Technical Notes and Analytic Methods, 2006

This section explains concepts of transplant data, defines the data items appearing in the Reference Tables, and documents the analytic methods used throughout this report. The Reference Tables are divided into 14 subject-area sections and a Supplementary Tables section that includes "legacy tables" in formats no longer used in the main sections, as well as experimental tables that may be included in the main set of tables in future reports. These notes also cross-reference those data tables to which each topic applies.

The OPTN/SRTR data reported here are based primarily on data collected by the OPTN, validated by data from other sources. For detailed explanations of the how the data are collected, supplemented, and analyzed, please see the "Transplant Data" and "Analytical Approaches" chapters in previous editions of this report. (1)

The 2006 *Annual Report* includes new tables showing patient and graft survival outcomes at one month, three years, five years, and 10 years, by year of transplant. Other recent methodological changes to the way the data are collected and computed are described below.

TIME PERIODS COVERED

Most tables are based on OPTN/SRTR data current as of May 1, 2006. This date was chosen to allow the maximum amount of time possible to obtain and validate data while ensuring completion of the report by year- end. All cohorts were chosen to reflect the most recent statistics possible while minimizing the probability of change due to the submission of additional data. Data are subject to change on the basis of future data submission or correction.

Most tables present data by year from 1996 to 2005. Tables showing posttransplant survival use cohorts of transplants that may be from earlier years to allow for fuller reporting of follow- up. For a more detailed discussion of the choice of cohorts for different analyses and counts, see previous editions of this report (1).

DECEASED AND LIVING DONOR CHARACTERISTICS

Donor tables show frequency counts and percentages for deceased and living donors by year, broken out by selected demographic and medical factors (donor age, race, gender, blood type, cause of death, circumstance of death, mechanism of death, and donor relation). The deceased donor tables also present organ utilization statistics by year, which list organs of any type recovered and transplanted from these donors. Table 1.1 presents counts of donors by organ for deceased and living donors. Section 2 presents organ-specific counts and percentages of donors by donor characteristics for deceased and living donors, as well as the organ utilization tables.

Deceased Donor Characteristics and Organ Utilization

Characteristics of deceased donors and the utilization of organs from them are presented in the following tables:

Table 1.1	Summary Table: All Donors by Organ and Donor Type
Table 2.1	All Donors (Deceased)
Table 2.2	Kidney Donors (Deceased)
Table 2.3	Pancreas Donors (Deceased)
Table 2.4	Liver Donors (Deceased)

Table 2.5	Intestine Donors (Deceased)
Table 2.6	Heart Donors (Deceased)
Table 2.7	Lung Donors (Deceased)
Table 2.12	Organ Utilization, Any Organ
Table 2.13	Organ Utilization, Kidney
Table 2.14	Organ Utilization, Pancreas
Table 2.15	Organ Utilization, Liver
Table 2.16	Organ Utilization, Intestine
Table 2.17	Organ Utilization, Heart
Table 2.18	Organ Utilization, Lung

These data are obtained from the OPTN Deceased Donor Registration (DDR) form. Only deceased donor organs recovered by United States organ procurement organizations (OPOs) are included in these tables.

For the purposes of this report, a “recovered” deceased donor is one from whom at least one vascularized solid organ (kidney, pancreas, liver, intestine, heart, or lung) is recovered for the purpose of organ transplantation, even if the organ is eventually not used for a transplant. Organ-specific donors (e. g., “ kidney donors” or “liver donors”) are those from whom at least one organ of that type is recovered. If more than one organ is recovered from a donor, that donor is included in each organ-specific donor count. Hearts recovered for heart valves, pancreata recovered for islet cells, and livers recovered for extracorporeal liver or hepatocytes are not counted.

Donors are divided into three mutually exclusive and complete categories. All donors meeting the criteria for expanded criteria donors (ECD) for kidney are classified as ECD, regardless of whether the kidneys were allocated under the ECD system. Non-ECD donors are classified as either donor after cardiac death (DCD) or standard criteria donor (SCD); donors who meet the criteria of both ECD and DCD are classified as ECD. In addition, organ recovery and transplant rates are reported both overall, and within each donor type. Note that not all recovered organs are actually transplanted. Data tables pertaining to the recovery and disposition of organs are presented in Section 3, Deceased Donor Organ Recovery and Disposition.

Living Donor Characteristics

Living donor characteristics are presented in the following tables:

Table 2.8	All Donors (Living)
Table 2.9	Kidney Donors (Living)
Table 2.10	Liver Segment Donors (Living)
Table 2.11	Lung Lobe Donors (Living)

These data are based on OPTN Living Donor Registration forms and include living donors from whom organs were transplanted in the United States between 1996 and 2005. The year of reporting is based on the organ recovery date as reported to the OPTN. The numbers of living pancreas, intestine, and heart donors are too small to offer meaningful information, and therefore are not presented in detail.

Some living donations described are the result of complicated operations. Questions are frequently asked about how a living donor heart transplant can be possible. This happens rarely, but can result when a heart-lung transplant is performed. In this case, the recipient's heart has been enlarged from the disease that affected the lungs. The person's own heart may damage the donor lungs if they are transplanted alone, whereas the combined heart-lung bloc is more physiologically matched. The heart of the recipient is useful as a transplant for a large person whose own heart size needs are large. Similarly, "domino" liver transplants may be performed in the case of familial amyloidosis, a disorder that progresses slowly. A candidate who has a very short life expectancy without a transplant or who is otherwise a high-risk candidate may be willing to accept an otherwise normal liver from a donor with familial amyloidosis (who in turn receives a different liver), even though it will cause the disease many years later. Both types of living donor transplants described here are included in these counts.

The number of transplants using living donors may be different from the number of living donors. This is because there is a small number of multi-organ living donors and there may be multiple donors for one transplant. For example, a living donor might donate a kidney and pancreas segment; or two living donors might each donate a lung lobe for one transplant procedure.

DECEASED DONOR ORGAN RECOVERY AND DISPOSITION

The deceased donor organ disposition tables show frequency counts and percentages for each disposition category (i. e., local or shared transplant, local or shared nonuse, research, foreign exported, used for organ parts, and unknown) for all deceased donor organs recovered by United States OPOs, by organ type and year. In addition, tables are presented showing frequency counts of the reasons for nonuse of recovered organs intended for transplant and nonrecovery of consented organs. ("Consented" refers to organs from potential donors whose families have given permission for organ recovery for the purpose of transplantation.)

Table 1.2 shows the number of organs recovered from all deceased donors. Section 3 shows organ-specific recovery and disposition data.

Table 1.2	Summary Table: Organs Recovered from Deceased Donors (All Organs)
Tables 3.1, 3.2, 3.3	Kidney Disposition, Nonuse, and Nonrecovery
Tables 3.4, 3.5, 3.6	Pancreas Disposition, Nonuse, and Nonrecovery
Tables 3.7, 3.8, 3.9	Liver Disposition, Nonuse, and Nonrecovery
Tables 3.10, 3.11, 3.12	Intestine Disposition, Nonuse, and Nonrecovery
Tables 3.13, 3.14, 3.15	Heart Disposition, Nonuse, and Nonrecovery
Tables 3.16, 3.17, 3.18	Lung Disposition, Nonuse, and Nonrecovery

Organ Disposition Data

When a donor donates both kidneys or both lungs, each organ is counted separately. In cases where a liver, intestine, or pancreas is split, both segments can have dispositions and each segment may be counted in these tables. Hearts recovered for heart valves, pancreata recovered for islet cells, and livers recovered for hepatocytes or extracorporeal liver are not counted. The year of reporting is based on the start of organ preservation as recorded on the DDR form.

A locally transplanted organ is one that is transplanted within the immediate service area of the OPO that recovers the organ. A shared transplant involves an organ shipped to a transplant center outside the immediate service area of the OPO. Determination of local and shared organs is made by examining the relationship between the OPO at which an organ is procured and the center at which it is transplanted, at the time of transplant. Any recovered organ intended for transplant that is neither transplanted nor used in research is referred to as not used.

Nonuse of Recovered Organs and Nonrecovery of Consented Organs

The reasons for nonuse of recovered deceased donor organs intended for transplant and nonrecovery of consented organs are shown for all organs from deceased donors who donated at least one solid organ. (For example, consent is obtained for one donor to donate two kidneys, a liver, and a heart. The kidneys are recovered and used in a transplant. The liver is recovered, but the organ is damaged. The liver, therefore, is listed in the table on organs recovered but not transplanted. The heart, which also is consented for transplantation, is found to have poor function before it is recovered. The heart, therefore, is listed in the table on organs consented but not recovered.) These tables do not include donors whose organs were consented but from whom no organs were ever recovered for transplant. For nonrecovery of consented organs, when both kidneys or both lungs are not recovered, each organ is counted separately.

UNITED STATES OPOs: DONORS PROCURED AND TRANSPLANT CENTERS IN SERVICE AREA

Table 4.1 shows the number of deceased donors procured by year for each OPO. Table 4.2 lists the transplant centers within each OPO's current CMS-designated Donation Service Area (DSA), by the OPO's home state. Transplant centers in some states are served by OPOs in other states; in such cases, the reader is referred to an alternate home state indicated in the table. OPO and transplant center data were obtained from the CMS-designated service areas as reported to the OPTN by May 1, 2006.

The OPOs listed in Table 4.1 include those operating between 1996 and 2005. OPOs operating during only a portion of this period list "-" donors recovered for years during which they were not functioning. Donor comparisons across years may be difficult, because donors from one or more previously operational organizations have been incorporated into the OPO currently serving their area and because OPO service areas change over time.

Table 4.1 Deceased Donors Procured by U. S. Organ Procurement Organizations

Table 4.2 Transplant Centers Within Each OPO CMS-Designated Service Area, by Home State of OPO

WAITING LIST PATIENT CHARACTERISTICS

The waiting list tables show frequency counts and percentages of certain demographic and medical factors for patients awaiting transplantation at each year- end.

Tables 1.3 and 1.4 in the summary section show the OPTN waiting list at year-end and selected characteristics for all organs, including the active or inactive waiting list status of these patients. In each organ-specific section, waiting list tables are presented in Table x.1, where x refers to the organ-specific section. Table x.1a focuses only on patients with active waiting list status, while Table x.1b compares active and inactive waiting list patients on a shorter list of characteristics (age, race/ethnicity, sex, waiting time, and primary diagnosis).

Table 1.3 Summary Table: Waiting List Size (All Organs)

Table 1.4 Summary Table: Waiting List Patient Characteristics (All Organs)

Table 5.1 Kidney Waiting List Patient Characteristics

Table 6.1 Pancreas Transplant Alone Waiting List Patient Characteristics

Table 7.1 Pancreas After Kidney Waiting List Patient Characteristics

Table 8.1 Kidney-Pancreas Waiting List Patient Characteristics

Table 9.1 Liver Waiting List Patient Characteristics

Table 10.1	Intestine Waiting List Patient Characteristics
Table 11.1	Heart Waiting List Patient Characteristics
Table 12.1	Lung Waiting List Patient Characteristics
Table 13.1	Heart-Lung Waiting List Patient Characteristics

These data represent patients on the waiting list at the end of each year, according to data available May 1, 2006. OPTN members have direct responsibility for submitting, maintaining, and monitoring all waiting list data from the time patients are listed until they are removed from the list. These waiting list profiles are based on all information available about these patients, including information received after the date of the snapshot (i. e., December 31 of each year). Patients who die or receive a transplant before the center removes them from this list (usually a matter of only a few days) are treated as being removed from the list at death or transplant. Patients on the kidney-pancreas waiting list, regardless of whether they have indicated they will accept one organ without the other, are counted only in the kidney-pancreas waiting list totals.

Some patients are listed at different centers for the same organ type or listed for multiple organ types at the same time (e. g., both a kidney and a liver). With the exception of Table 1.3, which shows both individual registrations and patients, all waiting list characteristic tables show data adjusted for multiple listings of potential transplant recipients so that individuals will not be counted more than once. Therefore, the totals reflect the number of candidates rather than number of registrations. When patient characteristics (age, race, etc.) are different between two registrations for the same person, the more recent registration is used. For characteristics that are likely to be different (inactive/active status, waiting time, etc.), we choose by the characteristic that best reflect a patient's status on the waiting list (e. g., higher ranking, longer waiting time).

Panel Reactive Antibody (PRA). Peak PRA levels are shown only for the kidney waiting list. These data are not required for patients waiting for other organs.

Patient Status. For the heart waiting list, this item reflects medical urgency status categories used for allocation, as well as inactive waiting list status. For the liver waiting list, this item reflects medical urgency status categories used for allocation before 2002, or the Model for End-Stage Liver Disease / Pediatric End-Stage Liver Disease (MELD/PELD) score along with applicable exceptions according to the system implemented in 2002. It should be noted that urgency status systems have changed over time, which may affect interpretation of trends in urgency status. Medical urgency status categories, present and historical, are described in detail in the Glossary.

Time Waiting. This item reflects the total length of time from each waiting list registration until the date of the snapshot, including inactive time. It does not include any time transferred from a prior registration.

TIME TO TRANSPLANT AND MEDIAN WAITING TIME

"Time to Transplant" is shown in Table 1.5 and in Table x.2 of each organ-specific section. For livers and hearts, "Events after Listing" replaces the "Time to Transplant" tables reported in previous years due to the recent year's allocation policy changes for evaluating urgency status instead of relying solely on waiting time.

Table 1.5	Summary Table: Time to Transplant (All Organs)
Table 5.2	Kidney Time to Transplant
Table 6.2	Pancreas Alone Time to Transplant
Table 7.2	Pancreas After Kidney Time to Transplant
Table 8.2	Kidney-Pancreas Time to Transplant
Table 9.2	Liver Events After Listing

Table 10.2	Intestine Time to Transplant
Table 11.2	Heart Events After Listing
Table 12.2	Lung Time to Transplant
Table 13.2	Heart-Lung Time to Transplant
Table 15.1	Supplementary Table: Median Waiting Time (All Organs)

The "Time to Transplant" tables report how long it takes for 10%, 25%, and 50% (the median) of the registrants to be transplanted (whether from a deceased or living donor) for each cohort of new waiting list registrations in each calendar year. These tables take the point of view of a new waiting list registrant wishing to know his or her prospects for getting a transplant from any source. Waiting time, shown only in Table 15.1, measures only actual time actively waiting on the list (excluding periods at inactive status), and considers only transplants from a deceased donor as a "success" or event. Another related table, median waiting time among actual recipients of transplants, is not shown in this *Annual* Report. Chapter X in the 2005 report (1) describes the difference in perspective between these various tables; Table TN-1, below, documents the difference in two models.

Table TN-1. Primary Differences in Time to Transplant and Median Waiting Time Models

Reason for Removal or Current Active Status	Time to Transplant (Tables 1.5, x.2*)	Median Waiting Time (Table 15.1)
Inactive Time	Included	Excluded
Censor / Event Treatment of Outcomes		
Deceased Donor Organ Tx	Transplant	Transplant
Living Donor Tx	Transplant	Censor
Tx at Another Center	Transplant	Transplant
Transfer to Another Center	Censor	Censor
Death or Worsened Condition	Non-Transplant	Censor
Condition Improved	Censor	Censor
May 2, 2006	Censor	Censor

Tx = Transplant. *x.2 refers to the second table in each organ specific section.

In Table TN-1, note the difference between the "censored" registrations and those with "non-transplant" as a result. The latter, applied to registrants who have died in the "Time to Transplant" models, correctly accounts for the fact that these registrants will never receive a transplant, by extending the time to transplant for these registrants out far beyond any calculated percentiles. Censored registrations, on the other hand, use the assumption that after this removal, had this registrant remained on the waiting list, he or she would have had similar results to other registrants who actually did remain on the list at that time since listing. In order to measure only time actually spent waiting, the median waiting time calculation censors all non-transplant events.

The Kaplan-Meier method (2) is used to fit both types of models, using the statistical procedure PHREG in version 9.1 of SAS (3). To exclude inactive time from the Median Waiting Time calculation, discontinuous intervals of risk were implemented (4). More detail about the Kaplan-Meier method can be found in the 2005 report (1).

Figures for recent years in these tables may show the symbol "+". This is because there may not have been sufficient time for 50% of the registrants to have received transplants. (See Table TN-2 for an example in which we are unable to compute the median time to transplant.) For heart-lung and intestine transplants, median time to transplant cannot be determined for most of the one-year registrant cohorts. This can occur if mortality is so high for a given cohort that more than 50% of the registrants may have died before 50% have been transplanted.

For completeness, all categories of demographic and medical factors are listed in the tables, including those with no transplants in the cohort (N= 0). The "+" symbol indicates that the statistic has not been calculated because of insufficient follow-up time for 50% of the cohort to be transplanted.

Table TN-2. Time to Transplant: Hypothetical Example of Median Not Computable

	2002	2003	2004	2005
Number of Registrations	23,495	24,419	27,126	29,135
10th Percentile of TT	107	107	111	108
25th Percentile of TT	338	353	357	355
Median TT	1,136	+	+	+
Median TT 95% C.I. Lower Bound	1,110	+	+	+
Median TT 95% C.I. Upper Bound	1,171	+	+	+

TT = Time to transplant. Source: Table 5.02a.

DEATHS AND DEATH RATES ON THE WAITING LIST

The death rate tables show the number of patients ever on the waiting list during the year, the number of patients reported to have died while awaiting transplantation, and the annual death rates per 1,000 patient years at risk. For patients already on the waiting list at the start of a given year, the period at risk begins on January 1; for patients added to the list during the year in question, the period at risk begins on the waiting list registration date. The period at risk ends on December 31, the date of death, or the date of waiting list removal (whichever is earliest). Table 1.6 shows the overall death rates for all organs.

Deaths and death rates for each organ-specific waiting list are presented in Table x.3 of each organ-specific section.

Table 1.6	Summary Table: Death Rates (All Organs)
Table 5.3	Kidney Waiting List
Table 6.3	Pancreas Transplant Alone Waiting List
Table 7.3	Pancreas After Kidney Waiting List
Table 8.3	Kidney-Pancreas Waiting List
Table 9.3	Liver Waiting List
Table 10.3	Intestine Waiting List
Table 11.3	Heart Waiting List
Table 12.3	Lung Waiting List
Table 13.3	Heart-Lung Waiting List

The term "patient years" describes the actual amount of time each patient spends on the waiting list. For example, Patient A is on the list for six months, Patient B is on the list for three months, and Patient C is on the list for the entire year.

Patient A contributes 0.5 patient years to the calculation, Patient B contributes 0.25 patient years, and Patient C contributes 1 patient-year to the calculation.

These tables count deaths and time at risk on a per-person, rather than per-listing, basis. For any time that a patient is listed at more than one center, each listing is weighted accordingly. If a patient is listed at more than one center, each day of waiting time is weighted according to the total number of centers where the patient is listed on that day. For example, if a patient is listed at two centers, the total waiting time at each center is multiplied by 0. 5.

The annual death rate per 1,000 patient years at risk, therefore, is the number of deaths for every 1,000 patient years on the waiting list. The rate is calculated by dividing the number of patients who died in a given year by the sum of the years (including partial years) that patients spent waiting and then multiplying by 1, 000. The number 1,000 was chosen, rather than the familiar 100, because of small death rates in some categories.

These tables contain data on all patients who have been removed from or are still active on waiting lists. The OPTN members have direct responsibility for submitting, maintaining, and monitoring all data from the time their patients are listed until they are removed from the list. In addition, deaths reported from other OPTN sources that are associated with the same patients are incorporated into the calculation of the patient's death. The SRTR includes deaths listed in the Social Security Death Master File (SSDMF) and Centers for Medicare & Medicaid Services (CMS) data sources to provide additional death ascertainment. This step captures deaths that may have occurred before patients have been removed from the waiting list.

The OPTN receives notification of a death on the waiting list when a patient is removed from the waiting list with the reason given (via the appropriate code) as death. The year indicated is that in which the death was reported or the patient was removed from the waiting list. Before October 25, 1999, the OPTN did not track date of death, only the date on which the death was reported.

Note that patients who are removed from the waiting list because they are too ill to receive a transplant and who subsequently die are not included in the number of deaths on the waiting list.

Patient age is calculated as of December 31 of the indicated year, even if the patient had not yet reached a birthday when removed from the list during the year.

In categories with fewer than 10 patients in the cohort, death rates are not calculated and the symbol "*" appears.

The breakdown of death rates by waiting list status has changed significantly. Previous releases reported these statistics by medical urgency status at the time of listing. Starting with the 2006 report, all time at risk and events are attributed to the "current" medical urgency status, following patients from one status to another. As a result, the tables show much more information classified as during "inactive status", since many patients may switch from another initial status to inactive during their time on the waiting list.

TRANSPLANTS AND TRANSPLANT RECIPIENT CHARACTERISTICS

Tables 1.7, 1.8, and 1.10 present counts of all single- and multi-organ transplants by organ and donor type and by selected recipient demographic and medical characteristics. Organ-specific recipient characteristics are presented in Table x.4 of each organ-specific section.

Table 1.7	Summary Table: Transplants by Organ and Donor Type
Table 1.8	Summary Table: Multi-organ Transplants
Table 1.10	Summary Table: Transplant Recipient Characteristics
Table 5.4	Deceased Donor and Living Donor Kidney Recipients
Table 6.4	Pancreas Transplant Alone Recipients

Table 7.4	Pancreas After Kidney Recipients
Table 8.4	Kidney-Pancreas Recipients
Table 9.4	Deceased Donor and Living Donor Liver Recipients
Table 10.4	Intestine Recipients
Table 11.4	Heart Recipients
Table 12.4	Deceased Donor and Living Donor Lung Recipients
Table 13.4	Heart-Lung Recipients

Transplant recipient characteristics data are based primarily on the OPTN Transplant Candidate Registration (TCR) and Transplant Recipient Registration (TRR) forms. Transplant counts are based on the OPTN donor feedback process, which begins tracking a transplant based on donor organ allocation, or on living donor transplant reports from transplant centers. When a patient is registered on a waiting list or receives a living donor transplant, a TCR form is completed by a transplant center. The TRR form is completed by a transplant center after a transplant and is submitted to the OPTN for processing.

While kidney-pancreas and heart-lung transplants are shown as one transplant, other multi-organ transplants of two or more different organ types appear in the organ-specific tables for each organ involved. For example, a kidney-liver transplant would be included in both the kidney data and the liver data. Table 1.8 shows a breakdown of such multi-organ transplants.

Table 1.7 presents a breakdown of transplants for all organs by deceased donor and living donor. Because living donor pancreas, intestine, and heart (from heart-lung recipients who donate their viable heart) transplants are rare, such transplants are reported only in Table 1.7. Each organ section only includes deceased donor transplants, unless it explicitly states otherwise, as is the case with kidneys, livers, and lungs. Counts reflect the number of transplants, not the number of organs; therefore, each donor is not counted if there are multiple donors, as may be the case with living donor lung lobe transplants.

The organ-specific tables show, for particular characteristics, the number and percentage of transplants by category, for each year, for that type of transplant. Some characteristics may have unknown values. This occurs when transplant centers report values as unknown, or when forms are still outstanding. The percentages in the tables are based on the total reported categories, including the unknown cases. The data are subject to change on the basis of future data submission or correction.

Particular recipient characteristics are discussed below.

Patient Description and Type of Procedure. These data are collected via the TRR form. “Unknown” cases primarily reflect data being missing or reported as unknown on TRR forms, or by TRR forms being delinquent. In the type of procedure listed for lung transplants, *en bloc* and bilateral sequential transplants are included in the double lung category; lung lobe transplants are categorized by the number of lobes received.

Age, Race/Ethnicity, Gender, Blood Type, and Residency. These data are collected via the TCR form. Unknown cases are accounted for primarily by TCR forms that are incomplete or not yet received. Race and ethnicity are reported together as a single data element, reflecting the way these data are collected. Since July 1, 2004, Hispanic/Latino ethnicity has been listed as one of many race/ethnicity choices, of which users may indicate one or many; previously, Hispanic/Latino ethnicity had been collected as a separate data field. Conversion from old race and ethnicity codes has helped ensure consistency in data reporting. Patients formerly reported as “white, Hispanic/Latino” are now coded as Hispanic/Latino; patients formerly reported as Hispanic/Latino and a race other than white are coded as that other race (e. g., “ African-American, Hispanic/Latino” is now coded as African- American). Patients of Middle Eastern or Arabian descent are now included in the white category, and patients of Indian Sub-Continent descent are now grouped into the Asian category; both were formerly reported as “other race.” In the residency table, US residents include both US citizens and resident aliens.

Primary Source of Payment. The recipient's primary source of payment (i. e., the largest contributor) for transplantation is obtained from TRR form. The payment categories reported are private insurance, Medicare, Medicaid, and "other," which includes government programs other than Medicare and Medicaid, donations, and payments made directly by the recipient.

Primary Diagnosis. The primary diagnosis of the disease causing organ failure for transplant recipients is obtained from the TRR and TCR forms. Diagnosis categories for each organ type are broad classifications of the recipients' indications for transplant. There are no primary diagnoses listed for pancreas and kidney-pancreas transplants, as nearly all pancreas recipients have diabetes as their primary diagnosis. Tables TN-7 through TN-11,
at the end of these notes, present the detailed diagnoses that are included in each broad category.

Occasionally, patients who receive retransplants are coded with diagnosis of "graft failure." When possible, the original diagnosis from the prior transplant is used in this table.

Cold Ischemia Time. Cold ischemia time statistics are collected for most organs, but only total ischemia time is reported for intestines, hearts, and lungs. The kidney cold ischemic time is used for kidney-pancreas transplants and the heart total ischemia time is used for heart-lung transplants.

Previous Transplant. This measure indicates whether a patient had a previous transplant of any solid organ. Because of the lack of historical transplant records in the database, multiple sources are used to determine if a recipient has had a previous transplant. The calculation is based on "Previous Transplants" fields on the Waitlist Registration, TCR and TRR forms, and historical transplant records associated with the same person. It also considers diagnoses on both the TCR and TRR of retransplant or graft failure, and organ primary non-function, as indicated on the TRR form for liver and intestine recipients. Because the reliability of previous transplant data on the TCR and TRR has been questionable, the SRTR determines previous transplant via either 1) existence of an historical transplant records; or 2) positive indication by two of the three registration sources (Waitlist, TCR, TRR).

Previous Transplant of the Same Organ. This indicator of a previous transplant is calculated as above, for transplants of the same organ type. For kidney-pancreas transplants, only a previous simultaneous kidney-pancreas transplant is considered to be a previous transplant of the same organ. For kidney-alone and pancreas-alone transplants, a previous transplant could be either a previous transplant of that same organ type or a previous simultaneous kidney-pancreas transplant. Similarly, for heart-alone and lung-alone transplants, a previous transplant could be either a previous transplant of that same organ type or a previous simultaneous heart-lung transplant.

Hospitalized at Transplant and Life Support at Transplant. These variables refer to the patient's condition immediately prior to the transplant procedure. In the tables, "Hospitalized" refers to patients hospitalized but not in an intensive care unit.

PRA (Panel Reactive Antibody). PRA levels, at time of transplant, are shown only for kidney and kidney-pancreas recipients. This item is taken from the Recipient Histocompatibility (RH) form. Unknown cases consist mostly of RH forms that are incomplete or not yet received.

Level of HLA Mismatch. This statistic, shown only for kidney and kidney-pancreas transplants, represents the number of HLA antigens found in the donor that are not shared by the recipient. This value is based on the six HLA antigens (two each for the A, B, and DR loci) reported on the Donor Histocompatibility (DH) form and the Recipient Histocompatibility (RH) form. Unknown cases primarily reflect incomplete DH or RH forms or forms not yet received. Mismatched antigens are identified according to the OPTN criteria regarding "split" and "parent" antigens. The mismatch scores for the A, B, and DR loci are now reported separately, in addition to the total mismatch score.

Waiting List Status at Transplant. For liver and heart transplants only, the waiting list medical urgency status at transplant is determined by linking each transplant back to the waiting list history file. The waiting list status represents the patient's degree of medical urgency. Waiting list status levels for heart, including pre-1999 and current definitions, are Status 1, 1A, 1B, and 2, with 1 (or 1A) being the most urgent. Before 2002, waiting list status levels for liver were Status 1, 2, 2A, 2B, 3, and 4. Starting in 2002, the MELD/PELD scores replaced the liver status levels in ranking a patient's medical condition, and ranges of MELD/PELD scores, along with exceptions, appear in the tables where status is reported.

INCIDENCE OF TRANSPLANT

Incidence of transplant, defined as the rate of transplantation for the entire population, is presented in Table x.5 of each organ-specific section.

Table 5.5	Kidney Transplants
Table 6.5	Pancreas Alone Transplants
Table 7.5	Pancreas After Kidney Transplants
Table 8.5	Kidney-Pancreas Transplants
Table 9.5	Liver Transplants
Table 10.5	Intestine Transplants
Table 11.5	Heart Transplants
Table 12.5	Lung Transplants
Table 13.5	Heart-Lung Transplants

The rates for incidence of transplant presented in these tables are ratios of transplants per 1 million population. Incidence for the entire population and for various cohorts of recipient age, race, ethnicity, and gender are included in these tables. Population figures for 1996 to 2005 come from the US Census Bureau monthly estimates for July of each year.

IMMUNOSUPPRESSION USE

Table 1.9 presents statistics on immunosuppression use by organ for 2004 and 2005. It shows the use of individual drugs for induction, maintenance at discharge, and one year following transplantation, as well as the distributions by maintenance regimen for the same periods. The denominator for the induction drug use table is the number of transplants for which any immunosuppression details are reported. The “Maintenance At Discharge” tables, which include use of both individual drugs and combination drug regimens, show distributions for use among recipients with functioning grafts at transplant. The “Maintenance Use at End of First Year” tables show these distributions for those with grafts functioning one year after transplant and with maintenance drug use recorded at the follow-up time.

Organ-specific immunosuppression use is presented in Table x.6 of each organ-specific section, as well as tables in the supplementary section.

Table 1.9	Summary Table: Immunosuppression Use, 2004-2005 (All Organs)
Table 5.6	Kidney Transplants
Table 6.6	Pancreas Alone Transplants
Table 7.6	Pancreas After Kidney Transplants
Table 8.6	Kidney-Pancreas Transplants
Table 9.6	Liver Transplants
Table 10.6	Intestine Transplants

Table 11.6	Heart Transplants
Table 12.6	Lung Transplants
Table 13.6	Heart-Lung Transplants
Table 15.4 – 15.6	Supplementary Tables: Steroid Avoidance and Withdrawal (Kidney, Liver, Heart)
Table 15.7 – 15.15	Supplementary Tables: Maintenance Immunosuppression Use at Two Years Following Transplantation (All Organs)

In each of the organ-specific sections, nine separate sub-tables describe immunosuppression use. The topics covered are *induction* drug use and its relationship with discharge regimen and steroid use; *maintenance* drug use, showing percent use by individual drugs and regimens by year, as well as persistence of regimen use over time; *steroid avoidance* at discharge and *steroid withdrawal* after transplant; and drugs used for *antirejection* therapy. These topics are described below.

Tables x.6a through x.6c for each organ-specific section focus on induction drug use. Table x.6a shows the percent usage by individual drug. The percentages are calculated by dividing the number of transplants in which a particular drug is used for induction by the number of transplants with immunosuppression information reported. Table x.6b shows the percent usage of each induction drug by discharge maintenance regimen for the most recent five years. Recipients are included only if their graft is functioning at transplant discharge and they have any immunosuppression information recorded. Table x.6c shows the percent usage of each induction drug by steroid use.

Tables x.6d and x.6e describe drugs used for maintenance at transplant discharge by showing the distributions by individual drugs, as well as by regimens. Recipients are included only if their graft is functioning at transplant discharge and they have any immunosuppression information recorded.

Tables x.6f and x.6g describe drugs used for maintenance at one year following transplantation by showing the distributions by individual drugs, as well as by regimens. Recipients are included only if their graft is functioning at transplant discharge and they have any immunosuppression information recorded.

Table x.6h shows persistence of discharge regimen by follow-up period (one, two, and three years following transplantation). The table contains the rate of continuation for each of the listed discharge regimens by follow-up period. These rates are calculated using the Kaplan-Meier method (1) for time between transplantation and discontinuation of the regimen, with the following considered as events: graft failure; death; a follow-up form indicating a different current regimen; and a follow-up form indicating that a “conflicting” regimen was used during the prior six-month or one-year period. Recipients are followed until the earliest of the above events, and censored at missing follow-up immunosuppression information or end of the follow-up period. (“Conflicting” regimens are records of two drugs taken in a single period that cannot clinically be taken simultaneously, indicating a switch in regimen sometime during the period. Such multiple records include cyclosporine vs. tacrolimus; azathioprine vs. mycophenolate mofetil; azathioprine vs. leflunomide; and sirolimus vs. everolimus.)

Table x.6i shows the rates of immunosuppression use for antirejection treatment during the first year following transplantation. The percentages are calculated by dividing the number of transplants in which a particular drug or drug category was used for antirejection treatment at any point in the year after transplant by the number of transplants where antirejection treatment was recorded.

Supplementary Tables 15.4 to 15.6 show statistics of steroid use at transplant discharge by donor type, discharge maintenance regimen for patients receiving first transplants of any organ, and the steroid withdrawal rate at one year and two years following transplantation among those who received steroids at discharge. The rate of steroid avoidance is defined as the percentage of patients who avoided using steroids as maintenance among patients receiving first transplants of any organ with a functioning graft at discharge. The rate of steroid withdrawal is defined as the percentage of patients who did not use steroids at the given follow-up time among patients who received steroids at discharge after receiving a first transplant of any organ, and who have a functioning graft and recorded maintenance drug use one year after transplantation.

Table TN-3: Immunosuppressive Drug Names in OPTN/SRTR Data

General Class	Generic Name	Brand Name
Corticosteroids	-prednisone	-Orasone, Deltasone
	-methylprednisolone	-Solu-Medrol, A-methaPred, Medrol
	-dexamethasone	-Decadron
Calcineurin inhibitors	-tacrolimus (or FK-506)	-Prograf
	-cyclosporine (also cyclosporin A, CsA)	-Sandimmune, Neoral; manufacturers of generic cyclosporine include SangStat (SangCya)*, Abbott (Gengraf), Apotex, Bedford Eon Labs, Geneva, Ivax Pharms, Novex, Morton Grove, and Pliva
Antimetabolites	-azathioprine (or AZA)	-Imuran
	-cyclophosphamide	-Cytoxan, Neosar
	-mycophenolate mofetil (or RS61443)	-CellCept
	-mycophenolic sodium (also ERL, mycophenolate acid)	-Myfortic
	-methotrexate	-Rheumatrex, Trexall
	-leflunomide (or LFL)***	-Arava
Polyclonal antibodies	-antithymocyte globulin (rabbit)	-Thymoglobulin
	-antithymocyte globulin (equine)	-ATGAM
	-Nashville rabbit antithymocyte globulin/serum (NRATG/NRATS)	
	-antilymphocyte globulin (ALG)	
Anti-CD3 monoclonal antibodies	-muromonab-CD3	-Orthoclone OKT3
Anti-CD52 monoclonal antibodies	-alemtuzumab***	-Campath-1H
Anti-IL-2 receptor monoclonal antibodies	-basiliximab	-Simulect
	-daclizumab	-Zenapax
TOR inhibitors	-sirolimus (or rapamycin)	-Rapamune
	-everolimus (or RAD0001)**	-Certican (Phase III Trial)
Other	-FTY720**	-(Phase III Trial)

Note: For some immunosuppressants, the original data collection forms list brand names instead of generic names. Current as of December 2005. * Currently withdrawn from the market. ** Currently only for investigational use. *** off label use

Supplementary Tables 15.7 to 15.15 show statistics of maintenance regimen use at two years following transplantation for each organ. The corresponding tables at time of discharge and one year following transplantation are produced in the organ-specific sections.

Note: For some immunosuppressants, the original data collection forms list brand names instead of generic names. The SRTR database, together with the tables and figures produced from them, follow the terms on the data collection forms. However, some of the chapters in this report refer to the drugs by their generic names when there is a one-to-one correlation between the reported brand name and the generic name. Table TN-3 lists the class, generic name, and brand name of the immunosuppressants listed most commonly in this report.

MULTIPLE-SOURCE FOLLOW-UP DATES (DEATH RATES AND PATIENT SURVIVAL)

The posttransplant death rate tables and the patient survival tables use follow-up data from several additional sources to determine time at risk. This *Annual Report* uses death information from any OPTN member institution, including both the transplanting center and any other center at which the patient may have been relisted or retransplanted, as well as the Social Security Death Master File (SSDMF) and CMS-ESRD data. As detailed in Chapter II of the 2002 *Annual Report* (4), the ascertainment of mortality using these combined sources is very good. We assume that a patient is alive if no death is reported during periods when we would expect to learn of a death from both sources.

Using multiple sources for death ascertainment has implications for statistical censoring in mortality analyses. If only follow-up forms returned to the OPTN were being used, censoring would occur when the patient became lost to follow-up, or when the follow-up form was filed. When multiple sources of death data are used, a patient must be followed after he or she is lost to follow-up, in order to account for time and events that are covered by other sources of mortality data. The multiple-source follow-up or censoring date is calculated as the transplant anniversary (six-month, one-year, two-year, etc.) immediately preceding the current database snapshot date (May 1, 2006), allowing an extra three months to ensure completion of forms. In some cases, this date falls before reports of deaths are submitted to the OPTN by member centers. In these cases, such events are excluded from the analysis for the following reason: Patients who are alive will only have follow-up status reported when forms are due at six months, one year, two years, and so on after transplant. When a patient dies, however, the center can report that the patient died on an early follow-up form, creating additional reporting on a (biased) sample of dead patients. Simply following patients until the last known OPTN follow-up date would include extra time for patients who die and have the follow-up form turned in early, but would not include this extra time for patients who are alive. To eliminate this bias in reporting deaths, the SRTR censors at the date of last expected follow- up.

DEATHS AND DEATH RATES FOR TRANSPLANT RECIPIENTS

The death rate tables show deaths per 1,000 patient years for patients receiving transplants during each year. Here, the term “patient years” describes the actual amount of time for which each patient has reported data after a transplant. For example, Patient A has reported data for six months after her transplant, Patient B only has reported data for three months, and Patient C has reported data indicating that he lived through the entire year. Patient A contributes 0.5 patient years to the calculation, Patient B contributes 0.25 patient years, and Patient C contributes 1 patient-year to the calculation.

The annual death rate per 1,000 patient years at risk, therefore, is the number of deaths for every 1,000 patient years of follow-up after transplant. The rate is calculated by dividing the number of patients who died within one year after transplant by the sum of the years for which patients have reported data and then multiplying by 1, 000. The number 1,000 was chosen, rather than 100, because of small death rates in some categories.

Death rates apply only within the first year of transplant. Patients are only included when the last expected follow-up is on or after the one-year transplant anniversary. The period at risk begins on the transplant date and ends on the date of death,

the one-year transplant anniversary, or the multiple-source follow-up date described above (whichever is earliest). Deaths and death rates for each organ are presented in Table x.7 of each organ-specific section.

Table 5.7	Kidney Transplants
Table 6.7	Pancreas Transplant Alone Transplants
Table 7.7	Pancreas After Kidney Transplants
Table 8.7	Kidney-Pancreas Transplants
Table 9.7	Liver Transplants
Table 10.7	Intestine Transplants
Table 11.7	Heart Transplants
Table 12.7	Lung Transplants
Table 13.7	Heart-Lung Transplants

Multiple sources of death, as described above, are used for the death rate tables. Deaths that are reported after the multiple-source follow-up date are not counted. In categories with fewer than 10 patients in the cohort, death rates are not calculated and the symbol "*" appears.

GRAFT AND PATIENT SURVIVAL

Tables 1.11 and 1.12 present national one-year graft and patient survival, both unadjusted and adjusted, for all organs by year of transplant from 1995 to 2004. Table 1.13 presents unadjusted national graft and patient survival for all organs at three months, one year, three years, five years, and 10 years. Overall survival rates for liver-intestine, kidney-liver, and kidney-heart transplants are shown in Table 1.13. Because of the small number of such multiple-organ transplants, there are no other specific survival tables for them.

Organ-specific tables of graft and patient survival by recipient characteristics and comparisons of changes over time are presented in Tables x.8 through x.13 of each organ-specific section. Adjusted survival appears in Tables x.8 and x.11 of each organ-specific section, while unadjusted survival appears in Tables x.9 and x. 12. Comparisons of changes over time are in Tables x.10 and x.13 of each organ-specific section. For kidney transplants, separate tables are presented for deceased non-ECD (SCD and DCD), deceased ECD, and living donor transplants. For liver transplants, separate tables are presented for deceased and living donor transplants. For lung transplants, unadjusted survival tables are presented separately for recipients of organs from deceased donors and living donors. Adjusted survival is presented only for deceased donor transplants, as the number of living donor transplants is too small to yield stable estimates. The kidney-pancreas section includes two sets of graft survival tables: one for kidney graft survival and one for pancreas graft survival.

Table 1.11	Summary Table: One-Year Graft Survival
Table 1.12	Summary Table: One-Year Patient Survival
Table 1.13	Summary Table: Graft and Patient Survival, Various Time Points
Table 5.8	Kidney Adjusted Graft Survival Rates, Deceased non-ECD
	Kidney Adjusted Graft Survival Rates, Deceased ECD
	Kidney Adjusted Graft Survival Rates, Living Donor

Table 5.9	Kidney Adjusted Graft Survival by Year of Transplant, Deceased non-ECD
	Kidney Adjusted Graft Survival by Year of Transplant, Deceased ECD
	Kidney Adjusted Graft Survival by Year of Transplant, Living Donor
Table 5.10	Kidney Unadjusted Graft Survival, Deceased non-ECD
	Kidney Unadjusted Graft Survival, Deceased ECD
	Kidney Unadjusted Graft Survival, Living Donor
Table 5.11	Kidney Unadjusted Graft Survival by Year of Transplant, Deceased non-ECD
	Kidney Unadjusted Graft Survival by Year of Transplant, Deceased ECD
	Kidney Unadjusted Graft Survival by Year of Transplant, Living Donor
Table 5.12	Kidney Adjusted Patient Survival Rates, Deceased non-ECD
	Kidney Adjusted Patient Survival Rates, Deceased ECD
	Kidney Adjusted Patient Survival Rates, Living Donor
Table 5.13	Kidney Adjusted Patient Survival by Year of Transplant, Deceased non-ECD
	Kidney Adjusted Patient Survival by Year of Transplant, Deceased ECD
	Kidney Adjusted Patient Survival by Year of Transplant, Living Donor
Table 5.14	Kidney Unadjusted Patient Survival, Deceased non-ECD
	Kidney Unadjusted Patient Survival, Deceased ECD
	Kidney Unadjusted Patient Survival, Living Donor
Table 5.15	Kidney Unadjusted Patient Survival by Year of Transplant, Deceased non-ECD
	Kidney Unadjusted Patient Survival by Year of Transplant, Deceased ECD
	Kidney Unadjusted Patient Survival by Year of Transplant, Living Donor
Table 6.8	Pancreas Transplant Alone Adjusted Graft Survival Rates
Table 6.9	Pancreas Transplant Alone Adjusted Graft Survival by Year of Transplant
Table 6.10	Pancreas Transplant Alone Unadjusted Graft Survival
Table 6.11	Pancreas Transplant Alone Unadjusted Graft Survival by Year of Transplant
Table 6.12	Pancreas Transplant Alone Adjusted Patient Survival
Table 6.13	Pancreas Transplant Alone Adjusted Patient Survival by Year of Transplant
Table 6.14	Pancreas Transplant Alone Unadjusted Patient Survival
Table 6.15	Pancreas Transplant Alone Unadjusted Patient Survival by Year of Transplant
Table 7.8	Pancreas After Kidney Adjusted Graft Survival Rates

Table 7.9	Pancreas After Kidney Adjusted Graft Survival by Year of Transplant
Table 7.10	Pancreas After Kidney Unadjusted Graft Survival
Table 7.11	Pancreas After Kidney Unadjusted Graft Survival by Year of Transplant
Table 7.12	Pancreas After Kidney Adjusted Patient Survival
Table 7.13	Pancreas After Kidney Adjusted Patient Survival by Year of Transplant
Table 7.14	Pancreas After Kidney Unadjusted Patient Survival
Table 7.15	Pancreas After Kidney Unadjusted Patient Survival by Year of Transplant
Table 8.8	Kidney-Pancreas — Kidney Adjusted Graft Survival Rates
	Kidney-Pancreas — Pancreas Adjusted Graft Survival Rates
Table 8.9	Kidney-Pancreas — Kidney Adjusted Graft Survival by Year of Transplant
	Kidney-Pancreas — Pancreas Adjusted Graft Survival by Year of Transplant
Table 8.10	Kidney-Pancreas — Kidney Unadjusted Graft Survival
	Kidney-Pancreas — Pancreas Unadjusted Graft Survival
Table 8.11	Kidney-Pancreas Unadjusted Graft Survival by Year of Transplant
Table 8.12	Kidney-Pancreas Adjusted Patient Survival
Table 8.13	Kidney-Pancreas Adjusted Patient Survival by Year of Transplant
Table 8.14	Kidney-Pancreas Unadjusted Patient Survival
Table 8.15	Kidney-Pancreas Unadjusted Patient Survival by Year of Transplant
Table 9.8	Liver Adjusted Graft Survival Rates, Deceased Donor
	Liver Adjusted Graft Survival Rates, Living Donor
Table 9.9	Liver Adjusted Graft Survival by Year of Transplant, Deceased Donor
	Liver Adjusted Graft Survival by Year of Transplant, Living Donor
Table 9.10	Liver Unadjusted Graft Survival, Deceased Donor
	Liver Unadjusted Graft Survival, Living Donor
Table 9.11	Liver Unadjusted Graft Survival by Year of Transplant, Deceased Donor
	Liver Unadjusted Graft Survival by Year of Transplant, Living Donor
Table 9.12	Liver Adjusted Patient Survival, Deceased Donor
	Liver Adjusted Patient Survival, Living Donor
Table 9.13	Liver Adjusted Patient Survival by Year of Transplant, Deceased Donor
	Liver Adjusted Patient Survival by Year of Transplant, Living Donor

Table 9.14 Liver Unadjusted Patient Survival, Deceased Donor

Table 9.15 Liver Unadjusted Patient Survival, Living Donor

Table 10.8 Intestine Adjusted Graft Survival Rates

Table 10.9 Intestine Adjusted Graft Survival by Year of Transplant

Table 10.10 Intestine Unadjusted Graft Survival

Table 10.11 Intestine Unadjusted Graft Survival by Year of Transplant

Table 10.12 Intestine Adjusted Patient Survival

Table 10.13 Intestine Adjusted Patient Survival by Year of Transplant

Table 10.14 Intestine Unadjusted Patient Survival

Table 10.15 Intestine Unadjusted Patient Survival by Year of Transplant

Table 11.8 Heart Adjusted Graft Survival Rates

Table 11.9 Heart Adjusted Graft Survival by Year of Transplant

Table 11.10 Heart Unadjusted Graft Survival

Table 11.11 Heart Unadjusted Graft Survival by Year of Transplant

Table 11.12 Heart Adjusted Patient Survival

Table 11.13 Heart Adjusted Patient Survival by Year of Transplant

Table 11.14 Heart Unadjusted Patient Survival

Table 11.15 Heart Unadjusted Patient Survival by Year of Transplant

Table 12.8 Lung Adjusted Graft Survival, Deceased Donor

Table 12.9 Lung Adjusted Graft Survival, by Year of Transplant, Deceased Donor

Table 12.10 Lung Unadjusted Graft Survival Deceased Donor

Lung Unadjusted Graft Survival, Living Donor

Table 12.11 Lung Unadjusted Graft Survival by Year of Transplant, Deceased Donor

Lung Unadjusted Graft Survival by Year of Transplant, Living Donor

Table 12.12 Lung Adjusted Patient Survival, Deceased Donor

Table 12.13 Lung Adjusted Patient Survival by Year of Transplant, Deceased Donor

Table 12.14 Lung Unadjusted Patient Survival, Deceased Donor

Lung Unadjusted Patient Survival, Living Donor

Table 12.15 Lung Unadjusted Patient Survival by Year of Transplant, Deceased Donor

Lung Unadjusted Patient Survival by Year of Transplant, Living Donor

Table 13.8	Heart-Lung Adjusted Graft Survival Rates
Table 13.9	Heart-Lung Adjusted Graft Survival by Year of Transplant
Table 13.10	Heart-Lung Unadjusted Graft Survival
Table 13.11	Heart-Lung Unadjusted Graft Survival by Year of Transplant
Table 13.12	Heart-Lung Adjusted Patient Survival
Table 13.13	Heart-Lung Adjusted Patient Survival by Year of Transplant
Table 13.14	Heart-Lung Unadjusted Patient Survival
Table 13.15	Heart-Lung Unadjusted Patient Survival by Year of Transplant

Cohorts

Cohorts for survival analyses are chosen to reflect the most recent cohort with sufficient time lag to observe outcomes for the entire period, while also providing the most relevant information reflecting the most current transplants possible. The *Annual Report* uses different cohorts for the different survival periods. The years for the cohorts are the most recent years for which the particular survival period elapsed by the end of 2005 as shown below. The time range indicates the period in which the transplant was received.

Three-month	2003 - 2004
One-year	2003 - 2004
Three-year	2001 - 2004
Five-year	1999 - 2004
Ten-year	1994 - 2004 (Table 1.13 only)

Exclusions

Patient survival statistics for each organ are computed only for the first transplant of that type that a patient received, and exclude subsequent transplants of the same type for that patient. For kidney-liver, kidney-heart, or liver-intestine transplants, recipients who have had a previous transplant of either organ are excluded. For kidney-pancreas transplants, only patients who have had a previous simultaneous kidney-pancreas transplant are excluded. Similarly, for heart-lung, only patients who have had a previous simultaneous heart-lung transplant are excluded. Graft survival statistics do not exclude these patients.

In order to present survival rates for the most common transplant procedures, the cohorts used for these analyses exclude a number of higher-risk or more unusual procedures. Living donor transplants are excluded for all but the living donor kidney, living donor liver, and living donor lung transplant tables, with the exception of adjusted survival rates following living lung donor transplantation (which are not shown due to small cohort sizes). Multi-organ transplants are excluded from the organ-specific tables, with three exceptions: Kidney-pancreas and heart-lung transplants are shown in separate tables, and intestine tables include both intestine-only and combined liver-intestine transplants. Overall short- and long-term survival for kidney-liver, kidney-heart, and liver-intestine transplants are shown in Table 1.13. Heterotopic transplants are excluded for liver and heart transplants.

Descriptions of Additional Factors

Unadjusted survival figures in the organ-specific sections are reported separately for the following patient and transplant procedure characteristics: recipient age, race/ethnicity, sex, blood type, previous transplant, US residency, hospitalization at transplant, life support at transplant, donor age, yearly center transplant volume, and cold ischemia time. For pancreas, the previous transplant characteristics include previous transplants of either kidney or pancreas. For kidney-pancreas, the previous transplant characteristic includes previous kidney, previous pancreas, and previous simultaneous kidney-pancreas transplant.

For specific organs, additional factors include PRA at transplant (kidney and kidney-pancreas), level of HLA mismatch (kidney, pancreas, and kidney-pancreas), relation of donor to recipient (living donor kidney, living donor liver), dialysis required during the first week following transplantation (deceased and living donor kidney), procedure type (heart and lung), and waiting list status at time of transplant (liver and heart).

Donor Age. Donor age is obtained from the Donor Registration form. Delinquent or incomplete forms constitute most unknown cases.

Center Volume. Center volume is calculated for each organ, center, and time period as the average number of transplants during the two calendar years included in the cohort of patients reported on for the period. For each organ, centers are grouped into approximate quintiles by center volume (tertiles for intestine because of the small number of centers performing intestine transplants). Survival is then reported for patients in each group. For kidneys and livers, center volume includes both deceased and living donor transplants. All other living donor transplants are excluded. For all organs, center volume includes multi-organ transplants (including kidney-pancreas and heart-lung) that include the organ of interest. For example, a heart-lung transplant would contribute to the center volume count for hearts, lungs, and heart-lungs. For kidney-pancreas tables, center volume is calculated differently for the patient and graft survival tables. For patient survival, kidney-pancreas center volume includes only kidney-pancreas transplants and multi-organ transplants that include kidney- pancreas. For tables of kidney graft survival from a kidney-pancreas transplant, center volume is calculated as it would be for kidney and so includes kidney and kidney-pancreas transplants, as well as other multi-organ transplants that include a kidney. For tables of pancreas graft survival from a kidney-pancreas transplant, center volume is calculated as it would be for pancreas and so includes pancreas and kidney-pancreas transplants, as well as other multi-organ transplants that include a pancreas.

Dialysis in the First Week. For kidney transplants only, whether patients required dialysis within the first week following transplant is collected from the TRR form. For these data, the cohorts used are restricted to transplants that did not fail within the first week of transplantation. In other words, the survival rates shown are conditional on the graft's functioning at least one week after transplantation.

Relation of Donor to Recipient. Relation of donor to recipient is shown only for living donor kidney, living donor liver, and living donor lung transplants. The data currently are collected on the Living Donor Registration (LDR) form. Delinquent or incomplete LDR forms make up most of the unknown cases.

Computation of Survival Rate

The value N shown in each table represents the number of transplants on which a survival rate is based. This number may be different for graft and patient survival because patient survival includes only first transplants of that type, whereas graft survival includes all transplants. For graft survival, survival time for each transplant is calculated as the number of days from the date of transplant to the date of graft failure or death (if applicable) or the latest follow-up date reported. For patient survival, survival time for each transplant is calculated as the number of days from the date of transplant to the date of death (if applicable) or the multiple-source follow-up date (described above). Each of these tables provides the standard errors (statistical measures of precision) along with each survival rate. Categories that include relatively few transplants generally exhibit large standard errors. This is an important consideration when comparing survival rates within the tables.

For completeness, all categories of demographic and medical factors were listed in the tables, including those with no transplants in the cohort (N= 0).

Patients are followed until death or the multiple-source follow-up date. Deaths that are reported after the multiple-source follow-up date are not counted. Patients are followed only from their first transplant of the organ; as noted above, the SRTR has found that reasonably complete death ascertainment may be obtained with the multiple death sources used.

Unadjusted Survival Rate

The unadjusted survival rate calculations were performed using the statistical procedure LIFETEST in version 9.1 of SAS (3). Using LIFETEST, the survival rates were estimated using the Kaplan-Meier method (2), and standard errors were estimated using Greenwood's formula (6).

Adjusted Survival Rate

Survival rates are adjusted to allow the reader to compare rates across years. The adjusted rates shown reflect what the survival rate would be if the patient case mix was the same in all years as it was in the last year.

The adjusted survival rate calculations are performed using a Cox proportional hazards regression model for time to graft failure or death (7). This involves using the statistical procedure PHREG in version 9.1 of SAS (3). Possible adjustments include age, gender, race, and diagnosis. Table TN-4 indicates, by organ type, the adjustments that are applied.

In the organ-specific sections, the adjusted survival tables only report rates by age, gender, race, and diagnosis. Here the rates in each table are adjusted for the characteristics other than those of the table itself (e. g., kidney survival by age is adjusted for gender, race, and diagnosis). The major diagnosis categories used for adjustment are listed in Table TN- 5.

For pediatric patients (i. e., under 12 for lung and under 18 for all other organs), the adjustment by diagnosis is not applied.

In the survival tables by year (i. e., Tables 1.11a, 1.12a), survival rates are adjusted to the characteristics of the recipients who received a transplant in the last year of the table. In the organ-specific tables, survival rates are adjusted to the characteristics of the recipients in the three-month or one-year cohort.

Table TN-4. Adjustments Applied to Survival Tables, by Organ Type

Organ Type	Age	Sex	Race	Diagnosis
Kidney	X	X	X	X
PTA	X	X	X	
PAK	X	X	X	
KP	X	X	X	
Liver	X	X	X	X
Intestine	X			
Heart	X	X	X	X
Lung	X	X	X	X*
Heart-Lung	X			

*Deceased donor transplants only.

Table TN-5. Major Diagnosis Categories Used for Adjustment of Survival Tables

Organ	Major Diagnosis Categories
Kidney	Diabetes, Other
Liver	Non-Cholestatic Cirrhosis, Other
Heart	Cardiomyopathy, Coronary Artery Disease, Other
Lung	Cystic Fibrosis, Primary Pulmonary Hypertension, Idiopathic Pulmonary Fibrosis, Other (including Emphysema/COPD)

Interpreting Survival Rates Between Groups

The "P-value" is the approximate probability that a difference in survival between two groups is due to random chance alone, and that there is no real difference between the rates. P-values < 0.05 are usually considered statistically significant, meaning that the difference in survival is probably not just due to random chance.

The P-value can be calculated using the survival estimates themselves and their standard errors using the formula shown in Table TN-6 in an Excel spreadsheet. Let "survival % #1" and "survival % #2" be the survival percentages for any two groups to be compared. The " Std. Err." is the standard error associated with each survival percentage. This approximation is less accurate for survival percentages close to 0% or 100%.

Table TN-6. P-Value Calculation for Survival Rates

Spreadsheet Columns			
A	B	C	D
Survival % #1	Std. Err. #1	Survival % #2	Std. Err. #2
94.0	0.2	92.3	0.6

P-value = 2*(1 - normdist (ABS(A1-C1)/SQRT(B1*B1+D1*D1)))

PREVALENCE OF PEOPLE LIVING WITH A FUNCTIONING TRANSPLANT

Table 1.14 presents an estimated count, by year, of the number of US residents living with a functioning transplant. Organ-specific prevalence counts, by recipient characteristic, are presented in Table x.16 of each organ-specific section.

Table 1.14	Summary Table: Prevalence of Living Recipients (All Organs)
Table 5.16	Kidney Transplants
Table 6.16	Pancreas Alone Transplants
Table 7.16	Pancreas After Kidney Transplants
Table 8.16	Kidney-Pancreas Transplants
Table 9.16	Liver Transplants
Table 10.16	Intestine Transplants
Table 11.16	Heart Transplants

Table 12.16 Lung Transplants

Table 13.16 Heart-Lung Transplants

In a manner similar to the graft survival rate tables, the nine years of the tables count individuals who are alive and are identified as having a functioning graft at year- end. Individuals who are known to be alive but are lost to follow-up or have a graft failure are not counted. The last year (2005) is not reported because of insufficient follow- up.

TRANSPLANT CENTER ACTIVITY

Table x.17 of each organ-specific section presents information on the number of transplants performed each year, by state and transplant center.

Table 5.17 Kidney Transplants

Table 6.17 Pancreas Alone Transplants

Table 7.17 Pancreas After Kidney Transplants

Table 8.17 Kidney-Pancreas Transplants

Table 9.17 Liver Transplants

Table 10.17 Intestine Transplants

Table 11.17 Heart Transplants

Table 12.17 Lung Transplants

Table 13.17 Heart-Lung Transplants

Transplant center activity is defined as the number of deceased and living solid organ transplants performed by each transplant center, by type of organ and by year. The total number of transplants in each state is also computed. The transplants are recorded at the center where they originally occur and may not reflect the experience of particular surgeons or teams. Mergers or changes of ownership are not reflected.

Kidney-pancreas and heart-lung transplants are reported in separate tables. Other multi-organ transplants are reported in each organ-specific table. For example, a kidney-liver transplant would be reported in both the kidney transplant activity table and the liver transplant activity table.

DONOR AND RECIPIENT TUMOR DATA

The donor and recipient tumor tables show overall frequency counts for transplants from donors with a history of cancer, as well as recipient recurrence of pretransplant malignancies, *de novo* (non-recurrent) posttransplant solid malignancies, and posttransplant lymphoproliferative disorder. Frequency counts and percentages of the type of cancer also are shown for kidney, liver, and heart transplants. The donor and recipient tumor tables are presented in Tables 14.1 - 14. 10.

Table 14.1 Organs from Donors with a History of Cancer — All Organs

Table 14.2 Recurrence of Pretransplant Malignancies — All Organs

Table 14.3 De Novo Posttransplant Solid Malignancies — All Organs

Table 14.4 Posttransplant Lymphoproliferative Disorder — All Organs

Table 14.5 Kidney Donors with a History of Cancer

Table 14.6 De Novo Posttransplant Solid Malignancy — Kidney

Table 14.7 Liver Donors with a History of Cancer

Table 14.8 De Novo Posttransplant Solid Malignancy — Liver

Table 14.9 Heart Donors with a History of Cancer

Table 14.10 De Novo Posttransplant Solid Malignancy — Heart

Donor Data

Data on organs from donors with either a history of cancer or cancer seen at the time of procurement are obtained from the DDR form.

Recipient Data

Recipient tumor data are taken from the TCR, TRR, and follow-up forms. Note that until 1999, posttransplant reporting of tumors was done on a voluntary basis. Therefore, tables are presented to show the distribution of types of tumor among all tumors reported. By no means are these tables intended to provide a measure of the incidence of posttransplant tumor occurrence. In 1994 the OPTN began collecting data on posttransplant lymphoproliferative disorder (PTLD) following thoracic organ transplants, and in 1996 they added all other organ transplants.

Although the OPTN has historically collected data on other posttransplant malignancies, until recently these data did not specify whether the tumor was recurrent or *de novo*, and there were few details regarding the specific cancer site. This year's *Annual Report* presents data obtained since 1999, when detailed tumor data collection began.

Organ-specific data on the type of cancer are shown for kidney, liver, and heart. Due to the small number of tumors for other transplanted organs, there are no other organ-specific tables presented here.

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Table TN-7. Kidney Primary Diagnosis Categories

Primary Diagnosis Categories	Diagnoses	
Glomerular Diseases	Anti-GBM	Mesangio-Capillary 2 Glomerulonephritis
	Chronic Glomerulonephritis: Unspecified	Systemic Lupus Erythematosus
	Chronic Glomerulosclerosis: Unspecified	Alport's Syndrome
	Focal Glomerularsclerosis	Amyloidosis
	Idio/Post-Inf Crescentic Glomerulonephritis	Membranous Nephropathy
	IGA Nephropathy	Goodpasture's Syndrome
	Hemolytic Uremic Syndrome	Henoch-Schoenlein Purpura
	Membranous Glomerulonephritis	Sickle-Cell Anemia
	Mesangio-Capillary 1 Glomerulonephritis	Wegener's Granulomatosis
Diabetes	Diabetes: Type I Insulin Dep/Juvenile Onset	Diabetes: Type I Non-insulin Dep/Juv Onset
	Diabetes: Type II Insulin Dep/Adult Onset	Diabetes: Type II Non-insulin Dep/Adult Onset
Polycystic Kidneys	Polycystic Kidneys	
Hypertensive Nephrosclerosis	Hypertensive Nephrosclerosis	
Renovascular and Other Vascular Diseases	Chronic Nephrosclerosis: Unspecified	Progressive Systemic Sclerosis
	Malignant Hypertension	Renal Artery Thrombosis
	Polyarteritis	Scleroderma
Congenital, Rare Familial, and Metabolic Disorders	Congenital Obstructive Uropathy	Medullary Cystic Disease
	Cystinosis	Nephrophthisis
	Fabry's Disease	Prune Belly Syndrome
	Hypoplasia/Dysplasia/Dysgenesis/ Agenesis	
Tubular and Interstitial Diseases	Acquired Obstructive Nephropathy	Oxalate Nephropathy
	Analgesic Nephropathy	Radiation Nephritis
	Antibiotic-induced Nephritis	Acute Tubular Necrosis
	Cancer Chemotherapy-Induced Nephritis	Cortical Necrosis
	Chronic Pyelonephritis/Reflex Nephropathy	Cyclosporine Nephrotoxicity
	Gout	Heroin Nephrotoxicity
	Nephritis	Sarcoidosis
	Nephrolithiasis	Urolithiasis
Neoplasms	Incidental Carcinoma	Renal Cell Carcinoma
	Lymphoma	Wilms' Tumor
	Myeloma	
Other	Other Specify	Familial Nephropathy
	Rheumatoid Arthritis	

Table TN-8. Liver Primary Diagnosis Categories

Primary Diagnosis Categories	Diagnoses	
Non-Cholestatic Cirrhosis	Laennec's Cirrhosis (Alcoholic)	Cirrhosis: Postnecrotic — Other Specify
	Laennec's Cirrhosis and Postnecrotic Cirrhosis	Cirrhosis: Drug/Indust Exposure Other Specify
	Cirrhosis: Postnecrotic — Type C	Cirrhosis: Postnecrotic — Type B and D
	Cirrhosis: Cryptogenic — Idiopathic	Cirrhosis: Postnecrotic — Type A
	Cirrhosis: Postnecrotic — Autoimmune, Lupoid	Cirrhosis: Postnecrotic — Type D
	Cirrhosis: Postnecrotic — Type B-Hbsag+	Cirrhosis: Postnecrotic — Chronic Active Hepatitis (PNC CAH)
	Cirrhosis: Postnecrotic — Type Non A Non B	Cirrhosis: Fatty Liver — NASH
	Cirrhosis: Postnecrotic — Type B and C	
Cholestatic Liver Disease/Cirrhosis	Primary Biliary Cirrhosis (PBC)	PSC: Other Specify
	Sec Biliary Cirrhosis: Other Specify	PSC: Ulcerative Colitis
	Sec Biliary Cirrhosis: Caroli's Disease	PSC: No Bowel Disease
	Sec Biliary Cirrhosis: Choledochol Cyst	PSC: Crohn's Disease
	Choles Liver Disease: Other Specify	(PSC=Primary Sclerosing Cholangitis)
	Neonatal Cholestatic Liver Disease	
Biliary Atresia	Biliary Atresia: Other Specify	Biliary Atresia: Alagille's Syndrome
	Biliary Atresia: Extrahepatic	Biliary Atresia: Hypoplasia
Acute Hepatic Necrosis	AHN: Etiology Unknown	AHN: Other Specify
	AHN: Type B- Hbsag+	AHN: Type B and C
	AHN: Drug Other Specify	AHN: Type B and D
	AHN: Non-A Non-B	AHN: Type D
	AHN: Type C	Hepatatis C: Chronic or Acute
	AHN: Type A	Hepatitis B: Chronic or Acute
	Acute Alcoholic Hepatitis	
Metabolic Diseases	Metdis: Alpha-1-Antitrypsin Deficiency A-1-A	Metdis: Glyc Stor Dis Type II (GSD-II)
	Metdis: Wilson's Disease	Metdis: Glyc Stor Dis Type I (GSD-I)
	Metdis: Hemochromatosis-Hemosiderosis	Metdis: Hyperlipidemia-II, Homozygous Hypercholesterolemia
	Metdis: Other Specify	Metdis: Maple Syrup Urine Disease
	Metdis: Tyrosinemia	
	Metdis: Primary Oxalosis/Oxaluria, Hyperoxaluria	
Malignant Neoplasms	PLM: Hepatoma — Hepatocellular Carcinoma	PLM: Other Specify
	PLM: Hepatoma (HCC) and Cirrhosis	PLM: Fibrolamellar (FL-HC)
	PLM: Cholangiocarcinoma (CH-CA)	Bile Duct Cancer
	PLM: Hepatoblastoma (HBL)	Secondary Hepatic Malignancy Other Specify
	PLM: Hemangioendothelioma-Hemangiosarcoma	(PLM=Primary Liver Malignancy)

Other	Other Specifiy	Familial Cholestasis: Byler's Disease
	Cystic Fibrosis	Trauma Other Specify
	Budd-Chiari Syndome	Graft vs. Host Disease Secondary to Non-Liver Tx
	TPN/Hyperalimentation Ind Liver Disease	Chronic or Acute
	Neonatal Hepatitis Other Specify	Benign Tumor: Polycystic Liver Disease
	Congenital Hepatic Fibrosis	Benign Tumor: Other Specify
	Familial Cholestasis: Other Specify	
	Benign Tumor: Hepatic Adenoma	

Table TN-9. Intestine Primary Diagnosis Categories

Primary Diagnosis Categories	Diagnoses	
Short Gut Syndrome	Intestinal Atresia	Massive Resection Secondary to Tumor
	Necrotizing Enterocolitis	Massive Resection Secondary to Mesenteric Arterial Thrombosis or Embolus
	Intestinal Volvulus Secondary to Malrotation	Massive Resection Secondary to Mesenteric Venous Thrombosis
	Intestinal Volvulus Secondary to Adhesions	Short Gut Syndrome: Specify
	Intestinal Volvulus Sec. to Persistent Omphalomesenteric Duct	Short Gut Syndrome: Unspecified
	Gastroschisis	
	Massive Resection Secondary to Inflammatory Bowel Disease (Crohn's Disease)	
Functional Bowel Problem	Hirschsprung's Disease	Protein-losing Enteropathy
	Neuronal Intestinal Dysplasia	Microvillous Inclusion Disease
	Pseudo-obstruction, Neuropathic	Functional Bowel Problem: Specify
	Pseudo-obstruction, Myopathic	Functional Bowel Problem: Unspecified
Retransplant/Graft Failure	Retransplant/Graft Failure	
Other	Other Intestinal Disease: Specify	Other: Specify

Table TN-10. Heart Primary Diagnosis Categories

Primary Diagnosis Categories	Diagnoses	
Cardiomyopathy	Dilated Myopathy: Idiopathic	Hypertrophic Cardiomyopathy
	Dilated Myopathy: Myocarditis	Restrictive Myopathy: Idiopathic
	Dilated Myopathy: Other Specify	Restrictive Myopathy: Amyloidosis
	Dialted Myopathy: Post Partum	Restrictive Myopathy: Sarcoidosis
	Dilated Myopathy: Familial	Restrictive Myopathy: Endocardial Fibrosis
	Dilated Myopathy: Adriamycin	Restrictive Myopathy: Other Specify
	Dilated Myopathy: Viral	Restrictive Myopathy: Secondary To Radiation/Chemotherapy
	Dilated Myopathy: Alcoholic	
Coronary Artery Disease	Coronary Artery Disease	Dilated Myopathy: Ischemic
Congenital Heart Disease	Congenital Heart Disease	
Valvular Heart Disease	Valvular Heart Disease	
Retransplant/Graft Failure	Heart Re-Tx/GF: Coronary Artery Disease	Heart Re-Tx/GF: Hyperacute Rejection
	Heart Re-Tx/GF: Other Specify	Heart Re-Tx/GF: Primary Failure
	Heart Re-Tx/GF: Non-Specific	Heart Re-Tx/GF: Chronic Rejection
	Heart Re-Tx/GF: Acute Rejection	Heart Re-Tx/GF: Restrictive/Constrictive
Other	Cardiac Disease: Other Specify	Cancer
	Heart: Other Specify	

Table TN-11. Lung and Heart-Lung Primary Diagnosis Categories

Primary Diagnosis Categories	Diagnoses	
Congenital Disease	Eisenmenger's Syn: Arterial Septal Defect	Eisenmenger's Syn: PDA
	Eisenmenger's Syn: VSD	Eisenmenger's Syn: Other Specify
	Eisenmenger's Syn: Multiple Congenital Anomalies	Congenital: Other Specify
Emphysema/COPD	Emphysema/COPD	
Cystic Fibrosis	Cystic Fibrosis	
Idiopathic Pulmonary Fibrosis	Idiopathic Pulmonary Fibrosis	
Primary Pulmonary Hypertension	Primary Pulmonary Hypertension	
Alpha-1-Antitrypsin Deficiency	Alpha-1-Antitrypsin Deficiency	
Retransplant/Graft Failure	Lung Re-Tx/GF: Obliterative Bronchiolitis	Lung Re-Tx/GF: Acute Rejection
	Lung Re-Tx/GF: Other Specify	Lung Re-Tx/GF: Primary Graft Failure
	Lung Re-Tx/GF: Non-Specific	Lung Re-Tx/GF: Restrictive
Other	Sarcoidosis	Pulmonary Vascular Disease
	Lung Disease: Other Specify	Occupational Lung Disease: Other Specify
	Bronchiectasis	Inhalation Burns/Trauma
	Pulmonary Fibrosis Other: Specify Cause	Rheumatoid Disease
	Lymphangioleiomyomatosis	Lung or Heart-Lung: Other Specify
	Obliterative Bronchiolitis (Non-Retransplant)	Secondary Pulmonary Hyertension