whether they would likely recover renal function post-liver transplant. In that study, the criteria to proceed with liver-kidney transplant required one of: interstitial fibrosis > 30%; global glomerulosclerosis > 40%; or membranoproliferative glomerulonephritis involving > 50% of glomeruli. These criteria were based on a conference abstract and a peer-reviewed paper both of which have not been published. It should be noted that these biopsy criteria, along with a GFR < 30 ml/min, were cited in the consensus conference organized in the US in 2006 (Davis, 2007), and in part in the 2012 consensus conference (Nadim, 2012). Similar criteria were used in one case series (Tanriover, 2008).

C. Heart-kidney transplant

Out of 17 papers, 7 were analyses of a variety of registries, including UNOS, CORR, ISHLT as well as a survey of all British heart transplant centers. There were two case-control studies, one of which was a single center study, and the other that was based on data from the Collaborative Transplant Study. Seven papers were single-center cohort studies, and one paper was based on the aggregated results from cohorts at three French centers.

A Canadian registry analysis showed that heart transplant patients on dialysis have worse outcomes than heart transplant patients without ESRD and a matched cohort of patients with ESRD alone. Much of this increased risk of death was reversed by kidney transplantation (Alam, 2007).

Depending on the comparison group, registry studies have shown both better and worse outcomes of heart-kidney transplant. The British survey showed worse outcome of heart-kidney transplants, but this was in comparison to all heart transplant recipients (Chikwe, 2002). Another registry study also found no difference in patient survival, and less rejection in heart-kidney transplants (Narula, 1997). With

adjustment for baseline factors, a more recent registry study found a decreased risk of death with heart-kidney transplant compared to heart transplant, but a higher risk of graft loss compared to kidney transplant recipients. Of note, patients who were not on dialysis at the time of heart-kidney transplant did not receive a survival advantage compared to isolated heart transplant. In addition, heart-kidney transplant patients had a lower risk of acute rejection than recipients of an isolated heart or kidney transplant (Gill, 2009). Another registry study of US data showed survival of heart-kidney transplant recipients to be similar to heart transplant alone and worse than kidney transplant alone. This study did demonstrate a survival benefit of heart-kidney transplant compared to remaining on the waiting list (Wolf, 2013). It was also the largest study of heart-kidney transplant recipients, with 684 patients over a 24-year period. This is an average of less than 30 patients per year, although the rate of such transplants is increasing.

Several case-control and cohort studies have shown similar or a lower rate of acute rejection in heart-kidney transplant compared to heart transplant (Vermes, 2001; Blanche, 2001; Groetzner, 2005; Hermsen, 2007; Luckraz, 2003; Kebschull, 2013). At least one study showed decreased chronic cardiac rejection among heart-kidney recipients (Pinderski, 2005).

The only lung-kidney study included was a registry study based on UNOS data. Recipients of a lung-kidney transplant had similar patient survival compared to a lung transplant alone, but worse than kidney transplant alone. There was no survival benefit of a lung-kidney transplant as compared to remaining on the waiting list. However, the number of lung-kidney transplants in this study was small (n=41), especially given the long time period of this study (1987-2010).

CONCLUSIONS

In summary, the data on which to make decisions about eligibility and allocation for combined organ transplant are limited. Even the largest registry study of simultaneous liver-kidney transplants contains only 2327 patients transplanted over a 20-year period. This is an average of only 116 patients/year, although the rate of liver-kidney transplants has increased significantly in the MELD era. While combined-organ transplantation may be associated with a higher risk compared to single-organ transplant, the results are still often acceptable. There have been some attempts to create rules as to which patients should receive a single versus a combined organ transplant, but these have not been validated in a variety of populations outside the centers in which they were created. There may be immunologic benefits to combined organ transplant. However, these benefits may no longer be present in the era of highly specific antibody testing, and may not necessarily translate to improved outcomes.

Table 1: Search strategy used in MEDLINE

#	Searches	Results	Search Type
1	organ transplantation/ or exp heart transplantation/ or kidney transplantation/ or liver transplantation/ or exp lung transplantation/	148065	Advanced
2	(heart-kidney or liver-kidney or lung-kidney or heart-liver).ti,ab.	14492	Advanced
3	(simultaneous adj3 transplant:).mp.	1126	Advanced
4	(combined adj4 transplant:).mp.	2559	Advanced
5	2 or 3 or 4	17755	Advanced
6	1 and 5	2747	Advanced
7	exp cohort studies/	1124315	Advanced
8	exp prognosis/	832907	Advanced
9	exp morbidity/	303133	Advanced
10	exp mortality/	239283	Advanced
11	exp survival analysis/	141238	Advanced
12	exp models, statistical/	205078	Advanced
13	prognos*.tw.	288284	Advanced
14	predict*.tw.	678044	Advanced
15	course*.tw.	391999	Advanced
16	diagnosed.tw.	264541	Advanced
17	cohort*.tw.	181429	Advanced
18	death.tw.	369517	Advanced
19	mo.fs.	354086	Advanced
20	indications.tw.	107687	Advanced
21	listing criteria.tw.	66	Advanced
22	or/7-21	3478830	Advanced
23	6 and 22	1684	Advanced
24	limit 23 to yr="1990 -Current"	1609	Advanced
25	limit 24 to english language	1459	Advanced

Table 2: Search strategy used in EMBASE

#	Searches	Results	Search Type
1	organ transplantation/ or exp heart transplantation/ or exp kidney transplantation/ or exp liver transplantation/ or exp lung transplantation/	197474	Advanced
2	(heart-kidney or liver-kidney or lung-kidney or heart-liver).ti,ab.	16198	Advanced
3	(simultaneous adj3 transplant:).mp.	1376	Advanced
4	(combined adj4 transplant:).mp.	3187	Advanced
5	or/2-4	20160	Advanced
6	1 and 5	3530	Advanced
7	exp mortality/	472442	Advanced
8	exp survival/	396554	Advanced
9	follow-up.mp.	797628	Advanced
10	ep.fs.	791613	Advanced
11	prognos:.tw.	356580	Advanced
12	survival.tw.	535336	Advanced
13	treatment indication/	83309	Advanced
14	listing criteria.tw.	87	Advanced
15	kidney transplantation combined with other organs: experience of Bologna.m_titl.	1	Advanced
16	outcomes of simultaneous heart-kidney transplant in the US.m_titl.	1	Advanced
17	proceedings of consensus conference on simultaneous liver kidney transplantation.m_titl.	1	Advanced
18	simultaneous liver kidney transplantation: a medical decision analysis.m_titl.	1	Advanced
19	clinical practice guidelines for management of atypical haemolytic uraemic syndrome in the United Kingdom.m_titl.	0	Advanced
20	or/15-19	4	Advanced
21	or/7-14	2527120	Advanced
22	6 and 21	1946	Advanced
23	limit 22 to (english language and yr="1990 -Current")	1623	Advanced
24	limit 23 to embase	1514	Advanced
25	20 or 24	1514	Advanced

REFERENCES

Table 3: LK-Case Control, Cohort Studies

First Author	Type of Study	Transplant Period	Patient Group # 1	# of Combined Transplant Patients	Patient Group # 2	# of Patients in Comparison Group	Key Results
Baccaro, 2010	Single-center, case-control study	1994-2004	Liver-kidney transplant	20	Liver transplant without chronic kidney disease	60	One-year patient and graft survival lower with LK transplant, no difference at three years.
Creput, 2003	Single center, case-control study	1986-1999	Liver-kidney transplant	45	Kidney transplant	86	Rate of acute renal rejection lower in LK transplant compared to kidney alone.
de la Cerda, 2010	Single center, case-control study and registry study	1995-2007	Liver-kidney transplant	10	Kidney transplant alone	20	Pediatric patients only. Lower acute rejection rate with LK transplant in both the case-control study, and in the pediatric UNOS database.
Moreno-Gonzalez, 2004	Single center, case-control study	1986-2001	Liver-kidney transplant	16	Liver transplant	48	No difference in survival between the two groups.
Opelz, 2002	Case-control study (Collaborative Transplant Study)	1985-2000	Liver-kidney and heart-kidney transplant	Liver-kidney (n=383), heart-kidney (n=105)	Kidney transplant	1083	Lower kidney survival at 1 year for LK transplant compared to kidney alone, but equal at 8 years post-transplant.

First Author	Type of Study	Transplant Period	Patient Group # 1	# of Combined Transplant Patients	Patient Group # 2	# of Patients in Comparison Group	Key Results
Van Wagner, 2009	Single center case-control study	1999-2007	Liver-kidney transplant	38	Liver transplant	38	HCV+ patients only. No difference in long-term patient and graft survival or time to HCV recurrence.
Wu, 2008	Single center, case-control study	1999-2006	Liver-kidney transplant	19	Liver transplant	50	Single-center in China. Lower patient survival among LK recipients, accounted for by deaths during first month post-transplant.
Bahirwani, 2008	Single center, cohort study	2000-2005	Liver-kidney transplant	13	Liver transplant	60	All patients with serum creatinine > 1.5 mg/dL pre-transplant. Patients with renal dysfunction > 12 weeks pre-transplant had higher risk of eGFR < 20 ml/min post-transplant.
Becker, 2003	Single center, cohort study	1984-2000	Liver-kidney transplant	38	Sequential liver-kidney transplant (either order)	9	Good results with simultaneous liver-kidney transplant. Outcome of kidney after liver transplant better than liver after kidney transplant.
Benedetti, 1996	Single center, cohort study	1980-1994	Liver-kidney transplant	16			Rejection rate in LKT similar to liver or kidney transplant alone.
Brinkert, 2009	Single center, cohort study	1995-2009	Liver-kidney transplant	7	Liver transplant	6	All pediatric patients with primary hyperoxaluria type I. Low mortality rate, and catch-up growth seen in most cases.

First Author	Type of Study	Transplant Period	Patient Group # 1	# of Combined Transplant Patients	Patient Group # 2	# of Patients in Comparison Group	Key Results
Brown, 1996	3 center study (NIDDK Liver Transplantation Database)	1990-1994	Liver-kidney transplant	23	Liver transplant	805	Patient and graft survival at 1 year worse for patients on dialysis who received renal transplant alone compared to LK transplant.
Campbell, 2005	Single center, cohort study	2000-2003	Liver-kidney transplant	13	Liver transplant	53	Patients with serum creatinine > 1.5 mg/dL pre-transplant. Duration of renal dysfunction pre-transplant more important than etiology in predicting renal outcome post-transplant.
Hanish, 2010	Single center, cohort study	2000-2007	Liver-kidney transplant	36	Kidney transplant alone	1283	No difference in patient survival between groups. Lower rate of antibody-mediated rejection in LK group.
Martin, 2008	Single center cohort study	1998-2006	Liver-kidney transplant	5			Patients with polycystic liver and kidney disease receiving pre-emptive renal transplant with liver transplant. Native kidneys continued to function well post-transplant.
Monico, 2001	Single center, cohort study	1968-2000	Liver-kidney transplant	9	Kidney transplant alone	10	Patients with primary hyperoxaluria. Recommend liver-kidney transplant for patients with type I primary hyperoxaluria.

First Author	Type of Study	Transplant Period	Patient Group # 1	# of Combined Transplant Patients	Patient Group # 2	# of Patients in Comparison Group	Key Results
Perera, 2009	Cohort study	1994-2008	Liver-kidney transplant for primary hyper-oxaluria type I	9	Simultaneous liver-kidney transplant for other causes	14	Pediatric patients only. Delayed recovery of renal function with primary hyperoxaluria but excellent long-term results.
Rasmussen, 1995	Single center cohort study	1984-1993	Liver-kidney transplant	21	Kidney or Liver transplant	Kidney (n=231), liver (n=457)	Lower rate of acute rejection and better graft survival with LK transplant compared to kidney transplant alone.
Rogers, 2001	Single center cohort study	1984-1995	Liver-kidney transplant	8	Sequential liver-kidney transplant (either order)	7	Pediatric patients only. Lower acute rejection rate with simultaneous LK transplant, but no difference in patient or graft survival.
Ruiz, 2010	Single center cohort study	1985-2007	Liver-kidney transplant	75			No difference in outcome of LKT based on need for dialysis at time of transplant. Very poor survival in patients receiving LKT as a re-transplant.

First Author	Type of Study	Transplant Period	Patient Group # 1	# of Combined Transplant Patients	Patient Group # 2	# of Patients in Comparison Group	Key Results
Ruiz, 2006	Single center cohort study	1988-2004	Liver-kidney transplant	99	Liver transplant alone with hepato-renal syndrome or kidney transplant	Liver (n=148), kidney (n=743)	Good outcomes overall with LK transplant. No difference of LK transplant compared to liver transplant alone in patients with hepatorenal syndrome for less than 8 weeks. Lower acute rejection rate with LK transplant.
Saidman, 1994	Single center cohort study	1983-1992	Liver-kidney transplant with a positive cross-match	6	Liver-kidney transplant with a negative crossmatch	32	Worse patient and graft survival in patients with a positive cross-match.
Ueno, 2006	Single center cohort study	1987-2003	Liver-kidney transplant	5	Liver transplant	9	Patients with polycystic liver disease. Good results with LK transplant.
Hibi, 2012	Single center cohort study	2000-2010	Liver-kidney transplant	74	Kidney transplant	544	Better patient and graft survival with kidney transplant alone, especially in patients HCV+ at time of transplant

First Author	Type of Study	Transplant Period	Patient Group # 1	# of Combined Transplant Patients	Patient Group # 2	# of Patients in Comparison Group	Key Results
Levitsky, 2012	Single center cohort study	2002-2009	Liver-kidney transplant with post-transplant radionuclide GFR	78	Liver-kidney transplant without post-transplant radionuclide GFR	77	Recovery of native kidney function post-transplant was highly variable; sensitivity and specificity of UNOS criteria for nGFR of ≤ 20 ml/min were 55.3% and 75.0%.
Weigand, 2011	Single center cohort study	2004-2006	Liver transplant	208			Patients with acute renal failure prior to LTPL showed the risk of remaining on RRT with a sensitivity of 67% and a specificity of 84%. No pre-transplant factors identified that predicted risk of post-transplant ESRD.

Table 4: LK Case Series, Other References

First Author	Type of Study	Transplant Period	Patient Group # 1	Number of Combined Transplant Patients	Patient Group # 2	Number of Patients in Comparison Group	Key Results
Cantarell, 1999	Single center case series	1993-1997	Liver-kidney transplant	2	Liver transplant	4	Patients with HCV and membranoproliferative glomerulonephritis. Recurrence of proteinuria in 2/4 patients with liver transplant alone, 0/2 with LK transplant.
Chava, 2010	Single center case series	1992-2007	Liver-kidney transplant	39	None		Good results of LK transplant.
Dar, 2011	Single center case series	2008-2009	Liver-kidney transplant with donor-specific antibody at time of transplant	6	None		Simultaneous liver-kidney transplants with donor-specific antibodies pre-transplant. Antibody-mediated rejection in 66% of patients. Class I antibodies quickly cleared post-transplant, while class II antibodies persisted.
Grewal, 2000	Single center case series	1984-1997	Liver-kidney transplant	12	Liver transplant	385	Pediatric patients only. Long-term survival of LK transplant similar to liver transplant. No difference in acute rejection rate.
Tanriover, 2008	Prospective case series	2003-2007	Decision to proceed to liver or simultaneous liver-kidney transplant made after	20			Patients evaluated for liver transplant with acute kidney injury > 4 weeks or CKD > 6 months with iothalamate GFR 30-59 ml/min. Renal biopsy performed and combined liver kidney transplant indicated if: interstitial fibrosis > 30%; glomerular sclerosis > 40%; or moderate

First Author	Type of Study	Transplant Period	Patient Group # 1	Number of Combined Transplant Patients	Patient Group # 2	Number of Patients in Comparison Group	Key Results
			renal biopsy				to severe arteriosclerosis. LK transplant avoided in some patients, with no adverse renal outcomes.
Wadei, 2008	Single center case series	2005-2008	Patients biopsied if unclear cause of renal dysfunction; on dialysis < 8 weeks; or iothalamate GFR < 40 ml/min	44			Decision for simultaneous liver-kidney transplant if interstitial fibrosis > 30%; global glomerulosclerosis > 40%; MPGN involving > 50% of glomeruli. All patients on dialysis who received liver transplant alone recovered renal function post-transplant.
Kiberd, 2011	Medical decision analysis using UNOS data	1998-2007	Liver-kidney transplant			Kidney transplant to pt with ESRD and liver transplant to patient with ESLD and ESRD	Combined allocation was the best strategy (+0.806 QALYs) if liver transplant recipients on dialysis have proportionately worse survival compared with kidney failure alone patients on dialysis. A second analysis incorporated the possibilities of being dialysis-free post-liver transplant due to resolution of hepatorenal syndrome. If the chance of recovery of renal function is 50% rather than 0%, the decision reversed. Here, the split allocation provided 1.02 more total QALYs than the combined allocation.

First Author	Type of Study	Transplant Period	Patient Group # 1	Number of Combined Transplant Patients	Patient Group # 2	Number of Patients in Comparison Group	Key Results
Brinkert, 2013	Single-center case series	2003-2011	Liver-kidney transplant	8	None		Pediatric population, all with autosomal recessive polycystic kidney disease and congenital hepatic fibrosis; patient survival 100%, kidney and liver graft survival 88% and 72%; no comparator group
O'Leary, 2013	Single-center case series	1985-2011	Liver-kidney transplant	86	None		Presence of pre-transplant class II DSA was associated with an increased risk of acute antibody-mediated renal rejection and acute liver rejection; class I DSA had no impact. Pre-transplant class II DSA affect patient, liver and kidney survival.

Table 5: Heart-Kidney References

First Author	Type of Study	Transplant Period	Patient Group # 1	Number of Combined Transplant Patients	Patient Group # 2	Number of Patients in Comparison Group	Key Results
Alam, 2007	Registry Study (CORR)	1981-2002	Heart transplant with ESRD	2709 with heart transplant, 105 developed ESRD	Matched cohort of ESRD patients on dialysis	201	Higher mortality with heart transplant and ESRD compared to heart transplant alone and to matched controls on dialysis. Survival post-renal transplant similar for heart transplant and non-heart transplant patients.
Cassuto, 2010	Registry study (UNOS)	1995-2008	Kidney-after-heart transplant	456	Simultaneous heart-kidney transplant, first or second kidney transplant alone	Simultaneous heart-kidney transplant (n=252), first kidney transplant alone (n=112,882), second kidney transplant alone (n=14,070)	Survival with kidney-after-heart transplant similar to simultaneous transplant but inferior to first kidney transplant alone. Worse outcomes of kidney after heart transplant with longer time on dialysis.
Chikwe, 2002	Survey of all British heart transplant centers (8)	1986-2002	Heart-kidney transplant	28, including 2 heart-lung-kidney transplants	Isolated heart transplant		In unadjusted analysis, worse outcome of simultaneous transplant at one, three, five and 10 years compared to heart transplant alone.

First Author	Type of Study	Transplant Period	Patient Group # 1	Number of Combined Transplant Patients	Patient Group # 2	Number of Patients in Comparison Group	Key Results
Gill, 2009	Registry study (UNOS/OPTN)	1998-2007	Heart-kidney transplant	263	Heart transplant or kidney transplant	Heart (n=16,710), kidney (n=68,833)	Outcome of simultaneous heart-kidney transplant worse than deceased-donor kidney transplant alone. Lower risk of death with simultaneous transplant compared to heart transplant alone, especially if on dialysis pre-transplant.
Narula, 1997	Registry study (UNOS/ISHLT)	1987-1995	Heart-kidney transplant	84	Heart transplant	14,340	Similar survival for heart-kidney transplant as heart transplant alone. Lower rate of heart acute rejection in heart-kidney recipients
Russo, 2009	Registry study (UNOS)	1995-2005	Heart-kidney transplant	264	Heart transplant	19109	Patients classified as low-, medium- or high-risk according to a risk score. Compared to patients with eGFR < 33 ml/min, only low-risk patients had better survival with heart-kidney transplant compared to heart transplant alone.
Opelz, 2002	Case-control study (Collaborative Transplant Study)	1985-2000	Liver-kidney and heart-kidney transplant	Liver-kidney (n=383), heart-kidney (n=105)	Kidney transplant	1083	Better 20-year renal graft survival and projected renal half-life in heart-kidney transplants compared to kidney transplant alone.
Vermes, 2001	Single center case-control study	1988-1997	Heart-kidney transplant	12	Heart transplant	24	Lower rate of heart acute rejection with heart-kidney transplant. Similar rate of patient survival.

First Author	Type of Study	Transplant Period	Patient Group # 1	Number of Combined Transplant Patients	Patient Group # 2	Number of Patients in Comparison Group	Key Results
Blanche, 2001	Single center, cohort study	1992-1999	Heart-kidney transplant	10	Heart transplant	169	No difference in patient survival up to five years, low rate of heart acute rejection.
Groetzner, 2005	Single center, cohort study	1995-2003	Heart-kidney transplant	13	Heart transplant	336	No difference in survival between heart-kidney transplant and heart transplant alone. Lower rate of heart acute rejection with heart-kidney transplant. More coronary artery vasculopathy with heart transplant alone.
Hermsen, 2007	Single center, cohort study	1987-2006	Heart-kidney transplant	19	Heart transplant or kidney transplant	Heart (n=515), kidney (n=3,188), sequential heart-kidney (n=8)	No difference in patient survival between heart-kidney transplant and heart transplant or kidney transplant alone. Lower rate of cardiac acute rejection and coronary artery vasculopathy with heart-kidney transplant.
Hsu, 2010	Single center, cohort study	1993-2006	Heart-kidney transplant	13	Heart transplant	32	Among patients with serum creatinine > 177 umol/L at time of transplant, similar patient and graft survival with heart-kidney transplant compared to heart transplant alone. No difference in dialysis-free survival post-transplant.

First Author	Type of Study	Transplant Period	Patient Group # 1	Number of Combined Transplant Patients	Patient Group # 2	Number of Patients in Comparison Group	Key Results
Luckraz, 2003	Single center cohort study	1986-2002	Heart-kidney transplant	13	Heart transplant	760	No difference in patient survival between heart-kidney transplant and heart transplant alone. Lower rate of cardiac acute rejection with heart-kidney transplant.
Pinderski, 2005	Single center cohort study	1990-2002	Heart-kidney transplant	8	Heart transplant, simultaneous heart-lung transplant, lung transplant	Heart (n=348, heart-lung (n=24), lung (n=82)	Lower rate of heart acute rejection, coronary artery vasculopathy with heart-kidney transplant vs. heart transplant alone. Highest survival with heart-kidney transplant.
Vermes, 2009	Cohort study at 3 French centers	1984-2007	Heart-kidney transplant	67	Heart transplant	2,981	No difference in survival between heart-kidney transplant and heart transplant alone. Low rates of heart and kidney acute rejection, coronary artery vasculopathy.
Wolf, 2013	Registry study (UNOS)	1987-2010	Heart-kidney transplant	684	Heart transplant or kidney transplant	Heart (n=47,440), kidney (n=189,038)	Survival of simultaneous heart-kidney transplant similar to heart transplant alone but worse than kidney transplant alone in unadjusted analysis.
Wolf, 2013	Registry study (UNOS)	1987-2010	Lung-kidney transplant	41	Lung transplant or kidney transplant	Lung (n=32,393), kidney (n=189,038)	Survival of simultaneous lung-kidney transplant similar to lung transplant alone but worse than kidney transplant alone in unadjusted

First Author	Type of Study	Transplant Period	Patient Group # 1	Number of Combined Transplant Patients	Patient Group # 2	Number of Patients in Comparison Group	Key Results
							analysis.
Kebschull, 2012	Single center, case-control study	1999-2008	Heart-kidney transplant	13	Kidney transplant	13	Similar renal function, renal acute rejection, graft and patient survival in both groups with 3 years of follow-up

APPENDIX B: US DATA REVIEW

Leading Practices for the Allocation of Organs for Combined Transplantation

March 22-23, 2012
Toronto, ON
Data Review
Updated February 2014

Canadian Society of Transplantation
LEADERSHIP IN CANADIAN TRANSPLANTATION

Canadian Blood Services
Société canadienne du sang

CHAPTER 1 – LIVER AND KIDNEY TRANSPLANTATION

Data resource

- Data from the Scientific Registry of Transplant Recipients (SRTR) for the years 2000-2011 were used for all analyses on combined organ transplant recipients. Note: The SRTR allows identification of patients on dialysis at time of extra-renal transplantation if the patient has received dialysis treatment for ≥1 week, however the exact duration of dialysis prior to the date of extra-renal transplantation cannot be determined.

- Data from the United States Renal Data System (USRDS) were used for analyses in which the survival of combined transplant recipients is compared with that of kidney only transplant recipients. In a sub-set of patients undergoing extra-renal transplantation, the duration of dialysis prior to extra-renal transplantation can be determined through linkage to the USRDS.

For the purposes of this report, these groups are exclusive (i.e. no patient appears in both groups).

The following paragraphs define how USRDS establishes a date of first ESRD treatment:

- A person is identified as having ESRD when a physician certifies the disease on the Centers for Medicare and Medicaid Services (CMS, formerly HCFA) ESRD Medical Evidence (ME) form, or when there is other evidence of chronic dialysis or a kidney transplant. Patients with acute kidney failure who are on dialysis for days or weeks, but who then recover kidney function, are excluded from the database if their ME forms have not been submitted. Patients who die soon after kidney failure without receiving dialysis are sometimes missed.

- The ESRD First Service Date (FSD) is the single most important data element in the USRDS database, and each patient must, at a minimum, have a valid FSD. This date is used to determine the incident year of each new patient and the first year in which the patient is counted as prevalent. The date 90 days after the FSD is used as the starting point for most survival analyses.

- The FSD is derived by taking the earliest of the date of the start of dialysis for chronic kidney failure, as reported on the ME form; the date of a kidney transplant, as reported on a CMS or OPTN transplant form, an ME form, or a hospital inpatient claim; or the date of the first Medicare dialysis claim. Most FSDs are obtained from the ME form. In the absence of this form, the date of the first Medicare dialysis claim or transplant usually supplies the FSD. In the few cases in which the date of the earliest dialysis claim precedes the first dialysis date reported on the ME form, the earliest claim date is used as the FSD. However, starting with the 2007 ADR, a patient entering into the ESRD program after December 31, 1994, has his or her FSD defined solely by the regular dialysis start date or the preemptive transplant date, whichever is earliest, on the ME

form. This new method of determining the FSD aligns more closely to the methods used by CMS. After careful monitoring and repeated comparative analyses of the traditional USRDS method to the new ME method, the USRDS began applying the ME method to incident patients entering into the ESRD program on or after January 1, 1995.

- Note MELD came in to effect 2/ 27/ 2002.

Section 1 - Liver only transplants (OLT) and simultaneous liver kidney (SLK) transplantation 2000-2011

Figure 1.1: Number of liver transplants in U.S. stratified by OLT and SLK

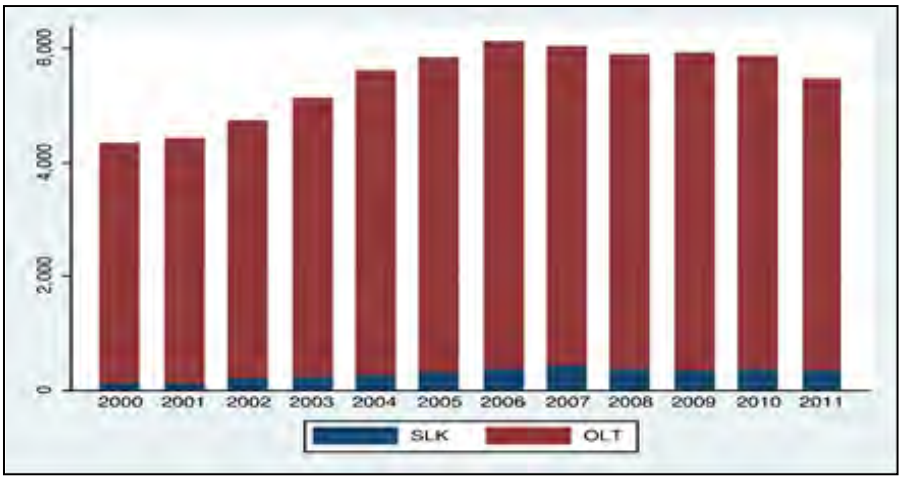


Figure 1.2: Proportion of SLK and OLT transplants by year

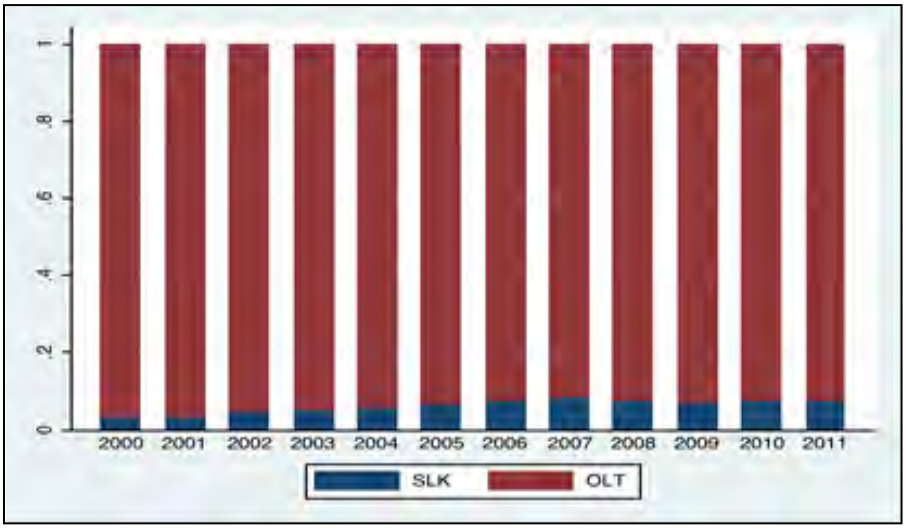


Table 1.1 - Number and proportion of liver only and simultaneous liver kidney transplants 2000-2011

TX year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
OLT n=64,423	4,196	4,225	4389	4,729	51,74	5,376	5,584	5,420	5,366	5,428	5,360	5,090
SLK n= 3,645 (%)	131 (3)	131 (3)	207 (5)	243 (5)	276 (5)	340 (6)	399 (7)	443 (8)	375 (7)	356 (7)	381 (7)	363 (7)

Section 2 - Use of OLT and SLK by level of kidney function at time of transplantation

Kidney function was estimated using the 4 variable equation derived from the Modification of Diet in Renal Disease Study. In this report, GFR should be interpreted as eGFR in ml/min/1.73/m^2 and it used the last available serum creatinine measurement prior to transplantation for calculation. Readers should be aware of the limitations of estimating kidney function using creatinine based methods in patients with extra-renal end organ failure.

Figure 2.1: Proportion of OLT and SLK among patients on dialysis at time of liver transplantation

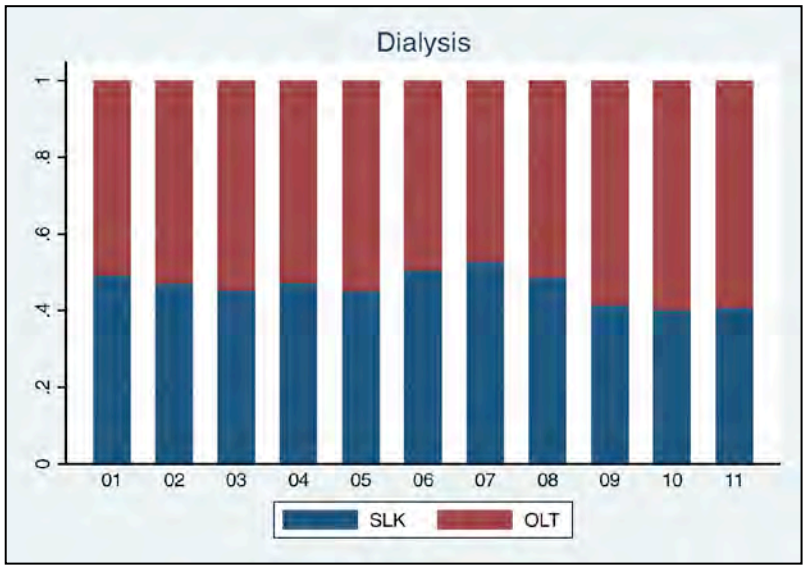


Table 2.1: Total number of patients on dialysis at time of liver transplantation and proportion with SLK transplant

TX year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total dialysis (n=6090)	151	326	378	469	556	605	667	631	720	834	743
SLK (%) Dialysis (n=2540)	80 (53)	141 (43)	158 (42)	195 (42)	239 (43)	290 (48)	326 (48)	275 (44)	270 (38)	295 (35)	271 (37)

Note - Number of patients on dialysis increased 5 fold, proportion with SLK was relatively stable.

Figure 2.2: Proportion of OLT and SLK among patients with MDRD GFR < 30 ml/min/ 1.73^2 not on dialysis at time of liver transplantation

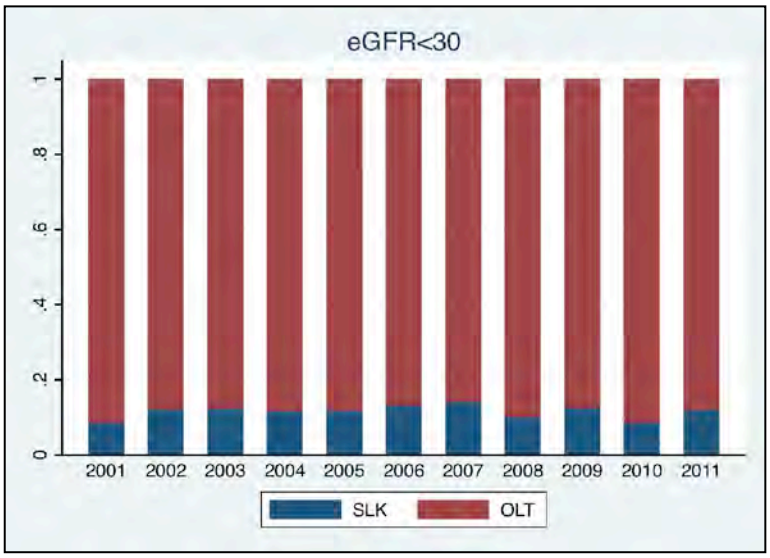


Table 2.2: Total number of patients with GFR < 30 at time of liver transplantation and proportion with SLK transplant

TX year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
(eGFR <30) n=5194	151	371	478	540	588	520	523	487	463	560	513
SLK (%) n=607	13(9)	45(12)	59(12)	63(12)	69(12)	68(13)	74(14)	49(10)	58(13)	48(9)	28(12)

Note - Number with eGFR < 30 increased 3 fold, proportion with SLK relatively constant.

Figure 2.3: Proportion of OLT and SLK among patients with MDRD GFR 30-60 ml/min/ 1.73^2 at time of liver transplantation

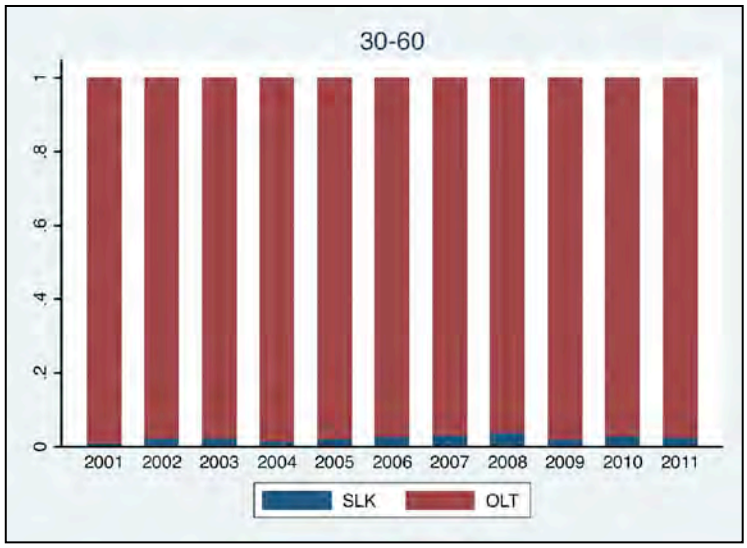


Table 2.3: Total number of patients with GFR 30-60 at time of liver transplantation and proportion with SLK transplant

TX year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
eGFR 30-60 n=12,001	398	930	1027	1172	1259	1282	1254	1217	1239	1134	1089
SLK (%) n=295	4(1)	21(2)	25(2)	17(2)	26(2)	34(3)	38(3)	45(4)	24(2)	33(3)	28(3)

Note - Relative constant number of patients with GFR 30-60 and use of SLK infrequent throughout

Figure 2.4: Proportion of OLT and SLK among patients with MDRD GFR >60 ml/min/ 1.73^2 at time of liver transplantation

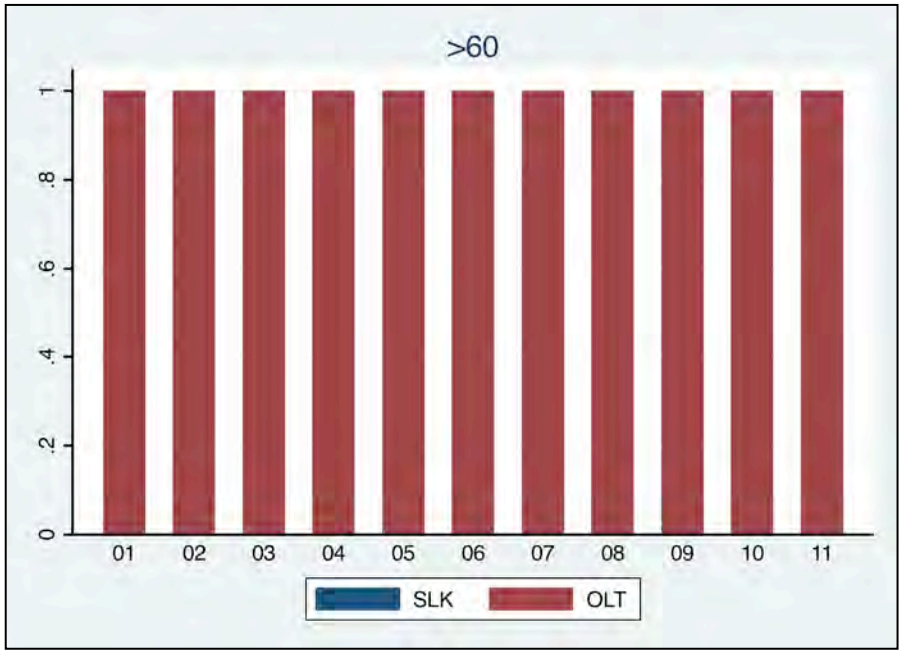


Table 2.4: Number of patients with GFR > 60 at time of liver transplantation and proportion with SLK transplant

TX year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
eGFR >60 n=33825	1221	2969	3089	3269	3313	3576	3409	3406	3362	3213	2998
SLK (%) (n=40)	2(0)	0(0)	1(0)	1(0)	6(0)	7(0)	5(0)	6(0)	4(0)	5(0)	3(0)

Note: Relatively constant number of patients with GFR >60 and almost no use of SLK

Figure 2.5: Kidney function at time of transplantation among SLK recipients

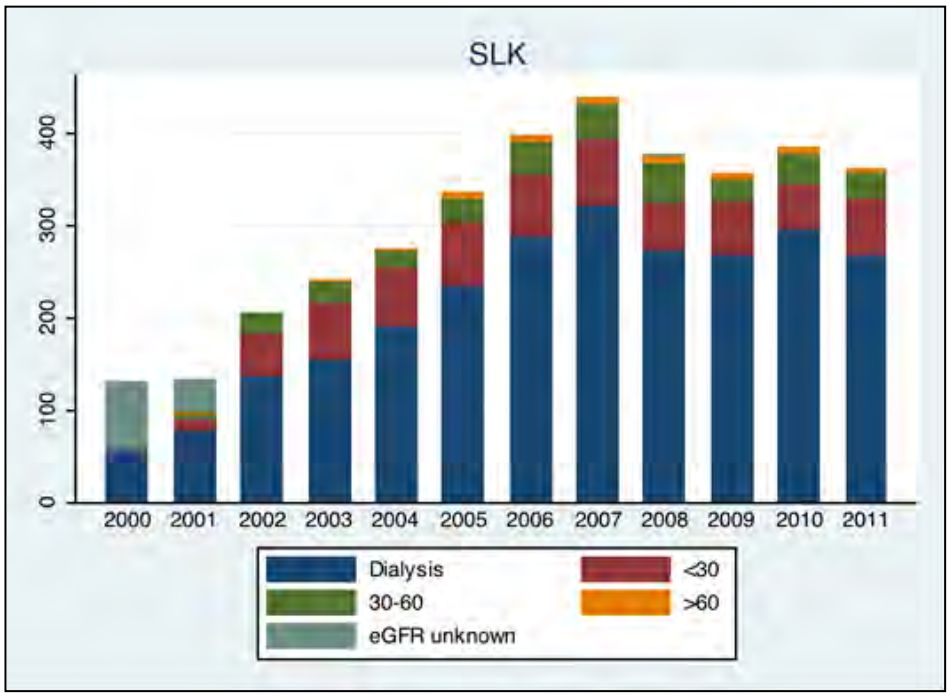


Table 2.5: Number of SLK recipients by year stratified by level of kidney function

TX year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
n	131	131	207	243	276	340	399	443	375	356	381	363
SLK Dialysis n= 2616	76	80	141	158	195	239	290	326	275	270	295	271
SLK eGFR <30 n=607	NA	13	45	59	63	69	68	74	49	58	48	28
SLK eGFR 30-60 n=295	NA	4	21	25	17	26	34	38	45	24	33	28
SLK eGFR> 60 n=40	NA	2	0	1	1	6	7	5	6	4	5	3

Note - About 65-70% of SLK were on dialysis at time of transplantation throughout study period

Section 3 - Duration of dialysis at time of liver transplantation

The duration of dialysis was determined through two methods:

- Linkage to USRDS first ESRD date allowed us to calculate the exact duration of dialysis prior to extra renal transplantation
- UNOS variable indicated that the patient was on dialysis for at least on week prior to liver transplantation, but the exact duration could not be calculated

Table 3.1: Duration of dialysis and use of OLF and SLK

Duration of Dialysis	OLF (%)	SLK (%)
USRDS Totals	959	2,061
0-1 months	483 (13.26)	356 (13.55)
1-2 months	103 (2.83)	250 (9.51)
2-3 months	24 (0.66)	165 (6.28)
3-4 months	12 (0.33)	97 (3.69)
4-5 months	15 (0.41)	75 (2.85)
5-6 months	16 (0.44)	62 (2.36)
6-12 months	40 (1.10)	271 (10.62)
> 12 months	266 (7.30)	785 (30.25)
UNOS Dialysis for at least 1 week	2,591 (73.68)	479 (20.89)
Total	**3,550**	**2,540**

Figure 3.1: Duration of dialysis (including UNOS category of dialysis for at least one week)

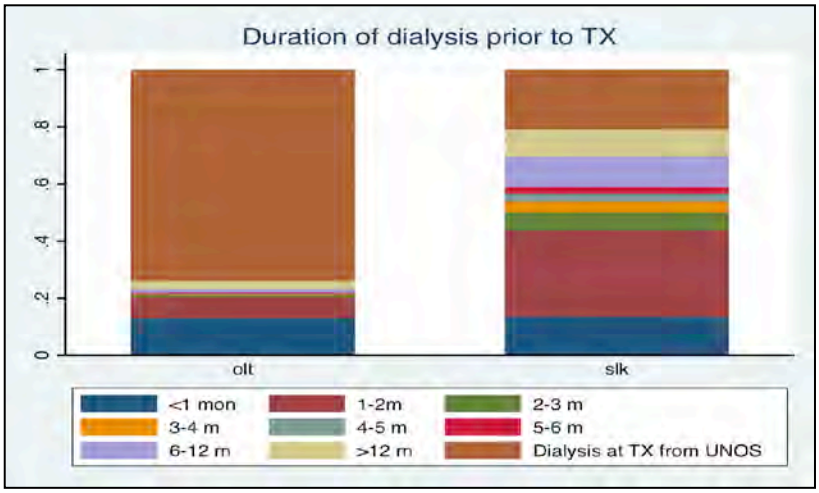
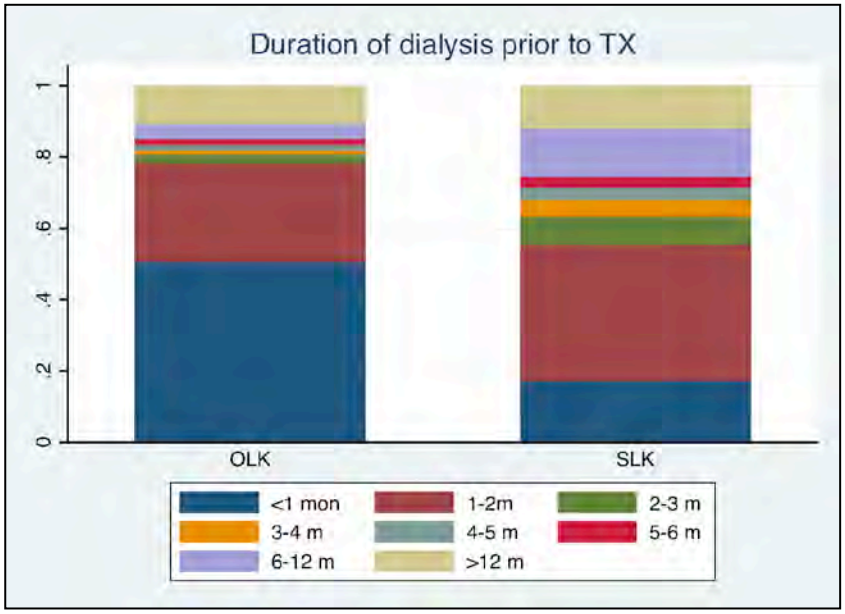


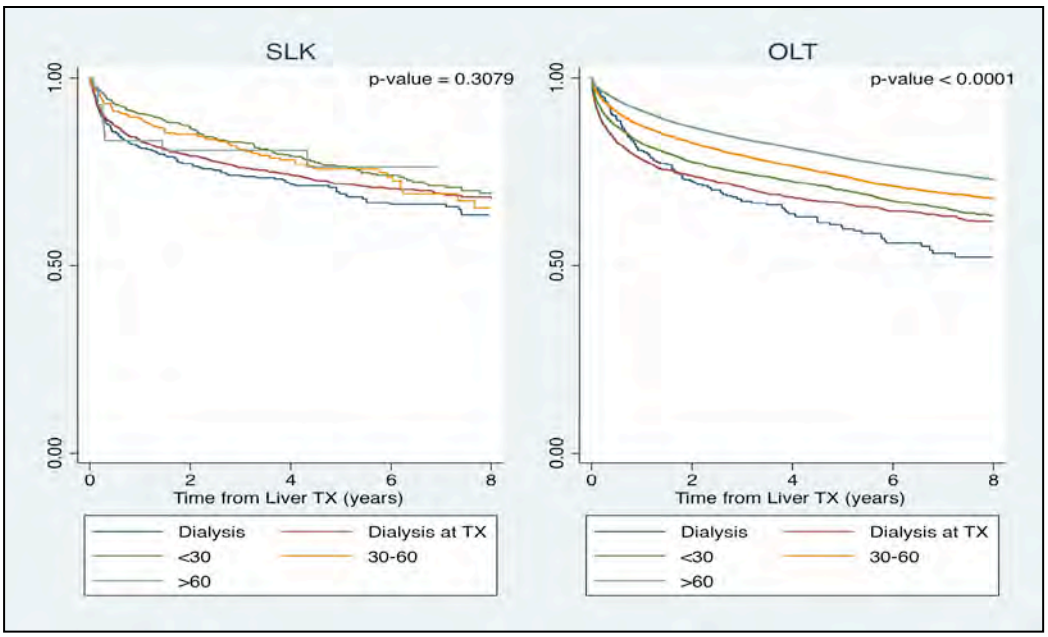
Figure 3.2: Duration of dialysis (excluding UNOS category)



Note - Few OLTs are on dialysis for >2 months (between 10-20% depending on exclusion of the UNOS category). Most SLK range from 66– 85% (depending on whether you include or exclude UNOS category) are on dialysis for > 1 month.

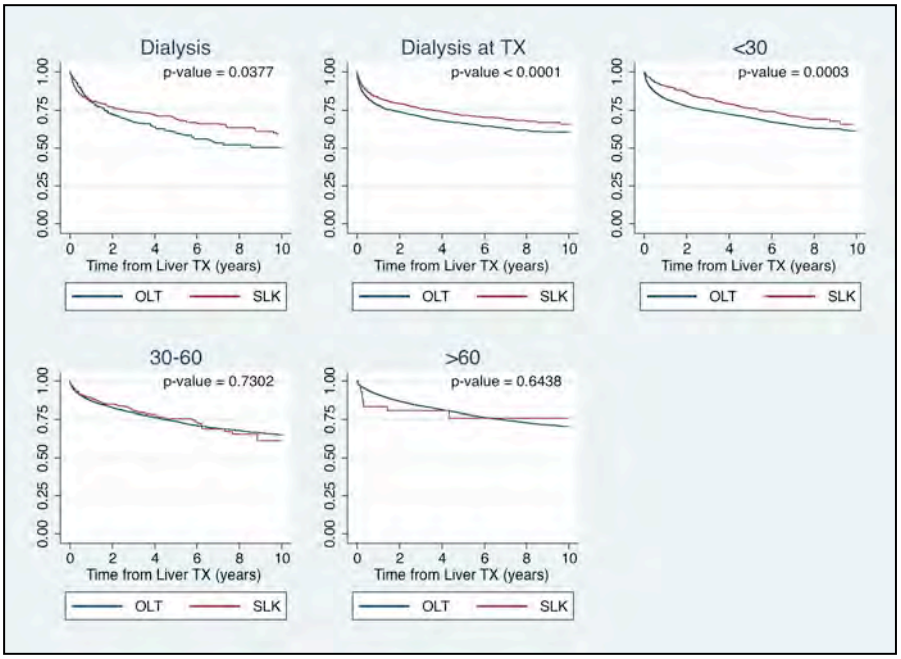
Section 4 - Patient survival

Figure 4.1: Patient survival after liver transplantation by level of kidney function for two dialysis groups as shown (Dialysis = USRDS; Dialysis at TX = UNOS)



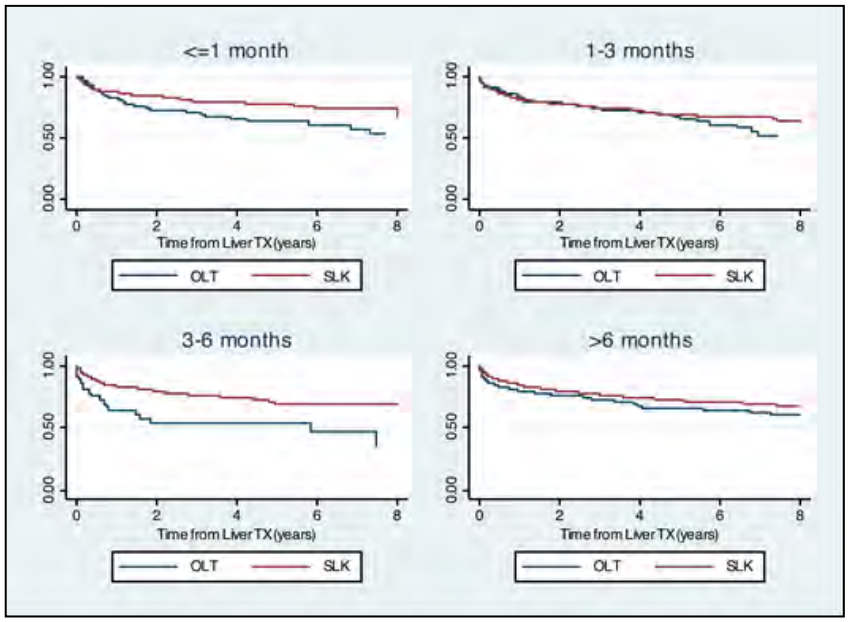
Note - Kidney function at time of liver transplant is associated with survival in OLT.
There was no association between kidney function at time of SLK and post-transplant survival.

Figure 4.2: Patient Survival in OLT and SLK by level of kidney function at time of liver transplantation for two dialysis groups as shown (Dialysis = USRDS, Dialysis at TX = UNOS variable)



Note - SLK associated with better survival in those on dialysis and those with GFR < 30.

Figure 4.3: Patient survival by dialysis duration

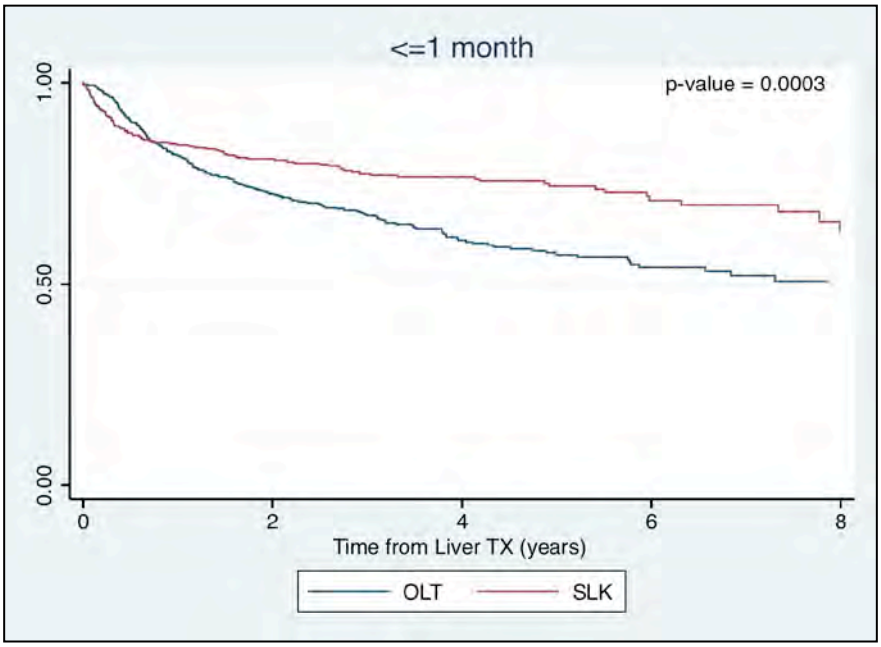


Note< 1 month includes USRDS patients with dialysis <1 month, and those with UNOS variable (indicating dialysis of at least 1 week). There were significant differences in survival for all groups except for dialysis duration of 1 – 3 months. If the "UNOS dialysis group" is excluded from the <1 month category, the difference in survival remains significant between OLT and SLK, see page 62 for supplementary Figure 4.4.

Table 4.1: Duplicate of Table 3.1 (page 63) - Duration of dialysis and use of OLT and SLK

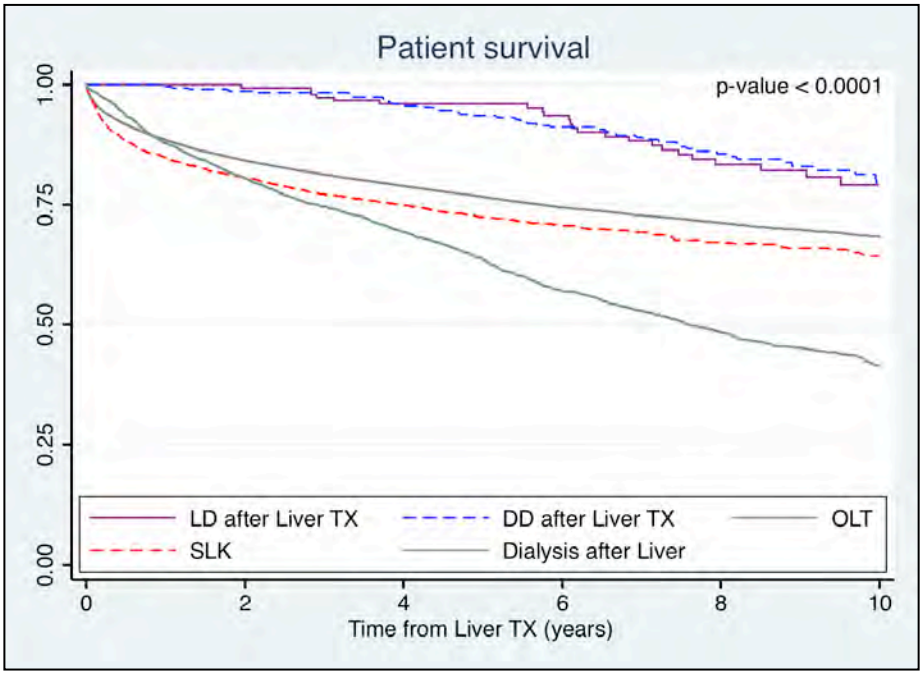
Duration of Dialysis	OLT (%)	SLK (%)
USRDS Totals	959	2,061
0-1 months	483 (13.26)	356 (13.55)
1-2 months	103 (2.83)	250 (9.51)
2-3 months	24 (0.66)	165 (6.28)
3-4 months	12 (0.33)	97 (3.69)
4-5 months	15 (0.41)	75 (2.85)
5-6 months	16 (0.44)	62 (2.36)
6-12 months	40 (1.10)	271 (10.62)
>12 months	266 (7.30)	785 (30.25)
UNOS Dialysis for at least 1 week	2,591 (73.68)	479 (20.89)
Total	**3,550**	**2,540**

Figure 4.4: Patient survival among those on dialysis (excluding liver transplant recipients identified as being on dialysis by UNOS dialysis variable only)



Note – provided as supplemental information

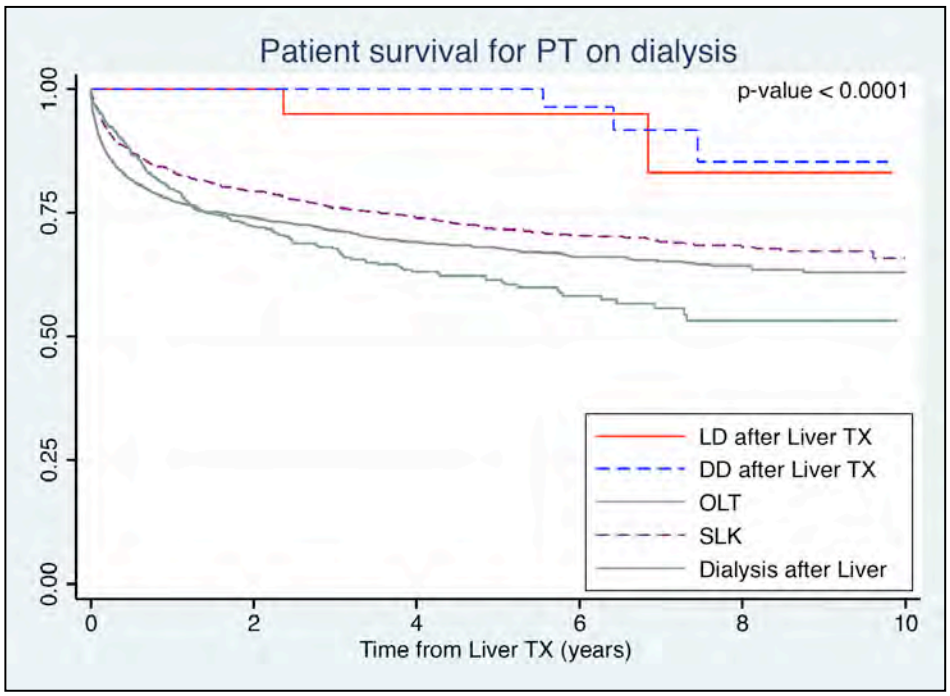
Figure 4.5: Patient Survival including patients who received kidney after liver transplant



Note - this analysis includes all liver transplants during the study period

- LD Kidney after liver transplantation: n=174. The time to kidney transplantation after liver transplant was: 3.8yr ± 2.5yr (median (Q25, Q75):3.4(1.5,5.9))
- DD Kidney after liver transplantation: n=347. The time to kidney transplantation after liver transplant was 4.2yr ± 2.5yr, (median (Q25, Q75):3.8 (2.3,5.7))
- OLT only: n=57,500; SLK: n=3,570
- Dialysis after Liver transplantation: n =2,979

Figure 4.6: Patient survival including those who received a kidney after liver transplant



Note - This analysis limited to the n=6090 who were on dialysis at the time of liver transplantation.

Patient number summary

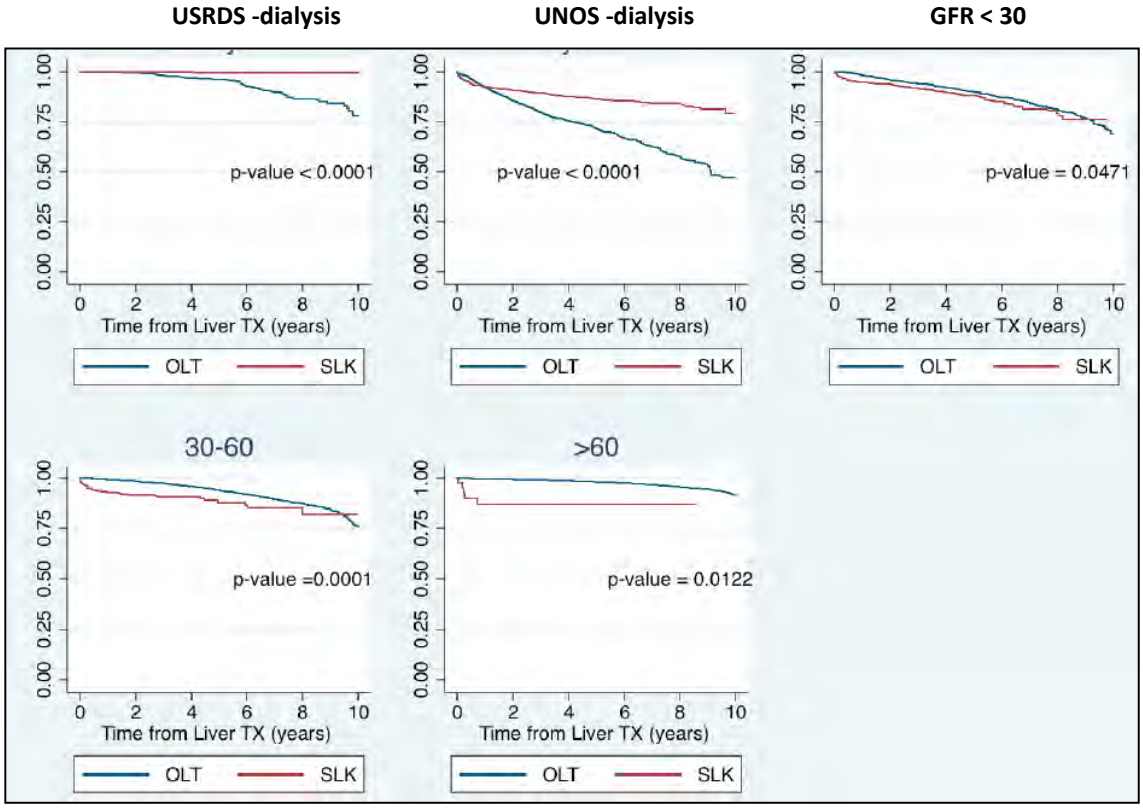
- # LD n=33, DD n=61, OLT n=3790, SLK n=801; Dialysis after liver transplant: n=509
- LD: time to kidney after liver transplant 3.2yr ± 2.4yr, median (Q25, Q75): 2.4(1.0,4.0))
- DD: time to kidney after liver transplant 3.8yr ±2.1yr, median (Q25, Q75):3.6 (2.4,4.8)

Section 5 - Kidney survival

- For the USRDS patients (n=959) are on Chronic Dialysis at the time of liver transplantation – so the outcome of kidney failure is a kidney after liver transplant.

- For the UNOS group (n=2591), these patients were considered as having acute dialysis at the time of liver transplantation. Kidney failure is therefore denoted by assignment of a Chronic Dialysis data in USRDS after liver transplantation (n=263) or kidney after liver transplantation (n=629).

Figure 5.1: Kidney survival for USRDS and UNOS groups



Section 6 – Patient survival for patients on dialysis at time of liver transplantation

Figure 6.1: Long-term survival

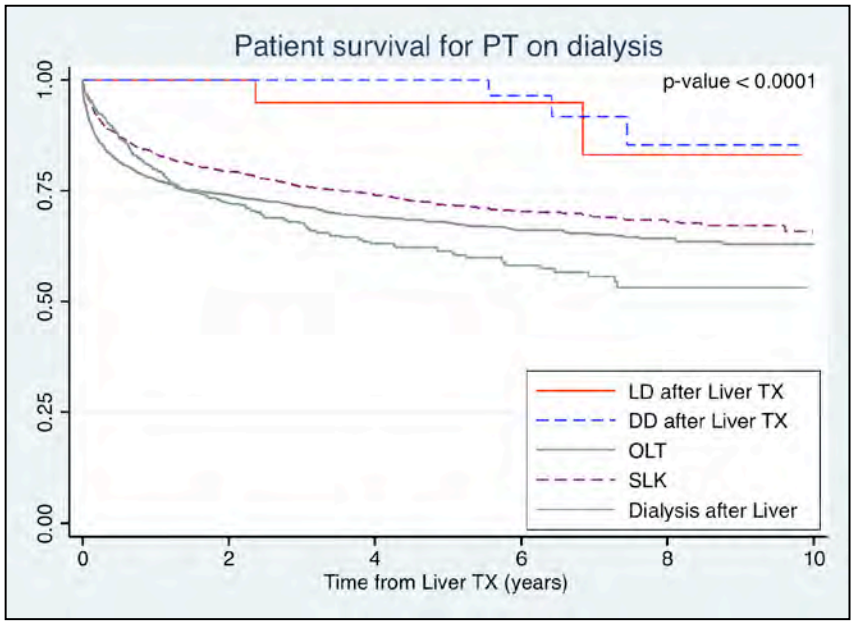
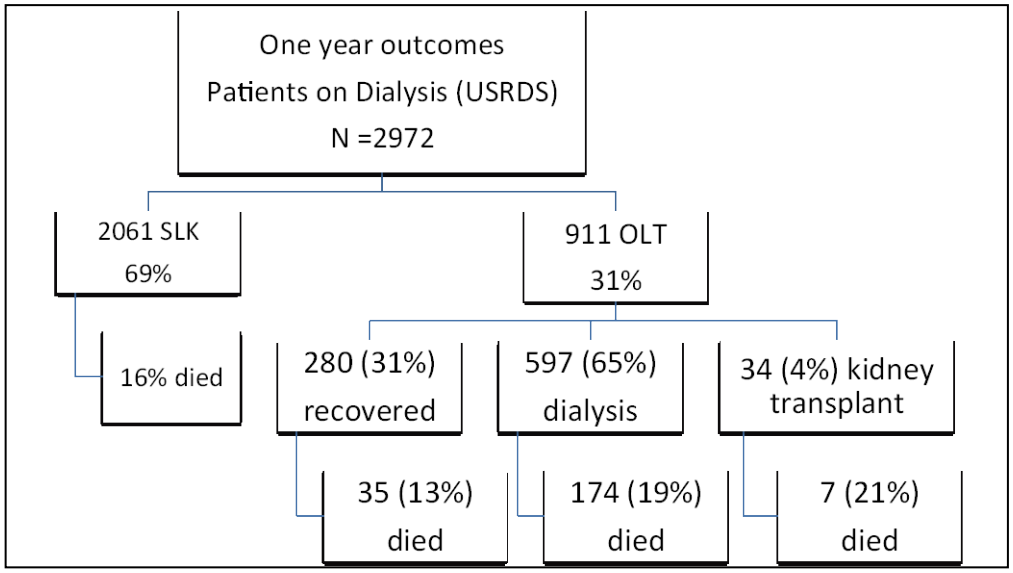


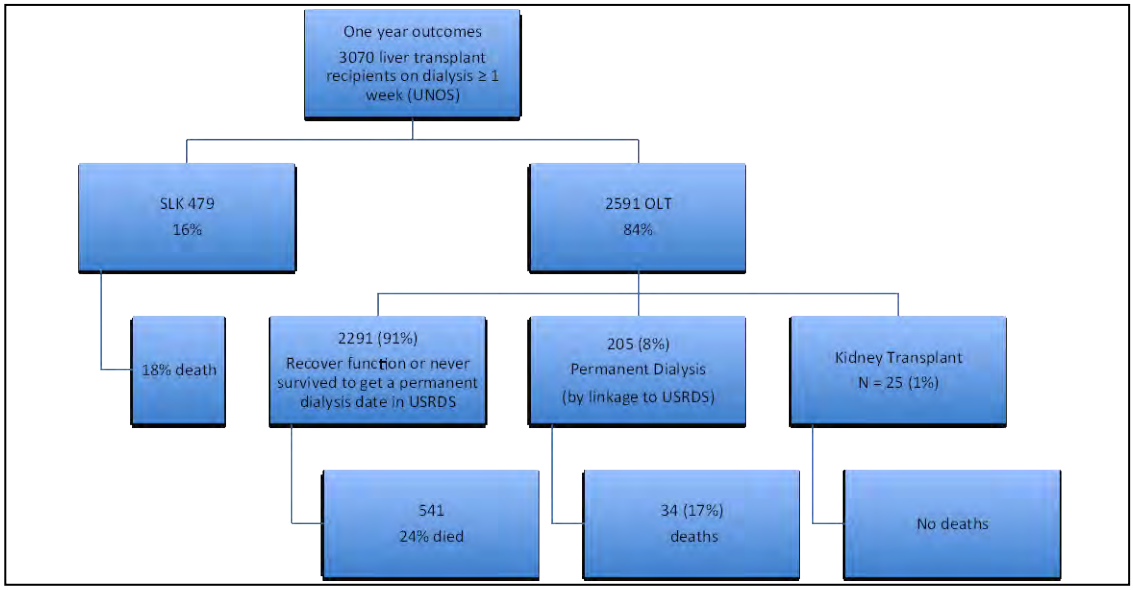
Figure 6.2: One year outcomes USRDS patients on dialysis at time of liver transplantation



Comment: SLK 16% mortality; OLT combined mortality 23%.

Note outcomes in 48 OLT patients could not be determined

Figure 6.3: One year outcomes UNOS patients on dialysis at time of liver transplantation



Note - SLK 18% mortality. OLT combined mortality 22%

Summary of One Year Outcomes: Although SLK has lower mortality than OLT, the mortality is much higher than that which would be anticipated in kidney only transplant recipient. Nonetheless, SLK may be justified if the relative survival advantage of a kidney transplant in a liver transplant recipient was similar to that in a kidney only transplant recipient. The subsequent analyses examine this issue.

Table 6.1: Characteristics of patients on chronic dialysis treatment (identified by linkage to USRDS) who received either a combined liver/kidney or a liver alone transplant

Characteristic	SLK (n=2061)	Liver alone (n=911)	P-value
Duration of dialysis before liver transplant (years)			<0.001
Mean (SD)	1.49 (2.30)	0.51 (1.32)	
Median (Q25, Q75)	0.5 (0.13,1.82)	0.05 (0.01,0.19)	
Recipient Age (years)			<0.001
Mean (SD)	51(13)	54(12)	
Median (q25,75)	54 (47, 60)	55 (49, 61)	
Recipient Female Gender (%)	34	36	<0.001
Recipient Race (%)			<0.001
White	75	84	
Black	18	12	
Other	7	4	
MELD Score			0.011
Mean (SD)	29 (8)	29(11)	
Median (q25,75)	28(24, 34)	29(23, 37)	
TX era (%)			<0.001
1994-1997	10	12	
1998-2001	13	15	
2002-2005	24	26	
2005-2008	25	28	
2009-2011	28	19	
Donor Age (years)			0.001
Mean (SD)	35(15)	40(17)	
Median (q25,75)	34 (22, 47)	41 (24, 53)	
Donor Female Gender (%)	40	41	0.720
Donor Race (%)			<0.001
White	79	83	
Black	17	14	
Other	4	3	

Figure 6.4: Patient survival

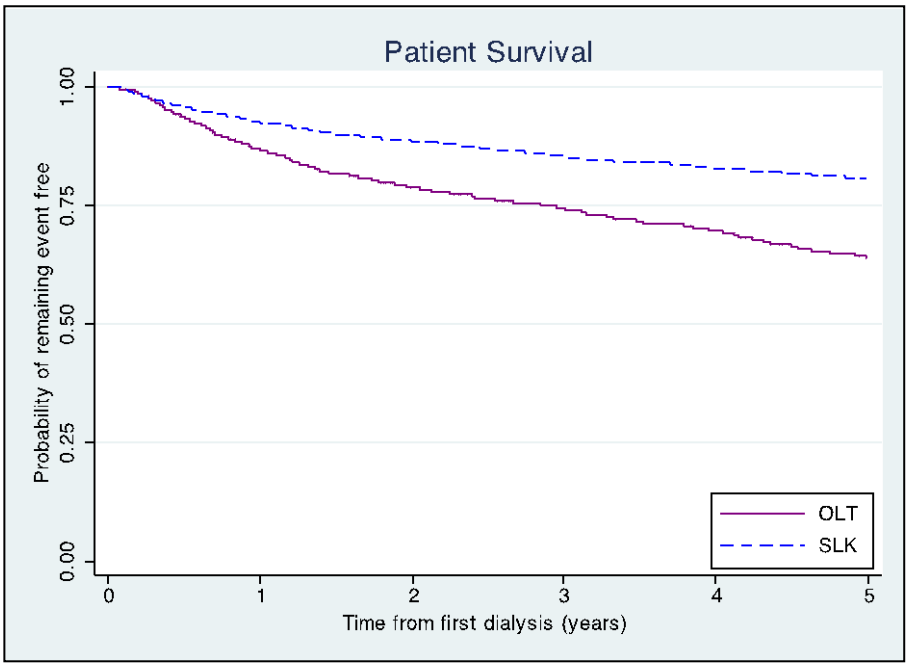


Table 6.2: Survival

Patient Survival (years)	OLT	SLK	Absolute Difference in Survival
1 year	0.856	0.931	0.075
3 year	0.722	0.863	0.141
5 year	0.616	0.818	0.202

Table 6.3: Characteristics of patients with "acute" dialysis treatment (identified in UNOS) who received either a combined liver/kidney (SLK) or a liver alone transplant

	SLK (n=479)	Liver alone (n=2,591)	P-value
Recipient Age (yrs) **Mean (SD)** **Median (q25,75)**	 52(12) 54 (47, 60)	 49(14) 52 (45, 59)	<0.001
Recipient Female Gender (%)	35	40	0.054
MELD Score **Mean (SD)** **Median (q25,75)**	 33 (9) 33(27, 39)	 33 (9) 28(27, 40)	0.537
TX era (%) **2001-2003** **2004-2007** **2008-2011**	 15 40 45	 12 36 52	<0.001
Recipient Race (%) **White** **Black** **Other**	 75 20 5	 79 17 6	0.087
Donor Age (years) **Mean (SD)** **Median (q25,75)**	 36(15) 35 (22, 47)	 38(17) 38 (24, 53)	0.574
Donor Female Gender(%)	38	40	0.720
Donor Race(%) **White** **Black** **Other**	 78 16 6	 85 10 5	<0.001

Figure 6.5: Patient Survival

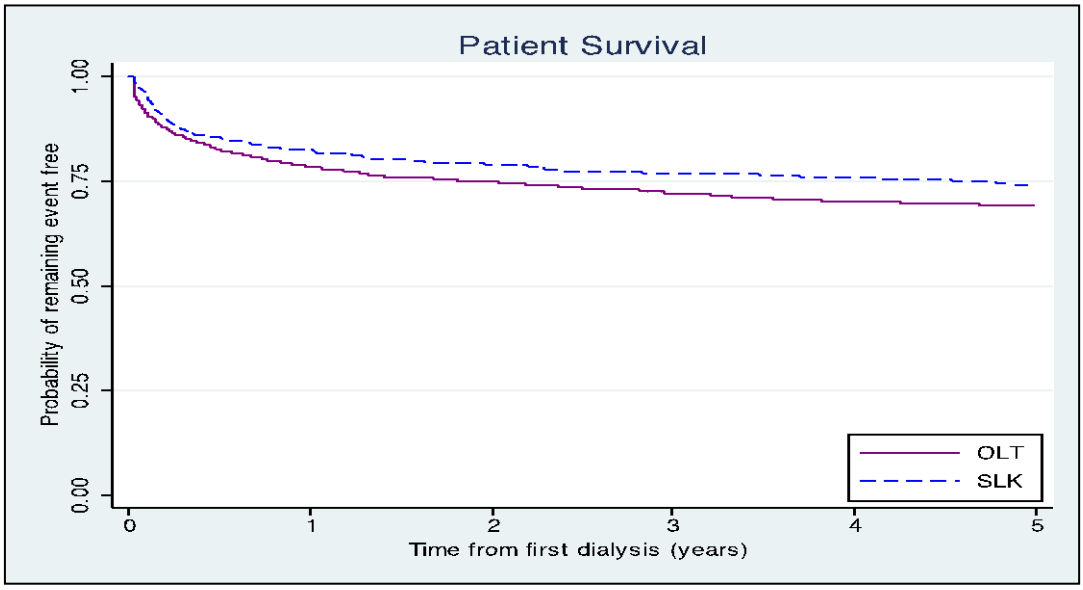


Table 6.4: Survival

Patient survival	OLT	SLK	Absolute Difference
1 year	0.771	0.844	0.073
3 year	0.706	0.795	0.088
5 year	0.674	0.769	0.096

Comment: There was 20% difference in survival in SLK versus OLT among chronic dialysis patients identified through the USRDS, and a 9.6% difference in survival among the "acute dialysis group" identified from UNOS, in whom we can only determine that they had received dialysis for ≥1 week prior to liver transplantation.

Comment

To compare the relative survival advantage of kidney transplantation in patients undergoing liver transplantation with that among kidney only transplant recipients we determined the difference in survival among recipients of a first kidney only deceased donor transplant and patients wait-listed for a deceased donor kidney transplant, using data provided by the USRDS for the years 1995-2002.

The difference in survival varied based on the duration of dialysis exposure prior to kidney transplantation. For simplicity we showed results for patients who received a deceased donor transplant within 6, 12, 24, 36, 60 months of dialysis as compared to patients who were wait-listed but not transplanted during the same time intervals. In each analysis, the survival of transplant recipients and wait-listed patients was determined from the date of first dialysis treatment. Survival of transplant

recipients was determined until death or end of study follow up (September 2007) and included survival after kidney transplant failure. Wait-listed patients were followed until transplantation from any donor source, permanent removal from the waiting list, death or end of follow up (September, 2007).

For simplicity of presentation, we provide demographics for patients who received a deceased donor transplant within five years of starting dialysis, and patients who were wait-listed within the first five years of dialysis but not transplanted.

Figure 6.5: Characteristics of first kidney only deceased donor transplant recipients and wait-listed patients (60 month cohort)

Characteristic	Transplant recipients within five years of dialysis initiation (n=27,706)	Patients wait-listed but not transplanted within 5 years of dialysis initiation (n=99,251)	P-value
Recipient age **Mean (SD)** **Median (q25, Q75)**	50 (9) 55 (47, 60)	55(9) 52 (45, 59)	<0.001
Female gender	35	40	<0.001
Race **White** **Black** **Other**	 61 31 8	 55 36 9	<0.001
Diabetes (%)	28	40	<0.001

Figure 6.6: Survival

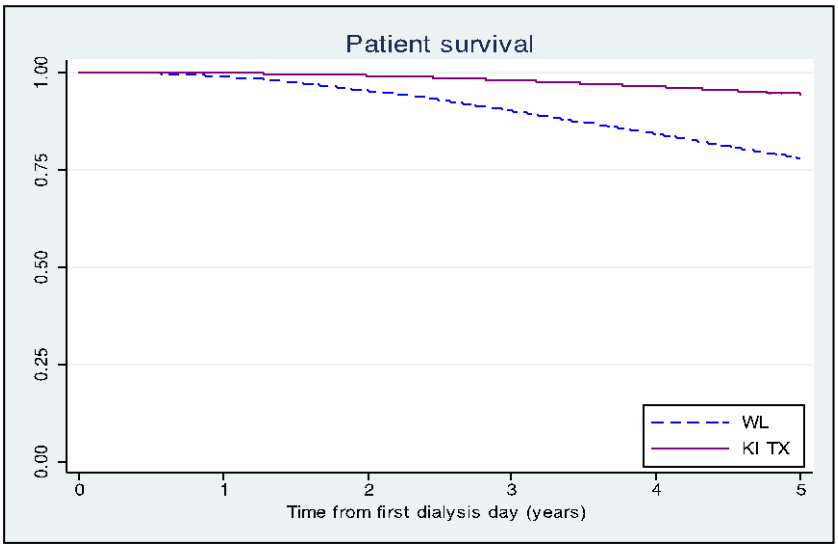


Table 6.6: Survival estimates

Years	WL (n=99,251)	TX (n=27,706)	Difference
1 year	0.985	0.997	0.012
3 year	0.873	0.972	0.099
5 year	0.724	0.925	0.201

Comment –There was a 20% difference in survival after five years in those treated with transplantation versus those wait-listed.

The comparable survival estimates for the 6, 12, 24, 36, month cohorts at five years after dialysis initiation are shown in Table 6.7, below.

Table 6.7: Survival estimates for Table 6.6. cohorts

Cohort	Number of transplant recipients	Survival at 5 years after dialysis initiation	Number of wait-listed patients	Survival at 5 years after dialysis initiation	Survival difference
0.5 year	1093	0.89	35,787	0.85	0.04
1 year	4406	0.88	78,884	0.82	0.06
2 year	12,333	0.89	98,446	0.70	0.19
3 year	19,084	0.88	107,873	0.70	0.18

In subset analyses, the difference in survival for diabetic kidney only transplant recipients compared to diabetic wait-listed patients were higher. For example among the five year cohort the survival difference was 26% (compared to 20%) in non-diabetic recipients.

Summary

Although patient survival after combined SLK transplants is clearly worse than that of kidney only transplant recipients, the relative survival benefit of kidney transplantation in liver transplant recipients is comparable to that in non-diabetic kidney only transplant recipients, but lower than that in diabetic kidney only transplant recipients.

CHAPTER 2 – HEART AND KIDNEY TRANSPLANTATION

Introduction

The data used for this analysis was obtained from SRTR for the treatment years 2000 to 2011.

Section 1 - Transplant activity for OHT and SHK

Figure 2.1: OHT and SHK transplants 2000-2011

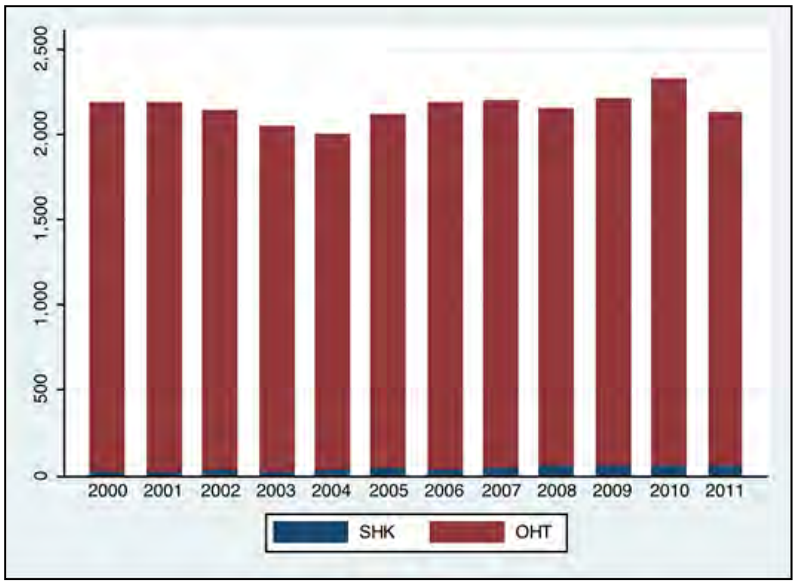


Figure 2.2: Percent SHK Transplants

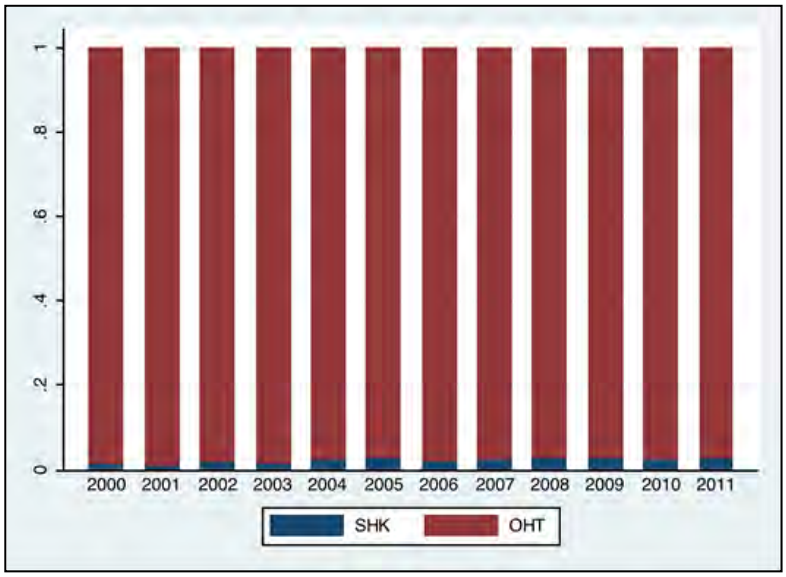


Table 1.1: Total number of heart transplants, number and percent of SHK transplants

TX year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total	1988	2020	1972	1919	1931	2001	2089	2090	2056	2077	2221	1810
SHK	32	30	47	38	45	53	47	65	66	56	62	48
SHK %	2%	2%	2%	2%	2%	3%	2%	3%	3%	3%	3%	3%

Note - Only 3% of heart transplants are SHK

Section 2 - Level of kidney function in OHT and SHK Recipients

Figure 2.1: Use of OHT and SHK among patients on dialysis

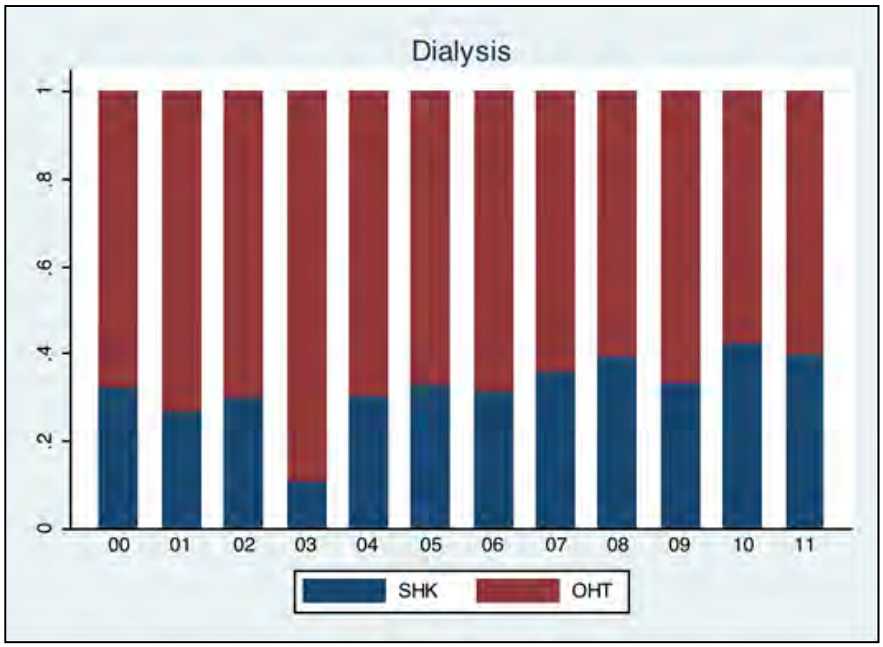


Table 2.1: SHK use among patients on dialysis

TX Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total Dialysis	84	75	94	86	94	105	88	104	93	90	92	72
SHK	27	20	27	10	29	34	27	38	37	30	39	29
SHK %	32%	27%	29%	12%	31%	32%	31%	37%	40%	33%	42%	40%

Note - Only 30-40% of heart transplant recipients on dialysis undergo SHK

Figure 2.2: Among Patients with GFR <30 (not on dialysis) use of OHT and SHK

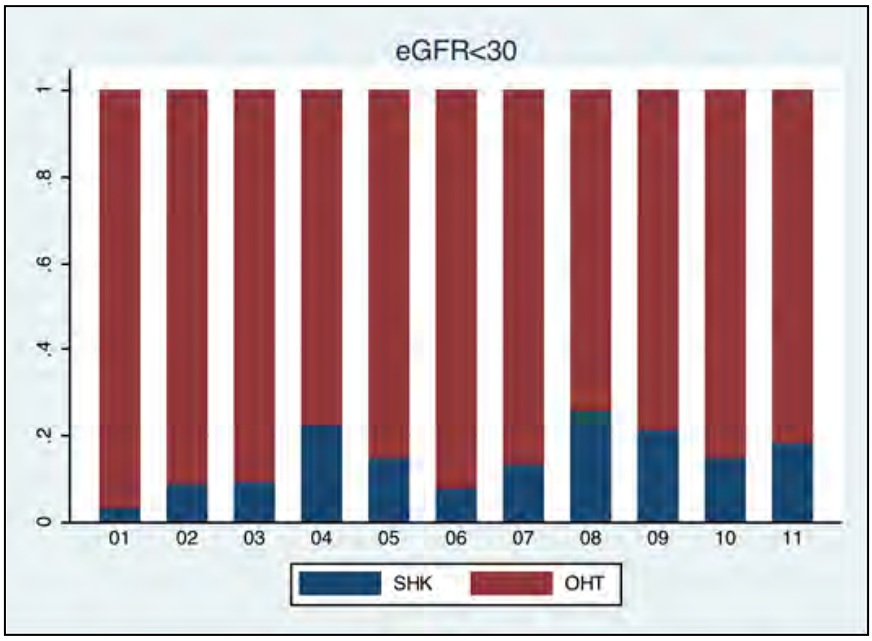


Table 2.2: SHK use among patients with GFR <30

TX Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total eGFR <30	87	66	74	66	68	50	68	58	61	54	54	86
SHK	3	6	7	15	10	4	9	15	13	8	10	5
SHK %	3%	9%	9%	23%	15%	8%	13%	26%	21%	15%	19%	6%

Note - Approximately 20% of heart transplant patients with GFR < 30 undergo SHK

Figure 2.3: Use of OHT and SHK among patients with GFR 30-60

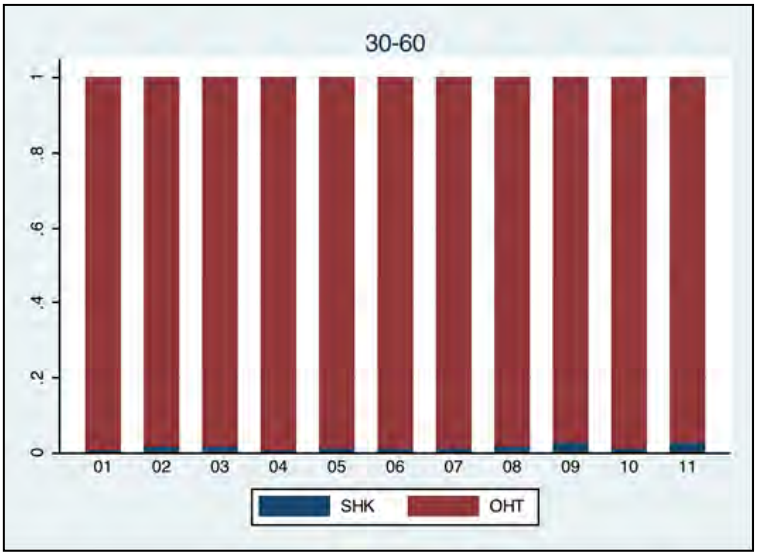


Table 2.3: SHK use among patients with GFR 30-60

TX Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total eGFR 30-60	642	681	688	632	596	649	632	674	586	593	659	549
SHK	2	4	11	11	4	8	9	9	11	17	10	10
SHK %	0%	1%	2%	2%	1%	1%	1%	1%	2%	3%	2%	2%

Note - A small number of patients with GFR 30-60 ml/min undergo SHK

Figure 2.4 Use of OHT and SHK among patients with GFR >60

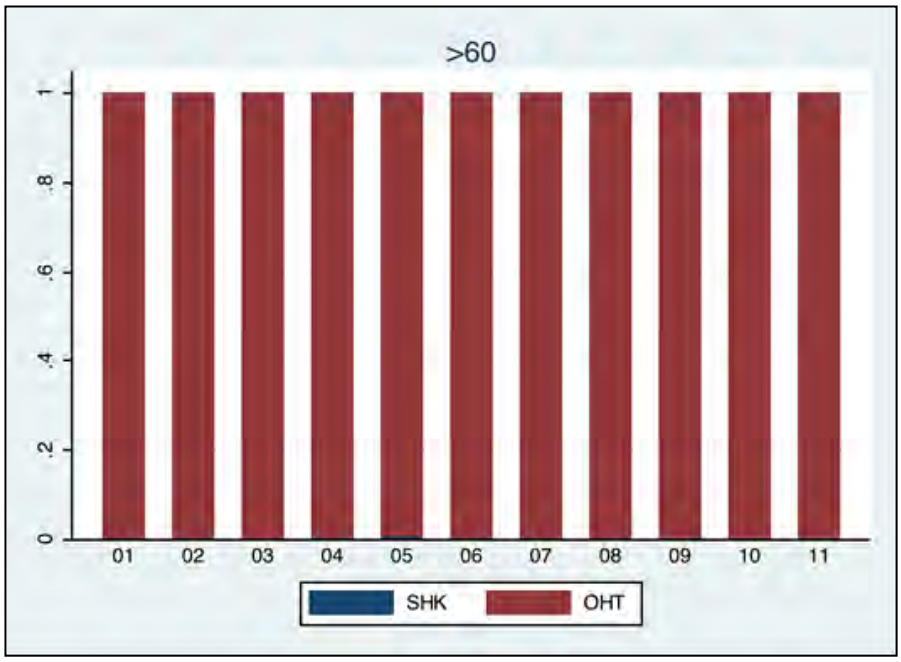
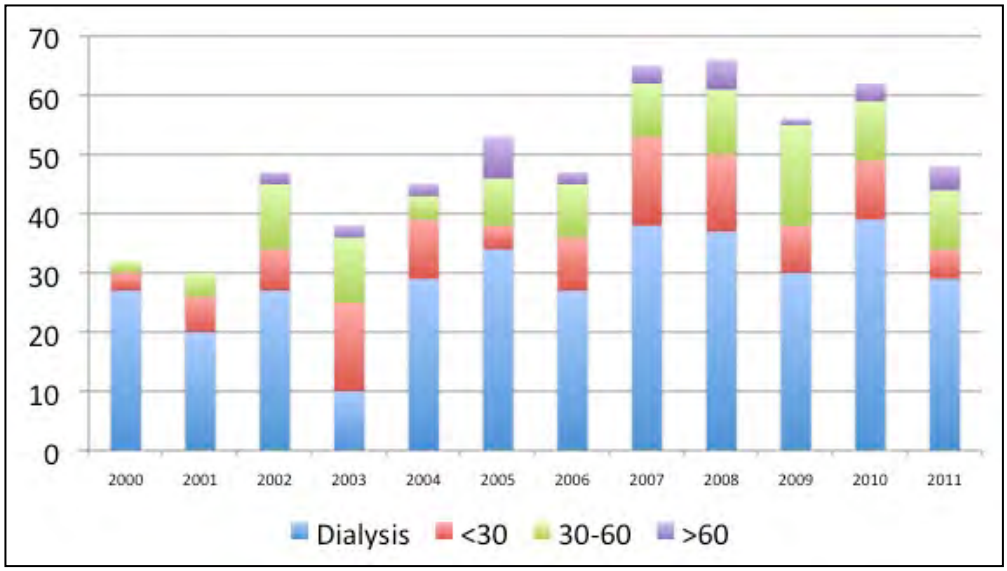


Table 2.4: SHK use among patients with GFR > 60

TX Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total eGFR>60	1175	1198	1116	1135	1173	1197	1301	1254	1316	1340	1416	1103
SHK	0	0	2	2	2	7	2	3	5	1	3	4
SHK %	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%

Note - Almost no SHK transplantation among those with GFR >60 ml/min

Figure 2.5: Kidney function in SHK recipients



Section 3 – Dialysis duration prior to heart transplantation

Duration of dialysis was determined through two methods:

- Linkage to USRDS first ESRD date allows calculation of the exact duration of dialysis.
- UNOS variable - indicates patient on dialysis for at least on week prior to heart transplantation but exact duration of dialysis is unknown.

Table 3.1: Duplicate of Section 3, Table 3.1 (page 63) - Duration of dialysis and use of OLT and SLK

Duration of Dialysis	OLT (%)	SLK (%)
USRDS Totals	959	2,061
0-1 months	483 (13.26)	356 (13.55)
1-2 months	103 (2.83)	250 (9.51)
2-3 months	24 (0.66)	165 (6.28)
3-4 months	12 (0.33)	97 (3.69)
4-5 months	15 (0.41)	75 (2.85)
5-6 months	16 (0.44)	62 (2.36)
6-12 months	40 (1.10)	271 (10.62)
> 12 months	266 (7.30)	785 (30.25)
UNOS Dialysis for at least 1 week	2,591 (73.68)	479 (20.89)
Total	**3,550**	**2,540**

Figure 3.1: Dialysis duration (includes UNOS Category of dialysis for at least one week prior to heart transplantation)

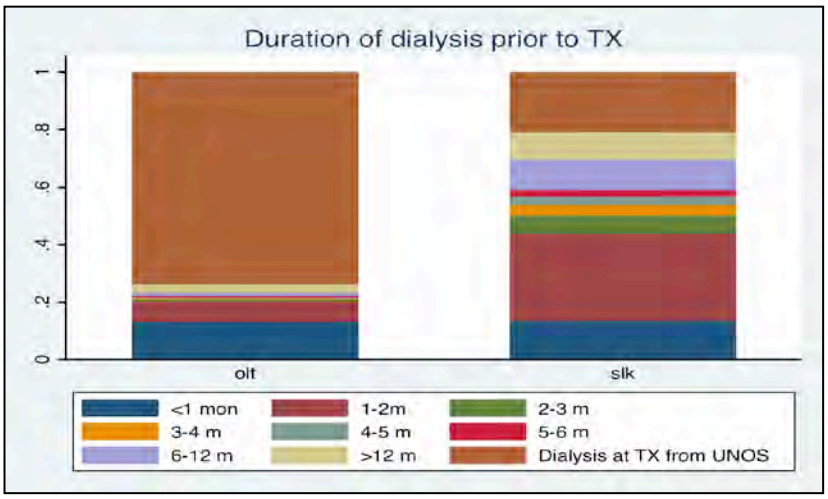


Figure 3.2: Duration of dialysis prior to treatment, (excludes UNOS category of dialysis for at least one week prior to heart transplantation)

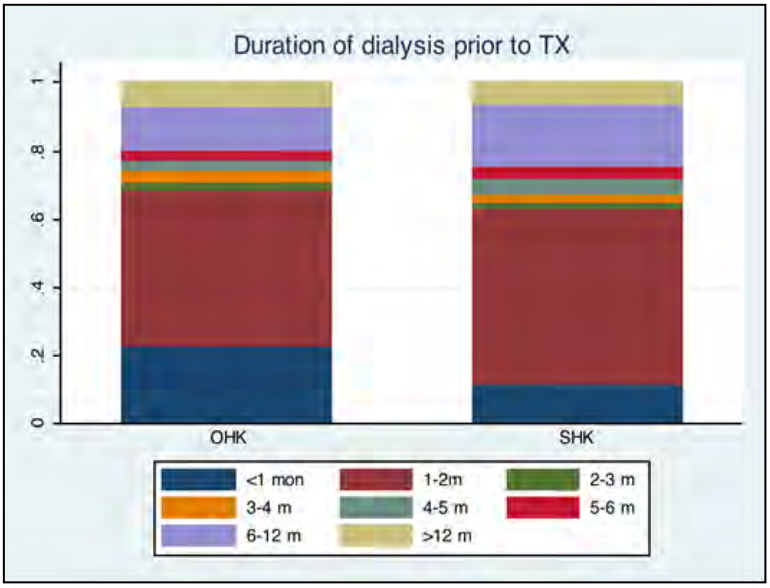
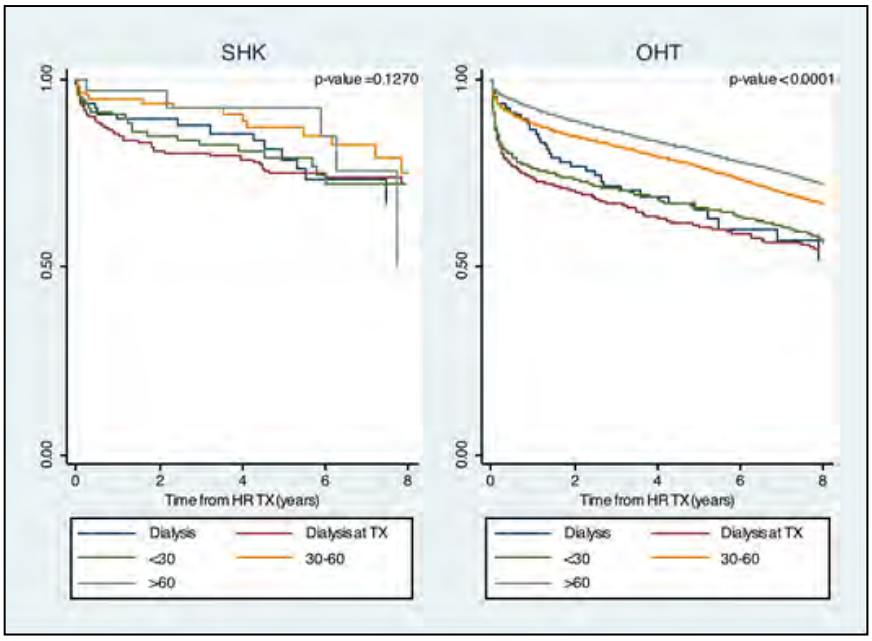


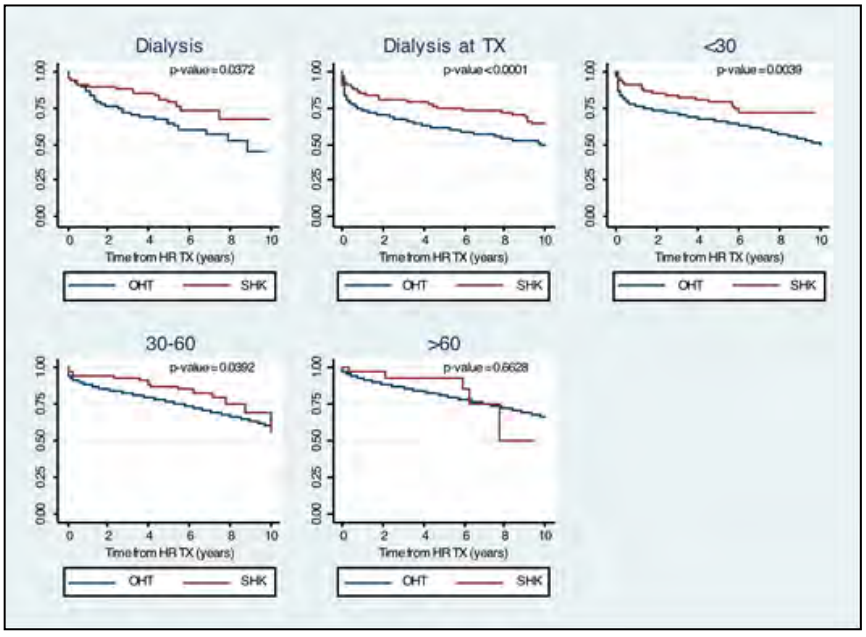
Table 3.2: Duration of dialysis for OHT and SHK

Duration of dialysis	OHT	SHK
0-1 months	63	30
1-2 months	12	16
2-3 months	7	4
3-4 months	7	6
4-5 months	3	12
5-6 months	6	9
6-12 months	17	50
> 12 months	61	146
UNOS (Dialysis) for at least 1 week	554	74
Total	730	347

Section 4 - Patient survival by level of kidney function

Figure 4.1: Patient survival after heart transplantation by level of kidney function for dialysis groups; Dialysis = USRDS; Dialysis at TX = UNOS Variable

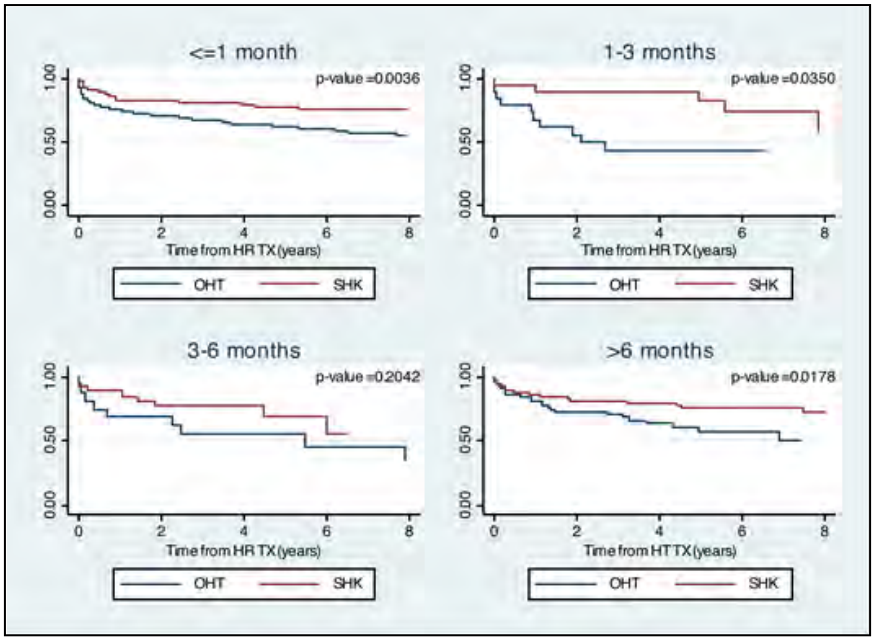




Note – kidney function associated with survival after heart transplantation in all groups except GFR >60. Note also the small numbers in 30-60 SHK group n=106.

Section 5 - Patient survival by dialysis duration

Figure 5.1: Patient survival by dialysis duration

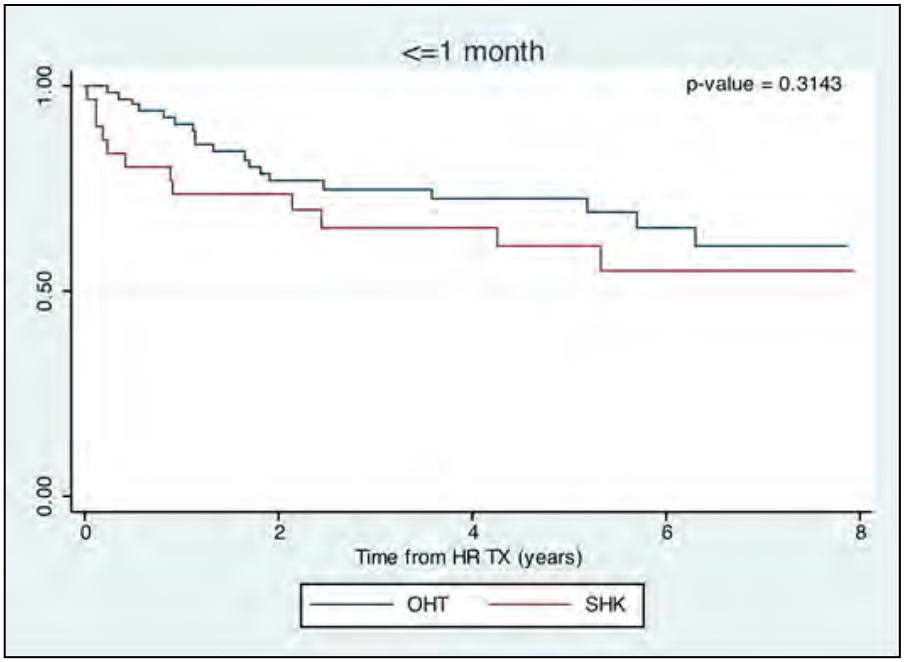


Note - Patients identified as requiring dialysis by UNOS variable are included in the < 1 month category

Table 5.1: Duration of dialysis and use of OHT and SHK

Duration of dialysis	OHT (%)	SHK (%)
0-1	63 (8.63)	30 (8.65)
1-2 months	12 (1.64)	16 (4.61)
2-3 months	7 (0.96)	4 (1.15)
3-4 months	7 (0.96)	6 (1.73)
4-5 months	3 (0.41)	12 (3.46)
5-6 months	6 (0.82)	9 (2.59)
6-12 months	17 (2.33)	50 (14.41)
> 12 months	61 (8.36)	146 (42.07)
UNOS Dialysis for at least 1 week	554 (75.89)	74 (21.33)
Total	**730**	**347**

Figure 5.2: Patient survival among those on dialysis (excluding heart transplant recipients identified as being on dialysis by UNOS dialysis variable only) n= 63 OHT, n=30 SHK



Note – This information is provided as a supplementary figure

Section 6 - Kidney survival

The following considerations apply to this section:

- For SHK recipients the outcome of kidney failure was defined as time to permanent dialysis or repeat kidney transplantation.
- For OHT recipients not on dialysis the outcome of kidney failure was defined as time to permanent dialysis or first kidney after heart transplant.

In OHT recipients on dialysis (Figures 6.1 and 6.2, below):

Figure 6.1 = URDS Dialysis Group (n=176)-– all of these patients were on chronic dialysis at time of heart transplantation– so this curve is a time to kidney transplant after heart transplantation. All patients were transplanted or censored at time of death.

Figure 6.2 – UNOS Dialysis Group (n=554) – outcome = a permanent dialysis date (n=64) from USRDS or a kidney after heart transplant (n=29).

Figure 6.1: Patient survival in all heart transplant recipients

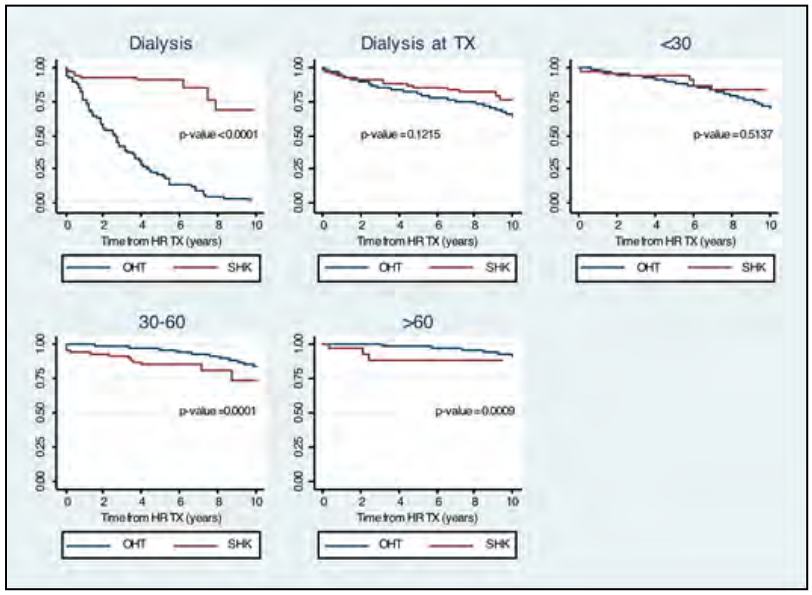
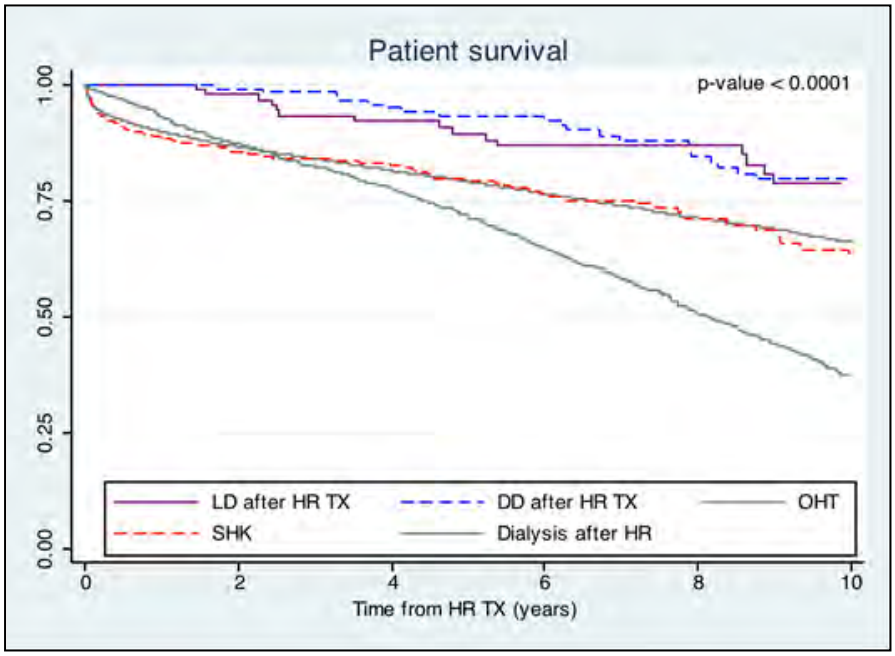


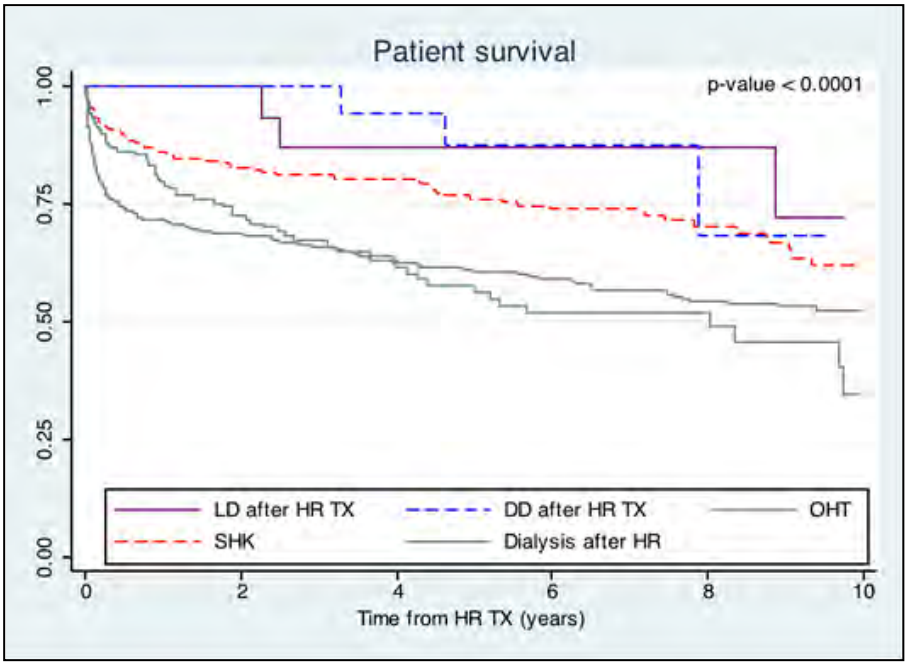
Figure 6.2: Patient survival including those with kidney after heart transplantation



Patient number summary for Figure 6.2

- LD kidney after heart transplant n=94
- DD kidney after heart transplant n= 117
- OLT only n=22,326
- SHK n=498
- Dialysis after OHT n=1,139
- Time to LD kidney after heart transplantation: 4.2yr ± 2.9yr (median (Q25, Q75):3.6(1.6,6.3))
- Time to DD kidney after heart transplantation: 5.2yr ± 2.5yr (median (Q25, Q75):5.2(3.0,7.0))

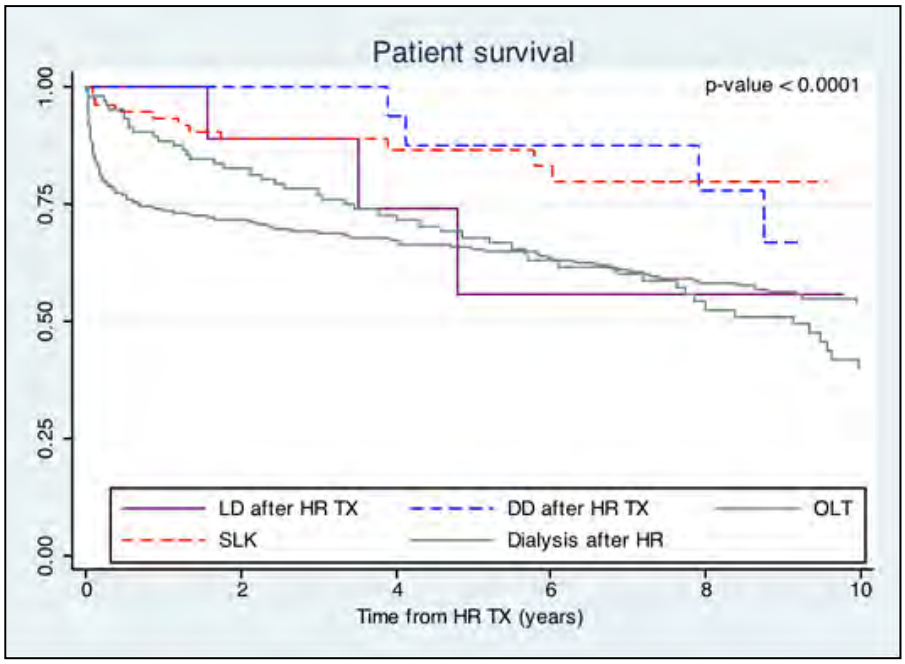
Figure 6.3: Patient survival among heart transplant recipients on dialysis (n=1047)



Patient number summary for Figure 6.3:

- LD kidney after heart transplantation n = 16
- DD kidney after heart transplantation n = 17
- OHT n= 532
- SHK n =317
- Dialysis after OHT n=152
- Time to LD kidney after heart transplantation: 2.4yr ± 2.4yr (median (Q25, Q75):1.4(1.0,3.4))
- Time to DD kidney after heart transplantation: 4.2yr ± 2.5yr (median (Q25, Q75):4.0(2.5,5.7)).

Figure 6.4: Patient survival among those with eGFR <30 (n=792)



Patient number summary for Figure 6.4:

- LD kidney after heart transplants n=9
- DD kidney after heart transplants n =17
- OHT n= 585
- SHK n =76
- Dialysis after OHT n=105
- Time to LD kidney after heart transplantation: 3.0yr ± 2.7yr (median (Q25, Q75):1.3(1.2,4.5))
- Time to DD kidney after heart transplantation: 3.7yr ± 2.1yr (median (Q25, Q75):3.3(1.9,4.2))

CHAPTER 3 – COMBINED LUNG AND KIDNEY

Data resource: SRTR from TX year 2000 to 2011

Figure 3.1: Lung transplant activity

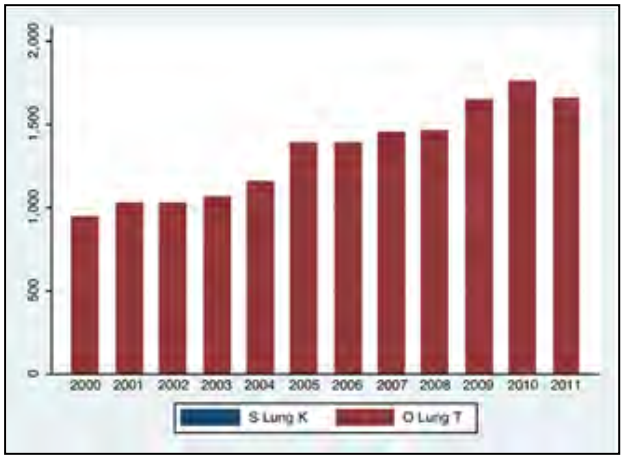


Table 3.1: Lung transplant activity by treatment year

TX Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Only Lung TX (n=15956)	939	1027	1026	1065	1151	1389	1388	1451	1463	1647	1758	1652
S Lung K (n=14)	0	0	0	1	1	1	1	2	2	2	1	3
S Lung K (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Figure 3.2: Kidney function in combined lung/kidney recipients

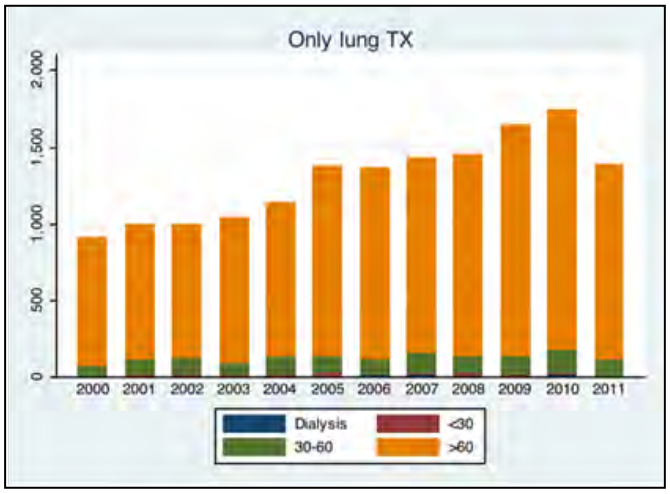


Figure 3.3: Kidney Function in lung transplant recipients

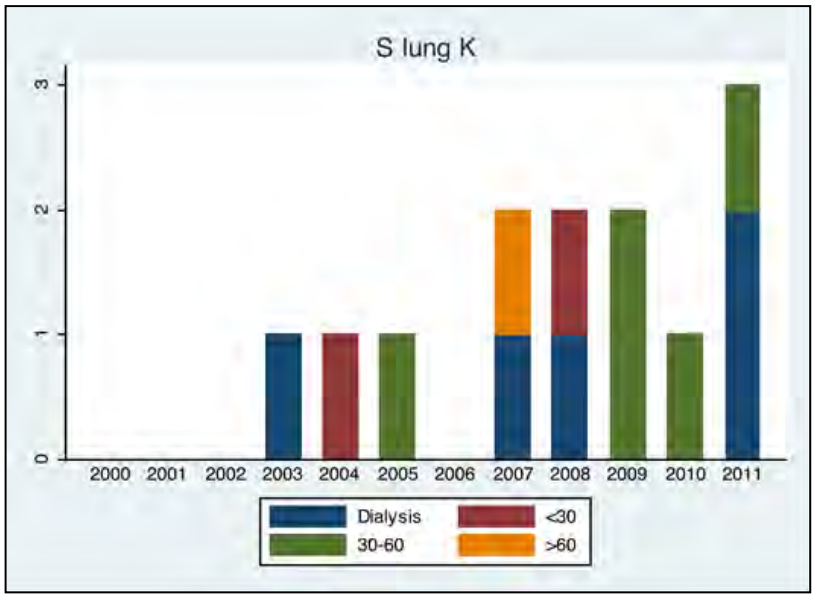


Table 3.2: Lung and combined kidney transplants

	Lung TX Only				S Lung Kidney			
TX year	**Dialysis**	**eGfr <30**	**30-60**	**>60**	**Dialysis**	**eGfr<30**	**30-60**	**>60**
2000	33	5	69	832				
2001	33	9	100	885	0			
2002	37	17	106	866	0			
2003	31	17	72	945	1			
2004	12	15	120	1004	0	1		
2005	24	16	120	1229	0		1	
2006	33	3	95	1257	1			
2007	29	13	133	1276	1			1
2008	18	15	109	1321	1	1		
2009	15	8	120	1504	0		2	
2010	29	11	156	1562	0		1	
2011	27	6	100	1276	2		1	

APPENDIX C: PARTICIPANT BIOGRAPHIES

CO-CHAIRS

Tom D. Blydt-Hansen, MD

Dr. Tom D. Blydt-Hansen received his MD from McGill University in 1992. He trained in Pediatrics and Nephrology at the Montreal Children's Hospital, and went on to receive further training in transplantation and research at the University of California, Los Angeles. He started his career at the University of Manitoba as a Pediatric Nephrologist and was Division Head of Nephrology from 2005-2014. Since 2014, he is Director of the Multi Organ Transplant Program at BC Children's Hospital.

He is the Past-President of the Canadian Society of Transplantation and is an established clinical and translational researcher. He is co-investigator on several nationally funded multi-center cohort studies including CAN-RESTORE, STOPP, CKiD, iCARE, ABLE and CNTRP that integrate the research model into active clinical care. His translational research program is focused on characterizing phenotypes of kidney allograft injury using urine metabolite profiling. He is lead investigator in the PROBE study, a CIHR funded multi-center cohort study to identify non-invasive urine biomarkers of allograft rejection in pediatric kidney transplant recipients.

Marcelo Cantarovich, MD

Dr. Marcelo Cantarovich is Professor of Medicine, Division of Nephrology, Department of Medicine, McGill University; Medical Director of the Kidney and Pancreas Transplant Program, and Associate Director of the Multi-Organ Transplant Program, Royal Victoria Hospital, McGill University Health Center, Montréal, Québec, Canada.

Dr. Cantarovich graduated in Medicine from University of Buenos Aires, Argentina, in 1980. He worked as a transplant coordinator at Argentina Transplant (CUCAI) from 1977 to 1982. He completed his residency in Internal Medicine in Buenos Aires and a fellowship in nephrology and transplantation at Université Paris-Sud in Paris, France from 1984 to 1988. His clinical interest is in multi-organ transplantation. His research focuses on immunopharmacology and on renal protection strategies in renal and non-renal transplant patients.

Dr. M. Cantarovich is Vice-President of The Transplantation Society (TTS), co-chair of TTS Education and CME Committee, co-chair of TTS Working Group on Education on Organ Donation and Transplantation for Schools, and past-President of the Canadian Society of Transplantation.

Peter Nickerson, BSc, MD, FRCPC

Dr. Peter Nickerson is a Clinical Nephrologist and Professor of Internal Medicine and Immunology and the Associate Dean (Research) at the University of Manitoba. He is the Executive Medical Director, Organs and Tissue Office, Canadian Blood Services (CBS).

Dr. Nickerson obtained his MD, Internal Medicine, and Nephrology training at the University of Manitoba, followed by a Transplant Research Fellowship at Harvard Medical School from 1991 to 1995.

Dr. Nickerson currently holds the Flynn Family Chair in Renal Transplantation at the University of Manitoba. His clinical research focuses on developing non-invasive techniques for diagnosis of renal

allograft rejection; mechanisms underlying acute and chronic rejection; and health care system design to enhance access to transplant.

CONTRIBUTORS

Ian P.J. Alwayn, MD, PhD

Dr. Ian Alwayn is an Associate Professor of Surgery, Pathology, and Microbiology & Immunology at Dalhousie University, Halifax, Nova Scotia and the Surgical Lead of the Multi-Organ Transplant Program at the Queen Elisabeth II Health Sciences Center in Halifax, Nova Scotia. He graduated *cum laude* from Leiden University Medical School in 1968 and completed his Surgical Residency at Erasmus MC, University Medical Center Rotterdam, both in The Netherlands. Dr. Alwayn completed a Research Fellowship at the Transplantation Biology Research Center, Massachusetts General Hospital/Harvard Medical School studying tolerance in xenotransplantation which led to his Ph.D. dissertation from Erasmus University, Rotterdam. Following his surgical training, Dr. Alwayn received a fellowship from the Dutch Cancer Society to specialize in hepatobiliary and solid organ transplant surgery in Rotterdam, Paris and Boston. Before moving to Canada, he was an attending Hepatobiliary and Transplant Surgeon at Erasmus MC, in Rotterdam.

Vince Bain, MD

Dr. Vince Bain is currently Professor of Medicine at the University of Alberta in the Department of Medicine and is also serving as Medical Director for the University of Alberta Liver Transplant Program. This adult transplant program includes 8 hepatologists, 3 transplant surgeons and combined they usually complete approximately 70 transplants per year including live donor transplants. His research interests in transplantation include immunosuppression drug trials and post-transplant disease recurrence.

Louis Beaulieu, MOA

Louis Beaulieu is the Chief Executive Officer of Transplant Québec and Secretary and Treasurer of the Board of Directors, a Québec-wide agency mandated by the Minister of Health and Social Services to coordinate organ donation in Québec since 2008. In January 2010, he was appointed, by the Cabinet of Québec, as a member of the Board of Directors of the Fonds de recherche du Québec – Santé (FRQ-S) which plays a leading role in planning and coordinating the development of research in Québec and allocates $100 million annually in awards and grants for research in health.

Louis Beaulieu is a member in good standing of the Ordre des orthophonistes et audiologistes du Québec since 1993. From 1996 to 2008, he was the President and Chief Executive Officer of the Ordre des orthophonistes et audiologistes du Québec. Alongside this, he was the Vice President (1998-2006) and then the President (2006-2008) of the Québec Interprofessional Council.

In 2011, Louis Beaulieu was elected Full member of The Transplantation Society (TTS) and member of the International Society for Organ Donation and Procurement (ISODP). He is also a member of the Association des directeurs généraux des services de santé et des services sociaux du Québec.

Louis Beaulieu obtained his first Bachelor's degree in Arts, from Université Laval (1986). He earned his second Bachelor's degree in Sciences in 1989, followed in 1993 by a Master's degree in speech language pathology and audiology from Université de Montréal. Ever since, in his capacity as practitioner and administrator, Louis Beaulieu has acted in the public arena, through the printed word, and within government circles as an advocate for speech language pathologists and audiologists and since 2008 to promote and develop organ donation for transplant patients in Québec.

Stephen Beed, MD FRCPC, Dip ABA, CCM

Stephen Beed is currently Medical Advisor, Nova Scotia Organ and Tissue Donation Program, Queen Elizabeth II Health Sciences Centre, Capital Health and also holds a position as Professor of Medicine, Critical Care and Anesthesia at Dalhousie University. Dr. Beed was also a member of the Canadian Blood Services Organ Expert Committee.

Anne Boucher MD, FRCPC

Dr. Anne Boucher obtained her medical degree at the University of Sherbrooke (1980). She completed her residency in internal medicine (1982) and nephrology (1984) at the University of Sherbrooke. She is a Fellow of the Royal College of Canada in Internal Medicine (1983) and Nephrology (1984). She did her post-doctoral fellowship training in immunopathology of the kidney at the University of Paris V, France (1984-1986) under the mentorship of Professors Dominique Droz and Laure-Hélène Noël at Necker-Enfants malades Hospital, Paris.

Dr. Boucher moved to the University of Montreal in 1986 to join the nephrology team as a transplant nephrologist at the Maisonneuve-Rosemont Hospital. She is currently a Professor in the Division of Nephrology and Transplantation at the University of Montreal and the Medical Director of the Kidney Transplant Program at the Maisonneuve-Rosemont Hospital (Affiliate Center of the University of Montreal) since 2006. She is also involved at Transplant Quebec (OPO) as a member of the Scientific Medical Committee since 2003 and as president since 2005. She is a member of the Royal College Nephrology Exam Board since 2007.

Dr. Boucher's primary interest is in immunology, renal pathology and clinical transplantation (clinical outcome, immunosuppressive drugs and clinical pathological correlation in renal allograft injury). Since 2009, Dr. Boucher and her colleagues have developed a bank of clinical data and biological tissues to support fundamental research in renal transplantation at the University of Montreal.

Michel Carrier, MD, FRCPC

Dr. Michel Carrier is the Surgical Director at the Montreal Heart Institute and Professor, Department of Surgery, University of Montreal. Dr. Carrier obtained his MD at Sherbrooke University in 1978 followed by a Transplant Research Fellowship in cardiothoracic surgery at the University of Arizona Health Science Center from 1985-1987.

Dr. Carrier has also obtained his Royal College of Physicians and Surgeons of Canada certification in General Surgery in 1982 and Cardiovascular and Thoracic Surgery in 1984. Dr. Carrier's major areas of interest are cardiovascular and thoracic surgery, cardiovascular physiology and heart and heart-lung transplantation.

Sandra Cockfield, MD

Dr. Sandra Cockfield received both her undergraduate and medical degrees from the University of Toronto. After completing residency training in general internal medicine and nephrology in Toronto, she joined the laboratory of Dr. Philip Halloran for a research fellowship focused on the regulation of MHC expression and its relationship to cytokine gene expression. She joined the Faculty of Medicine at the University of Alberta as an Assistant Professor and AHFMR Clinical Investigator in 1990. She is currently a Professor in the Division of Nephrology and Transplantation Immunology at the University of Alberta. She has served as Residency Program Director (1993-1999), Clinical Regional Program Director of the Northern Alberta Renal Program (1998-2002), and is currently the Medical Director of the Renal Transplant and the Nephrology Clinical Trials Programs. She has active research projects in several areas of clinical transplantation, including determinants of renal allograft outcome and viral infections post-transplantation.

Edward Cole, MD

Dr. Edward Cole received his Bachelor of Science and Master of Science from the University of Toronto in 1972 and 1973, respectively, and his MD from Memorial University of Newfoundland in 1975. Following four years of post-graduate training in internal medicine and nephrology at the University of Toronto, he received a Medical Research Council of Canada Fellowship for work in the laboratory of Dr. Curtis Wilson at the Research Institute of the Scripps Clinic that focused on glomerular immunopathology. He has been a member of the Faculty of Medicine at the University of Toronto since 1981, having worked at the Wellesley Hospital until 1984, St. Michael's Hospital until 1992, and is presently a staff nephrologist in the Renal Transplantation Program at the Toronto General Hospital. In 2001 he was appointed as Director, Division of Nephrology, University Health Network & Mount Sinai Hospital and in 2007 became the Amgen Professor of Nephrology. He is currently Professor of Medicine and, from 1996-2006; he was the Director of the Division of Nephrology, University of Toronto. He is founder and Chair of The Canadian Transplantation Society Kidney Working Group and Chair of the Steering Committee for National Kidney Registries. Dr. Cole was appointed Physician-in-Chief, University Health Network and Dr. Charles H. Hollenberg Chair in Medicine in May, 2010. He was recently awarded the Canadian Society of Transplantation Lifetime Achievement Award-2012. His major research interests

are in immunosuppressive drugs and clinical trials in renal transplantation with over 130 peer-reviewed publications.

Rosanne Dawson

Rosanne Dawson is legal counsel for Canadian Blood Services. She received her law degree in 2006 from the University of Ottawa and her Bachelor of Arts in 2002. Her main practice areas include health law, privacy and compliance. Before attending university, Rosanne worked as a medical laboratory technologist in Canada and Saudi Arabia.

Sean Delaney

Sean Delaney is currently employed by Canadian Blood Services in the capacity of Director of Organ Registries. He has experience working in the hospital, health region, and provincial government sectors in a variety of research and health administration roles. He played a key role in the development of the Living Donor Paired Exchange registry, and is the business lead for the current National Organ Waitlist (Heart, Lung, Liver, Pancreas, Small Bowel, Islet) and Highly Sensitized Patient Registry (kidney). Sean works and lives in Edmonton, Alberta. He is also a 14 year kidney transplant recipient.

Anne I. Dipchand, MD

Dr. Dipchand is a Paediatric Cardiologist and the Head of the Heart Transplant Program at the Hospital for Sick Children (SickKids) in Toronto. Her clinical practice focuses on heart failure and transplantation, and echocardiography. She also maintains a busy general paediatric cardiology practice at The Hospital for Sick Children.

Dr. Dipchand is extensively involved in the paediatric cardiology and heart transplantation communities locally, provincially and nationally within Canada. She serves on the Board of the MOT program at the University Health Network in Toronto, on the Steering Committee of the new University of Toronto Transplant Institute, and is member of the Transplant Steering Committee of the provincial organ procurement agency (Trillium Gift of Life Network). Nationally, she is the Past-Chair of the Canadian Society of Transplantation (CST) Education Committee, the Past-Chair of the CST Paediatric Committee, and the Secretary-Treasurer of the Canadian Cardiac Transplant Network Executive. Internationally, she is the Chair of the AST Pediatric Community of Practice, an executive member of the Paediatric Committee of the International Society of Heart and Lung Transplantation (ISHLT), a Councilor on the board of the International Pediatric Transplant Association (IPTA), and Chair of the IPTA Education Committee. Dr. Dipchand is a strong advocate for heart transplantation within Canada, especially with regards to paediatric issues and needs.

Dr. Dipchand has a strong interest in and has developed and/or spearheaded a number of local, national, and international symposia. She served as the local Co-Chair for the 6th Congress of the International Pediatric Transplant Association (IPTA) which took place in June 2011 in Montreal, Canada. Dr. Dipchand is actively involved in clinical research and is the President of the Pediatric Heart Transplant Study (PHTS) – an international study group. She is also the Founding President of the

Pediatric Heart Transplant Study Foundation. From a community perspective, Dr. Dipchand is a member of the Board of Directors of the David Foster Foundation, an organization committed to helping families of children who undergo a solid organ transplant and to increasing organ donor awareness in North America. She also actively spearheads opportunities for children and families of children with organ transplantation including participation at the World Transplant Games, and educational symposia.

Darren Freed, MD

Dr. Freed is a Cardiac Surgeon and Head, Surgical Heart Failure Program with the Winnipeg Regional Health Authority Cardiac Sciences Program. He obtained his MD from the University of Alberta in 1998 and completed his cardiac surgical training at the University of Manitoba where he also obtained a PhD in Physiology in 2004. In 2007, he completed a Clinical Fellowship in Cardiothoracic Transplantation and Ventricular Assist Devices at Papworth Hospital in Cambridge, United Kingdom. He is currently an Assistant Professor, Section of Cardiac Surgery, Department of Surgery, and holds a cross appointment in the Department of Physiology, University of Manitoba. His clinical activities encompass mechanical circulatory support for end-stage heart and lung failure as well as lung transplantation.

Ronnie Gavsie, President and CEO, Trillium Gift of Life Network

Ronnie holds a B.Sc. from McGill University and an MBA from the University of Ottawa. She brings leadership and health industry experience through her work as Senior Partner with KPMG LLP, President and CEO of the Ontario Genomics Institute, and Managing Director of the Research and Health Promotion Practice PwC LLP. Ronnie currently serves on the Dean's Advisory Board at the University of Ottawa's Telfer School of Management and on the Board of Directors of the Ontario Pharmacists' Association.

The Board of Directors of Trillium Gift of Life Network announced the appointment of Ronnie Gavsie as its new President and CEO, effective July 4, 2011.

Anand Ghanekar, MD

Dr. Anand Ghanekar is an abdominal organ transplant surgeon at the University Health Network and Hospital for Sick Children in Toronto.

John Gill, MD

John Gill is an Associate Professor of Medicine with Tenure at The University of British Columbia, Division of Nephrology, St. Paul's Hospital. John is an active researcher whose interests include clinical outcomes in kidney transplantation, access to care, clinical trials and health services research. He is the supervisor for Masters and PhD candidates at the UBC School of Population and Public Health. John is President Elect of the Canadian Society of Nephrology, Chair of the American Society of Transplantation Education Committee, and Associate Editor of the American Journal of Transplantation.

Nessa Gogan, MD Nephrology Program, Saint John Regional Hospital

Dr. Gogan's biography was not available at the time of printing.

Sophie Gravel

Recently appointed to the position of Program Manager, Organ Donation and Transplantation Projects at Canadian Blood Services, Sophie came from The Ottawa Hospital where she worked as a facilitator, assisting in the implementation of a novel inter-professional model of patient care.

Originally from Montreal, Sophie moved to Vancouver to obtain her master's degree in speech-language pathology; her 15 years of clinical experience span across the healthcare continuum in Canada and in Australia. While she pursued a master's degree in Public Health, Sophie worked as a project manager for the Australian government, implementing policies to develop the research field in palliative care, supportive care and survivorship. She also recently completed a contract as a policy analyst at Health Canada.

Bryce A. Kiberd, MD, FRCPC

Bryce A. Kiberd, MD, FRCPC, is professor of medicine at Dalhousie University and staff physician at the Queen Elizabeth II Health Sciences Centre, Halifax, Nova Scotia. He serves as medical lead of the Multi-Organ Transplant Program and the Kidney Transplant Program for Atlantic Canada.

After receiving his medical training at the University of Toronto, Dr. Kiberd completed his internship and residency at Dalhousie University, and fellowships at the University of Toronto and Stanford University, Palo Alto, California. He was also awarded fellowships by the National Institutes of Health and the National Kidney Foundation. Dr. Kiberd received his board certification in internal medicine with specialty certification in nephrology in both Canada and the United States. He was elected a fellow of the Royal College of Physicians and Surgeons of Canada. Dr. Kiberd's research interests include many of the medical issues and complications of kidney transplantation and kidney disease prevention strategies. He has a particular interest in using medical decision analysis to examine medical practice.

Daniel H. Kim, MD

Dr. Kim is an Associate Professor of Medicine at the University of Alberta and member of the Division of Cardiology at the Mazankowski Alberta Heart Institute where he is an Interventional & Heart Transplant Cardiologist. He is the Medical Director of Heart Transplantation and Medical Director of the Adult Cardiac Assist Devices Program.

After graduating from the University of Calgary Medical School, Dr. Kim went on to train in Internal Medicine, Cardiology and Inverventional Cardiology at the University of Alberta. He then proceeded to do a Fellowship in Heart Transplantation and Advanced Heart Failure at the prestigious Stanford University Medical Center, in California.

Since accepting an academic position at the University of Alberta in 2003, he has engaged in a busy academic clinical practice, while also dedicating himself to teaching, having received numerous teaching awards from the Faculty of Medicine & Dentistry, Department of Medicine, Department of Family Medicine, Cardiology Fellows, Internal Medicine Residents and the Medical Students Association.

His clinical interests are in Acute Care, Advanced Heart Failure and Heart Transplantation, as well as advanced cardiac procedures such as coronary interventions, invasive intracoronary imaging and coronary physiologic assessment.

He has authored and co-authored numerous publications in journals like Circulation, American Journal of Cardiology, American Heart Journal and American Journal of Transplantation, as well as being one of the primary authors of the most recent guidelines from the International Society of Heart & Lung Transplantation.

Research endeavors include topics in; Clinical Outcomes in Heart Transplantation, Non-invasive Testing in the Diagnosis of Rejection, the Role of Gene Transcription in Heart Transplant Rejection, Diastolic Heart Failure, as well as collaborations in numerous clinical trials.

S. Joseph Kim, MD, PhD, MHS, FRCPC

Dr. S. Joseph Kim is a staff nephrologist in the Division of Nephrology and co---director of the Kidney Transplant Program at the Toronto General Hospital, University Health Network. He is also an Assistant Professor in the Department of Medicine and the Institute of Health Policy, Management and Evaluation at the University of Toronto. He is the President of the Canadian Organ Replacement Register Board of Directors, Vice---Chair of the U.S. Organ Procurement and Transplantation Network Data Advisory Committee, and the Associate Head of the Kidney, Dialysis and Transplantation program at the Institute for Clinical Evaluative Sciences. Dr. Kim completed medical school, internal medicine residency, chief medical residency, and fellowships in nephrology and kidney transplantation at the University of Toronto. In 2008, he completed a PhD in epidemiology and a Masters in biostatistics at the Johns Hopkins Bloomberg School of Public Health. His research interests are in the areas of access to and outcomes of kidney transplantation using data from both centre--- and population---based cohorts. His methodological interests include survival analysis and statistical models for causal inference.

Norman M. Kneteman, MD, MSc, FRCSC, FACS

Dr. Norman Kneteman trained in surgery at the University of Alberta and did his Fellowship in multi-organ transplantation at Washington University School of Medicine in St. Louis, Missouri. He is currently Professor of Surgery at the University of Alberta, Regional Program Clinical Director of Transplantation and Co-Zone Clinical Section Chief, NARP and Transplants at University Hospital/Alberta Health Services. He heads the Alberta Liver Transplant Program and performed the first liver transplant at the University Hospital in 1989; he is also a practicing hepatobiliary/pancreatic/transplant surgeon. Current research interests include the role of liver transplantation in the treatment of HCC and development and evaluation of therapy for hepatitis C in a mouse model.

Gregory A. Knoll, MD

Dr. Greg Knoll is Professor of Medicine in the Division of Nephrology at the University of Ottawa and at the Ottawa Hospital. He is the Medical Director of Renal Transplantation at the Ottawa Hospital and a Scientist with the Clinical Epidemiology Program of the Ottawa Hospital Research Institute. Dr. Knoll was the previous President of the Canadian Society of Transplantation (2008-2009). He is involved in ongoing studies related to the measurement of renal function in kidney transplant recipients, the role of ACE-inhibitors in long-term patient and graft survival, systematic reviews on immunosuppressive strategies, determinants of survival following kidney transplant failure and the long-term effects of living kidney donation.

Michel Lallier, MD Liver Transplant Program, CHUM-Hopital Sainte Justine

Dr. Lallier's bio was not available at the time of printing.

Robert Levy, MD, FRCPC

Dr. Robert D. Levy trained in Respiratory Medicine at McGill University in Montreal and subsequently worked as a respirologist at the Royal Victoria Hospital in Montreal for 10 years. He was the Director of the Pulmonary Function Laboratories at the Royal Victoria and Montreal Chest Hospitals and a Research Director at the Meakins-Christie Laboratories. He moved to Vancouver in 1997 where he is a Professor of Medicine at the University of British Columbia. He initially practiced respiratory medicine in the Respiratory Division of the Vancouver Hospital and Health Sciences Centre. In September 2002, Dr. Levy took over the position of Head of the Division of Respirology at St. Paul's Hospital in Vancouver. He is currently the Medical Director of the Lung Transplant Program at the British Columbia Transplant Society and is co-director of the Pulmonary Hypertension Program at Vancouver Hospital and Health Sciences Centre.

Dr. Levy has published extensively in the fields of respiratory medicine and lung transplantation. His major research interests are related to physiologic and functional outcomes following solid organ transplantation. He has served as an examiner for the Royal College of Physicians and Surgeons of Canada in Respiratory Medicine. He was co-chair of the Canadian Lung Transplant Study Group from 1997-2001, and has served on the board of the Canadian Thoracic Society since 1997 where he is currently Chair of the Pulmonary Vascular Diseases Committee.

Dale Lien, BSc, MD, FRCPC, FACP, FCCP

Dr. Lien graduated from the University of Alberta medicine program in Edmonton in 1978. He completed an internship, Internal Medicine training, and Pulmonary Medicine training at the University of Alberta before continuing with a research fellowship at National Jewish Center for Immunology and Respiratory Medicine in Denver Colorado. In 1987 he returned to join the Pulmonary Division at the University of Alberta where he currently is a Professor of Medicine and practices at the University of Alberta Hospital. Among various positions served in the past, he has been director of the pulmonary medicine training program, director of undergraduate training for pulmonary medicine, and respiratory representative to

the Alberta Medical Association, Currently he is director of the lung transplant program, and co-director of the pulmonary hypertension program. Research interests include clinical investigation in the areas of pulmonary hypertension, pulmonary fibrosis and lung transplantation. Other interests include continuing medical education for practicing physicians and development of clinical practice guidelines.

Rahul Mainra, MD

Dr. Rahul Mainra is currently a Staff Transplant Nephrologist at St. Paul's Hospital in Saskatoon. He also has an appointment as a Clinical Assistant Professor with the Department of Medicine, University of Saskatchewan.

Dr. Mainra has completed a Masters in Medicine (Clinical Epidemiology) from the University of Sydney (Australia) as well as a Transplant Fellowship at Westmead Hospital, University of Sydney, New South Wales. He then completed a Nephrology Fellowship at the University of Western Ontario and Internal Medicine at the University of Saskatchewan Prior to this his BSc was a Major in Physiology.

Michel Paquet, MD Kidney Transplant Program, CHUM – Hopital Notre-Dame

Dr. Paquet's bio was not available at time of printing.

Deanna Paulson

Deanna Paulson is the Executive Director for the Northern Alberta Renal Program and Transplant Services. She has been involved in donation and/or transplantation since moving to Edmonton in 1998. The programs (HOPE, Recipient, Inpatient Unit, Comprehensive Tissue Center; and the Clinical Islet and Islet Lab) were amalgamated under one umbrella in 2005. The Northern Alberta Renal Program joined Transplant Services in 2011.

Vivek Rao, MD

Dr. Vivek Rao is the Chief of Cardiovascular Surgery and Professor of Surgery at the Toronto General Hospital where he is the Surgical Director of the Heart Transplant program. Dr. Rao completed his medical and surgical training at the University of Toronto prior to completing a fellowship in cardiac transplantation and mechanical circulatory support at New York's Columbia-Presbyterian Hospital. In addition to performing a wide variety of cardiac surgical procedures, Dr. Rao is a recognized expert in heart failure surgery. He currently holds the Munk Chair in Advanced Cardiac Therapeutics at the Peter Munk Cardiac Center, Toronto General Hospital. In 2006, he was named as one of Canada's "Top 40 under 40" by Caldwell Partners International.

Dena Mercer-Rice

Dena Mercer-Rice is a Director with the Organ Donation & Transplantation (ODT) program at Canadian Blood Services. She joined the ODT program almost two years ago. Prior to that she worked as a Program Manager with Canadian Blood Services' Stem Cells line of business, where her responsibilities

included policy development, strategy management, and business case development for the Public National Cord Blood Bank. Under Dena's leadership, the OneMatch Stem Cell and Marrow Network achieved accreditation with the World Marrow Donor Association in 2007, making Canada the seventh registry out of more than 50 registries worldwide to achieve this status. During her thirteen year tenure at Canadian Blood Services, Dena was also seconded to the Office of Strategy Management to work on the development of the corporate strategy management system. Dena holds a Bachelor of Arts and a Bachelor of Education from Memorial University of Newfoundland, as well as a Master of Business Administration from Charles Sturt University, Australia.

David N. Rush, MD, FRCPC, FACP, FASN

David Rush received an M.D. degree in 1972 from the National University of Tucumán, Argentina. His post-graduate training in Internal Medicine and Nephrology was undertaken at the University of Western Ontario in London. In 1982, he was recruited to the University of Manitoba in Winnipeg. In addition to several teaching awards, he was awarded the Nadine Jenkins Distinguished Service Award by The Kidney Foundation of Canada Manitoba Branch in 2003, and The Canadian Society of Transplantation Lifetime Achievement Award in 2008. He is currently Professor and Head of the Section of Nephrology at the University of Manitoba, Director of Transplant Manitoba – Adult Kidney Program, and Associate Medical Director, Manitoba Renal Program. His interests are clinico/pathological correlations in acute and chronic renal allograft rejection, non-invasive monitoring of the renal allograft and biomarker development, as well as medical education.

Jeffrey Schiff, MD

Dr. Jeffrey Schiff is an Assistant Professor of Medicine in the Department of Medicine at the University of Toronto. He completed his undergraduate medical school, Internal Medicine and Nephrology training at McGill University, followed by a Fellowship in Kidney and Pancreas Transplantation at McGill and Université de Montréal. He is a staff nephrologist at University Health Network and is also the Medical Director of the Pancreas Transplant Program, part of the Multi-Organ Transplant Program at UHN. He is also the Editor-in-Chief of the Transplant Now website, www.transplantnow.com.

Charles Scudamore, MD

Dr. Charles Scudamore is currently the Staff Surgeon at the Vancouver General Hospital and the B.C. Children's Hospital, the Surgical Director of the B.C. Liver Transplant Program, the Head of the Section of Hepatobiliary and Pancreatic Surgery, UBC.

Dr. Scudamore's main areas of interest are liver transplantation, hepatobiliary oncology, hepatobiliary trauma, early recognition of pancreatic cancer and respective techniques for advanced colorectal metastases to the liver.

Dr. Scudamore received his U.B.C. Masters Degree in Surgery, University of Cambridge and did Fellowships at the University of Hong Kong, Karolinska in Stockholm and St. Georges School of Medicine, London. He is also a visiting professor at the University of Edinburgh, Cambridge University, Oxford

University, The Hammersmith School of Medicine, Kings College, London, University of Edmonton, University of Winnipeg, Dalhousie University, Halifax, University of Washington, Seattle.

Lianne Singer, MD

Dr. Lianne Singer is medical director of the Toronto Lung Transplant Program at University Health Network, Toronto and Assistant Professor of Medicine at the University of Toronto.

Jean Tchervenkov, MD

Dr. Jean Tchervenkov is a Multi-organ Transplant Surgeon at McGill University since 1990. He is an Associate Professor of Surgery and was instrumental in establishing and developing the Liver Transplantation Programme at McGill in 1990. Under his leadership the Multi-organ Programme was solidified at the Royal Victoria Hospital since 1997. His research interests are many, but particularly he has presented work and has published on Hepatitis B after liver transplantation, immunosuppression protocols and outcomes after liver and kidney transplantation, expanded criteria donors for kidney transplantation, xenotransplantation and particularly B-cell function, and B and T lymphocytes function in the highly sensitized patient.

Nadine Valk

Nadine Valk is National Director of Programs and Public Policy for The Kidney Foundation of Canada. Nadine has a Master's degree in Public Administration (health policy) from Queen's University and over 20 years of experience working for health charities and non-profit organizations at the local, provincial and national levels.

Sandra White, RN

Sandra White graduated from General Hospital School of Nursing in 1985 and then went on to complete the BN program at MUN School of Nursing. She worked in the MedSurg ICU in St. John's HSC for 12 years and then went on to work with the Health & Community Services for one year. She continues to work in her current position as Organ Donation Coordinator since 1998. Since 2006 she has been Program Coordinator for OPEN (Newfoundland Organ Procurement Organization).

Jean-Luc Wolff, MD

Jean-Luc Wolff is a Nephrologist with particular interests in transplantation and ethics. He completed his residency in Hepatogastroenterology and Nephrology in Strasbourg (France) and his training in Transplantation and Immunology (Master of Science) at the Necker Hospital in Paris, France. Since 1991, he is Professor of Nephrology at the Sherbrooke University (Quebec) and the Centre Hospitalier Universitaire de Sherbrooke. Dr. Wolff is also a member of Transplant-Quebec.

Linda Wright MHSc, MSW, RSW

Linda Wright is Director of Bioethics and Palliative Care for University Health Network (UHN), Toronto. At the University of Toronto, Linda is an Assistant Professor in the Department of Surgery, Faculty of Medicine, and a member of the Joint Centre for Bioethics.

Linda provides clinical and organizational ethics consultation and education to a wide range of healthcare workers. Her primary research focus is on the ethical issues raised by organ transplantation. She lectures nationally and internationally on this subject, and has authored numerous book chapters and peer reviewed articles in leading medical journals. Linda has also reviewed for major bioethics and medical journals. Linda is a member of the Canadian Society of Transplantation Ethics Committee and serves on the Health Canada Expert Advisory Committee on Cells, Tissues and Organs.

Kimberly Young

Kim is the Executive Director, for Organ Donation and Transplantation with Canadian Blood Services, she brings a wealth of experience and knowledge from her previous role as Chief Executive Officer of the former Canadian Council for Donation and Transplantation (CCDT).

While with CCDT, Kim led the development of numerous pivotal leading practices and policies that have resulted in better patient care and improved clinical practices. Since joining Canadian Blood Services, Kim has continued to play a leadership role in the development of leading practices and with the development of patient registries such as the Living Donor Paired Exchange registry; and she worked with the organ and tissue donation and transplantation (OTDT) community in the development of a national system design.

As a key member of the OTDT leadership team at Canadian Blood Services, Kim's current focus is the ongoing integration of OTDT activities into the organization's existing business practices; working with stakeholders—from governments to clinicians—to improve the performance of OTDT in Canada; and supporting provincial programs in their ongoing change efforts.

Jeffrey Zaltzman MD, MSc, FRCPC

Dr. Zaltzman was born and raised in Montreal. He completed both his undergraduate studies and Medical School at McGill University. He did a residency in Internal Medicine at The University of Manitoba from 1986-1989, then moved to Toronto for both Nephrology and Transplant training. In addition he completed his MSc in Clinical Epidemiology at the University of Toronto in 1991-1994. He joined the Division of Nephrology at St. Michael's Hospital in 1993, where he played an active role in the resurgence of the kidney transplant program, and became its director in 2000. He was actively involved with medical education, and was the Director of the Internal Medicine residency program at St. Michael's Hospital. He continues as the educational director of Nephrology at the hospital. He has been involved in research ethics and served as the chair of the REB in 1996-98. He is the Medical Director of the Diabetes Comprehensive Care Program at St. Michael's Hospital, in addition to the CMO, Transplant of Trillium Gift of Life. He has been and continues to be actively involved with the Kidney Foundation of

Canada in both the provincial and National levels. His research interests are in the areas of chronic allograft nephropathy, cardiovascular issues in transplantation and transplant ethics.