

# Technical Methods for the OPO-Specific Reports

Reports Released January 2017

For the Fall 2016 Cohorts

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## Introduction

Seven sections with a total of 24 tables and 24 figures report statistics for the 58 individual organ procurement organizations (OPOs) and their donation service areas (DSAs). The statistics in these tables and figures are based on data available from the Organ Procurement and Transplantation Network (OPTN) as of February 29, 2016. The tables and figures report organ procurement and transplant activities. Generally, the same conventions OPTN has used previously to tabulate donors, organs, transplants, and transplant operations were used here. Individual descriptions of tables and figures follow below.

## Section A: Description of the Donation Service Area

Section A provides a broad geographic overview of the area of the United States served by the OPO.

**Figure A1** shows the DSA in the context of the nation and indicates the location of the OPO's headquarters. **Figure A2** zooms in on the DSA and shows the counties served by the OPO. Scientific Registry of Transplant Recipients (SRTR) staff worked with each OPO during 2013 to identify the counties it functionally serves. These counties may not match the list of official Centers for Medicare & Medicaid Services (CMS)-designated counties for each OPO. Section G gives a full description of the counties served. Figure A2 also shows the locations of transplant programs in the DSA. If OPOs share a county, the full county appears on the maps for both OPOs. All transplant programs in the DSA are identified in **Table A1**. Only programs that performed at least one transplant of the various types from July 1, 2015, to June 30, 2016, are listed. Programs not listed may have patients on the waiting list for the given organ types.

## Section B: US Population Density, Deaths, Death Rates, and Donations

Section B describes the population served by the OPO.

**Figure B1** is a map showing population density in the US with the DSA highlighted. Summary statistics are provided along with an indication of where the OPO ranks among the 58 OPOs. **Figures B2 and B3** are similar but provide different perspectives; Figure B2 focuses on deaths per million population and Figure B3 on deaths per 1000 square miles covered by the OPO. Population data are derived from the US Census Bureau. Section G gives a more detailed description of the counties served.

**Table B1** shows measures of donation rates and the basic components that determine these rates for each DSA. It also shows the national distribution of select observed measures as a reference.

Table B1 shows observed donor recovery and referral data reported to OPTN/SRTR from July 1, 2015, to June 30, 2016, based on the date of recovery. Below are details of measures shown.

### Eligible Deaths

Eligible deaths include any death or imminent death (ventilated and non-ventilated) reported by a hospital that is evaluated and meets organ donor eligibility requirements. Any patient aged 70 years or younger whose death meets neurological criteria, based on the American Academy of Neurology Practice parameters for determining brain death, and does not have any of the following indications:

- Tuberculosis
- Human immunodeficiency virus Infection with specified conditions
- Creutzfeldt-Jakob disease
- Herpetic septicemia
- Rabies
- Reactive hepatitis B surface antigen
- Any retrovirus infection
- Active malignant neoplasms, except primary central nervous system tumors and skin cancers

- Hodgkin disease, multiple myeloma, leukemia
- Miscellaneous carcinomas
- Aplastic anemia
- Agranulocytosis
- Fungal and viral encephalitis
- Gangrene of bowel
- Extreme immaturity
- Positive serological or viral culture findings for HIV

SRTR uses the OPO-reported “eligible death” indication in DonorNet® to determine whether the death is eligible. SRTR does not perform additional exclusions.

#### **Deceased Donors (All)**

All deceased donors recovered in the DSA. A deceased donor is a donor from whom at least one organ was recovered for the purpose of transplant.

#### **Deceased Donors Meeting Eligibility Criteria**

All deceased donors from whom at least one organ was recovered for the purpose of transplant and the death was indicated as an eligible death.

#### **Observed (Crude) Donation Rate**

The number of deceased donors meeting eligibility criteria per 100 eligible deaths.

#### **Expected Donation Rate**

The expected donation rate per 100 eligible deaths is the rate expected for an OPO based on the national experience for OPOs serving similar eligible donor populations and DSAs. This rate is adjusted for the distributions of age, sex, race, and cause of death among eligible deaths.

#### **Ratio of Observed to Expected Donation Rate**

The standardized ratio is calculated as the ratio of observed to expected donation rates where 1.0 is equal to the reference. A ratio above 1.0 indicates that the observed measure for the OPO is greater than would be expected given the national experience, and a ratio below 1.0 indicates that the observed measure is less than would be expected given the national experience. This standardized ratio is shown in relation to all 58 OPOs in **Figure B4**. Figure B4 shows data by the number of eligible deaths in each DSA to allow comparison with OPOs of similar size.

#### **95% Confidence Interval**

The 95% confidence intervals of these ratios reflect the random variation of the observed counts that can be expected over time. The intervals provide a range of plausible values for the true ratio of DSA-to-national donation rates, in light of the observed ratio. The range includes the true ratio 95% of the time. The width of the confidence interval varies by DSA, depending on the amount of data available and the variability within the data.

#### **P Value**

The *P* value represents the probability that the number of donors is as far or farther from the expected number as the observed number was, if the variability in number of donors were caused by random chance alone based on the binomial distribution. It measures the statistical significance (or evidence) for testing the (2-sided) hypothesis that the difference between the observed and expected donation rate is zero. A *P* value less than or equal to 0.05 indicates that the difference between the observed and expected donation rate is probably real and is not due to random chance; a *P* value greater than 0.05 indicates that the difference could plausibly be due to random chance.

**Figure B5** summarizes trends in organ-specific donations per 100 eligible deaths over the five most recent 1-year periods. The most recent year of organ-specific donations is also summarized in Table C2 and Figure C4, and more detail on these rates can be found in Section C.

**Table B2** shows the observed and expected measures of donation rates by hospital for each DSA. Hospitals are identified as unique providers by the combination of provider number, provider name, and provider city, state, and zip code. Within each DSA, the observed measures aggregate to the DSA-level donation statistics in Table B1. These are hospital-level breakdowns of statistics (eligible deaths, deceased donors meeting eligibility criteria, observed donation rate per 100 eligible deaths, and expected donation rate per 100 eligible deaths) shown in Table B1. Additional donors represent deceased donors who did not meet eligibility criteria.

## Section C: Organ Utilization

**Figure C1** summarizes the number of deceased donors and the number of organs transplanted, by organ type, between July 1, 2011, and June 30, 2016. These calculations are displayed by donor type (donation after brain death [DBD], donation after circulatory death [DCD]) in **Figures C2 and C3**. Terms are defined below.

### Donor Count

Recovered donors include any donor from whom at least one solid organ was recovered for the purpose of transplant, regardless of whether or not the organ was transplanted.

### Donation after Brain Death (DBD)

The number of recovered donors who were reported as *not* being recovered under a donation after circulatory death protocol is reported for each year. These donors are also included in the total donor count.

### Donation after Circulatory Death (DCD)

The number of recovered donors who were reported as being recovered under a donation after circulatory death protocol is reported for each year. These donors are also included in the total donor count.

**Table C1** summarizes organ utilization between July 1, 2015, and June 30, 2016. It shows the general organ disposition as indicated on the deceased donor registration and does not use the reason codes in determining the categorization. Below are details of measures shown.

### Organs Authorized

The numbers of organs authorized by organ type based on the deceased donor registration. Organs classified as “consent not requested” or “consent not obtained” on the deceased donor registration are not included in this count.

### Organs Not Recovered

The number of organs with “organ not recovered” indicated on the deceased donor registration.

### Organs Recovered, Not for Transplant

This number is calculated as the sum of recovered organs by organ type, i.e., up to two kidneys can be recovered from each donor, but only one heart.

### Organs Recovered for Transplant and Not Transplanted

The number of organs for which the deceased donor registration indicated the organ was recovered for transplant, but was ultimately not transplanted. This category may include organs that were recovered for the purpose of transplant but ultimately used for research.

### Organs Recovered and Transplanted

The number of organs recovered for transplant that were transplanted. This number includes organs recovered in this DSA/OPO that were exported to another DSA/OPO for transplant. Organs divided into segments (liver, lung,

pancreas, intestine) may account for more than one transplant; thus, it is possible for the sum of the organs not recovered and the three recovered categories to exceed the number of organs authorized.

This column is based on a count of recovered organs that were transplanted, which differs from the number of transplant operations. Since multiple organs can result in one transplant procedure (i.e., a double lung transplant) and a single organ can result in multiple transplant procedures (i.e., liver segments), the totals in this table may not agree with transplant counts in other tables. For the purposes of comparison, corresponding data for the entire US, at each time period, are also reported.

Technical note: each pair of kidneys recovered “en-bloc” and each pair of lungs recovered “en-bloc” is counted as two organs. Kidney recoveries are counted separately from pancreas recoveries, regardless of whether the organs were transplanted together (note: Tables F4, F5, and F6 summarize kidney and kidney-pancreas recipients separately). Similarly, other organ combinations (hearts and lungs) are counted individually, regardless of whether they are transplanted together. Heart valves and pancreas islet cells are not counted as recovered organs. These counts are based on date recovered and could be slightly different from numbers in other tables/figures that are based on date transplanted.

**Table C2** and **Figure C4** summarize the organ-specific observed and expected donation rates (overall donation rates are shown in Table B1). Table C2 shows observed and expected organ-specific rates. Figure C4 graphs the ratio of observed to expected donation rates with its 95% confidence interval. Below are details of measures shown in Table C2 and Figure C4.

#### **Observed (Crude) Organ-Specific Rates**

The number of donors of each organ type meeting eligibility criteria per 100 eligible deaths, for kidney, liver, heart, lung, and pancreas.

#### **Expected Organ-Specific Rates**

Differences among DSAs in the evaluation and conversion of potential donors by expected number of donors of each organ type among all eligible deaths.

#### **Organ-Specific P Value**

The *P* value represents the probability that the number of donors would be as far or farther from the expected number as the observed number was, if the variability in number of donors were caused by random chance alone. It measures the statistical significance (or evidence) for testing the (2-sided) hypothesis that the difference between the observed and expected donation rate is zero. A *P* value less than or equal to 0.05 indicates that the difference between the observed and expected donation rate is probably real and is not due to random chance, and a *P* value greater than 0.05 indicates that the difference could plausibly be due to random chance. The 2-sided *P* values presented in the organ-specific rates are used to identify cases in which observed rates are statistically different from (above or below) the expected rate.

#### **Ratio of Observed to Expected Donation Rate**

The standardized ratios shown in Figure C4 are calculated as the ratio of observed to expected donation rates where 1.0 is equal to the reference. The point estimate of the ratio is shown by a hollow circle. A ratio above 1.0 indicates that the observed measure for the OPO is greater than would be expected given the national experience, and a ratio below 1.0 indicates that the observed measure is less than would be expected given the national experience.

#### **95% Confidence Interval**

Figure C4 shows the 95% confidence intervals associated with the standardized donation rate ratios. The confidence intervals, depicted by lines on either side of the point estimate, reflect the random variation of the observed counts that can be expected over time. The intervals provide a range of plausible values for the true ratio

of DSA-to-national donation rates, in light of the observed ratio. The range includes the true ratio 95% of the time. The width of the confidence interval varies by DSA, depending on the amount of data available and the variability within the data.

**Figure C5** summarizes numbers of organs recovered per donor for the DSA/OPO compared with other DSAs/OPOs from July 1, 2015, to June 30, 2016. It shows the distribution of all OPOs in the nation in a bell-shaped curve with a horizontal line indicating the mean performance and a diamond shape indicating the performance of the OPO. If the diamond shape is located above the line, the OPO recovered more organs per donor than the national average.

**Figure C6** summarizes numbers of organs transplanted per donor for the DSA/OPO compared with other DSAs/OPOs from July 1, 2015, to June 30, 2016. It shows the distribution of all OPOs in the nation in a bell-shaped curve with a horizontal line indicating the mean performance and a diamond shape indicating the performance of the OPO. If the diamond shape is located above the line, the OPO transplanted more organs per donor than the national average.

These data are displayed by DBD and DCD status in **Figures C10 and C11**.

Technical note: each pair of kidneys recovered “en-bloc” and each pair of lungs recovered “en-bloc” is counted as two organs. Kidney recoveries are counted separately from pancreas recoveries, regardless of whether the organs are transplanted together. Similarly, other organ combinations (hearts and lungs) are counted individually, regardless of whether they are transplanted together. Organs divided into segments (liver, lung, pancreas, intestine) may account for more than one transplant; thus, it is possible for the sum of the organs not recovered and the three recovered categories to exceed the number of organs authorized. Heart valves and pancreas islet cells are not counted as recovered organs.

**Figure C7** is a bar graph summarizing organs transplanted per donor for the DSA/OPO from July 1, 2011, to June 30, 2016, with darker colors showing more recent time periods. These numbers are displayed by DBD and DCD status for the OPO and the US in **Figure C9**.

### Organ Yield per Donor

**Table C3** shows measures of organs transplanted per donor, or yield, for each DSA. The data were reported to OPTN/SRTR from July 1, 2014, to June 30, 2016, based on the date of transplant. Details of measures are described below.

### Number of Donors

All deceased donors in the DSA, defined as a decedent from whom at least one organ was recovered for the purpose of transplant.

### Observed Number of Transplanted Organs

The number of organs transplanted from deceased donors, for all organs (aggregate) and for kidney, liver, heart, lung, pancreas, and intestine.

Single lung and double lung transplants are both counted as one organ transplant. Kidney transplants are counted separately as zero, one, or two. Aggregate yield is the sum of the individual organ yields (0-7).

### Expected Number of Transplanted Organs

The number of organs expected to be transplanted from deceased donors, for all organs (aggregate) and for kidney, liver, heart, lung, pancreas, and intestine.

Expected yield is estimated from statistical models that take into account various donor characteristics in an attempt to adjust for differences in the types of donors each OPO manages. A separate risk-adjustment model is used for each of six organs: heart, intestine, kidney, liver, lung, and pancreas. The models were developed on

donors from whom at least one organ was recovered for the purpose of transplant. A detailed description of the models used to arrive at the estimates of expected yield is available on the SRTR website, [www.srtr.org](http://www.srtr.org).

#### **Observed Organs Transplanted per 100 Donors**

The number of organs transplanted from deceased donors per 100 deceased donors recovered in the DSA. A deceased donor is defined as any donor from whom at least one organ was recovered for the purpose of transplant. These rates are shown for all organs and for kidney, liver, heart, lung, pancreas, and intestine.

#### **Expected Organs Transplanted per 100 Donors**

The number of organs expected to be transplanted from deceased donors per 100 recovered deceased donors based on national experience. A deceased donor is defined as any donor from whom at least one organ was recovered for the purpose of transplant. These rates are shown for all organs and for kidney, liver, heart, lung, pancreas, and intestine.

#### **Observed per 100 – Expected per 100**

A value less than 0 indicates that the OPO yield was less than expected given the national experience; a value more than 0 indicates that the observed measure is greater than expected given the national experience.

#### **Ratio of Observed to Expected Transplant Rate**

A ratio above 1.0 indicates that the observed measure for an OPO is greater than would be expected given the national experience; a ratio below 1.0 indicates that the observed measure is less than would be expected given the national experience. These ratios are presented graphically in **Figure C8** to show the OPO relative to the other OPOs. In **Figure C8**, the x-axis represents the number of donors recovered by each OPO for comparison with other OPOs of relatively the same size.

#### **P Value**

The *P* value represents the probability that the number of organs transplanted would be as far or farther from the expected number as the observed number was, if the variability in number of donors were caused by random chance alone. It measures the statistical significance (or evidence) for testing the (2-sided) hypothesis that the difference between the observed and expected yield is zero. A *P* value less than or equal to 0.05 indicates that the difference between the observed and expected yield is probably real and is not due to random chance, and a *P* value greater than 0.05 indicates that the difference could plausibly be due to random chance. *P* values were obtained through a bootstrap process using 1000 bootstrapped samples.

#### **Total Organs Transplanted**

Figures C9, C10, and C11 show total organs transplanted by DBD and DCD status. Figure C9 shows time trends for the OPO and the US. Figures C10 and C11 show the distribution of all OPOs in the nation in a bell-shaped curve with a horizontal line indicating the mean performance and a diamond shape indicating the performance of the OPO. If the diamond shape is located above the line, the OPO transplanted more DBD or DCD organs than the national average.

## **Section D: Description of Donors Recovered by the OPO**

**Table D1** summarizes the characteristics of donors recovered during two time periods, July 1, 2014, to June 30, 2015, and July 1, 2015, to June 30, 2016, by the DSA/OPO. For purposes of comparison, corresponding data for the entire US at each time period are also reported. Below are details of measures shown.

#### **Donor Count**

The total number of recovered donors during this period by this DSA/OPO and throughout the US. Recovered donors are defined as any donor from whom at least one organ was recovered for the purpose of transplant,

regardless of whether or not the organ was transplanted. Table D1 identifies all donor types in the donor population. The summaries of the donor characteristics in Table D1 are based on these donor population counts.

#### **Race**

The percentages of recovered donors in each of five race categories. Race and ethnicity are reported together as a single data element, reflecting data collection (either race or ethnicity is required, but not both). Patients formerly coded as white and Hispanic are coded as Hispanic. Race and ethnicity sum to 100 percent. The categories are: Asian/Pacific Islander, black, white, Hispanic/Latino, a combined group for other races, and unknown. Missing values are reported as unknown.

#### **Age**

Donor age was determined at the date of death/organ recovery. The percentage of donors in each age range is reported. Missing values are reported as unknown.

#### **Sex**

Percentages of male and female donors. Missing values are reported as unknown.

#### **Blood Type**

Percentages of donors by ABO type (O, A, B, AB). Donors with ABO type A, A1, or A2 are classified as A. Donors with ABO type AB, A1B, or A2B are classified as AB. Missing values are reported as unknown.

#### **Cause of Death**

Percentages of recovered donors in each major cause-of-death category. The categories are: anoxia, stroke, central nervous system tumor, head trauma, other, and unknown. Any missing values are reported as unknown.

#### **Donation after Cardiac (Circulatory) Death (DCD)**

The percentage of recovered donors for whom circulatory death occurred.

### **Section E: Programs Transplanting Organs Procured by the OPO**

Section E presents “flight maps” showing locations of programs that transplanted organs from the OPO, with separate maps for each organ type. All arrows originate from the location of the OPO’s headquarters, not from the location of each donor hospital. Many programs in the OPO’s DSA do not appear on the map due to scale. Line thickness is standard and does not vary by volume. Each map is accompanied by a table showing full details for each program that transplants organs recovered by the OPO. Geographic indicators show whether the program is in the DSA (local), in the OPTN region (regional), or outside the OPTN region (national).

### **Section F: Transplants Facilitated by the OPO**

The tables in Section F summarize the characteristics of deceased donor transplant recipients who underwent transplant between July 1, 2014, and June 30, 2015, or between July 1, 2015, and June 30, 2016, with organs recovered by this OPO, with corresponding average values for the US. Only transplants resulting from locally procured donors are included. Separate tables are shown for kidney, kidney/pancreas, pancreas, liver, heart, heart-lung, and lung transplants. Below are details of measures shown.

#### **Total Number of Transplants**

The total number of recipients who underwent transplant with locally procured organs.

### **Race**

Percentages of recovered donors in each of five race categories. Race and ethnicity are reported together as a single data element, reflecting data collection (either race or ethnicity is required, but not both). Patients formerly coded as white and Hispanic are coded as Hispanic. Race and ethnicity sum to 100 percent. The categories are: Asian/Pacific Islander, black, white, Hispanic/Latino, a combined group for other races, and unknown. Missing values are reported as unknown.

### **Age**

Age was determined at the date of transplant. Percentages of recipients in each age range are reported. Missing values are reported as unknown.

### **Sex**

Percentage of male and female recipients. Missing values are reported as unknown.

### **Blood Type**

Percentages of recipients by ABO type (O, A, B, AB). Recipients with ABO type A, A1, or A2 are classified as A. Recipients with ABO type AB, A1B, or A2B are classified as AB. Missing values are reported as unknown.

### **Peak Panel-Reactive Antibody (Kidney, Pancreas, and Kidney/Pancreas Programs Only)**

Highest panel reactive antibody (PRA) value on the waiting list for recipients of kidney, pancreas, or kidney/pancreas transplants. Percentages of recipients in each PRA range (0-9, 10-79,  $\geq 80$ ) are reported. Missing values are reported as unknown.

### **Primary Cause of Disease (Not Shown for Pancreas and Kidney/Pancreas)**

Percentages of recipients in each major category of primary cause of organ failure, classified by primary diagnosis at the time of transplant. Major categories for each organ are shown below. Primary diagnosis group is not shown for pancreas and kidney/pancreas recipients because virtually all undergo transplant due to diabetes mellitus.

- Kidney
  - Glomerular diseases
  - Tubular and interstitial disease
  - Polycystic kidney disease
  - Congenital, familial, metabolic renal diseases
  - Diabetes mellitus
  - Renovascular and vascular diseases
  - Neoplasms
  - Hypertensive nephrosclerosis
  - Retransplant/graft failure
  - Other kidney diseases
  - Missing
- Liver
  - Acute hepatic necrosis
  - Non-cholestatic cirrhosis
  - Cholestatic liver disease/cirrhosis
  - Biliary atresia
  - Metabolic diseases
  - Malignant neoplasms
  - Other
  - Missing
- Intestine

- Short gut syndrome
- Functional bowel problem
- Retransplant/graft failure
- Other
- Missing
- Heart
  - Cardiomyopathy
  - Coronary artery disease
  - Retransplant/graft failure
  - Valvular heart disease
  - Congenital heart disease
  - Other
  - Missing
- Lung
  - Congenital disease
  - Retransplant/graft failure
  - Primary pulmonary hypertension
  - Cystic fibrosis
  - Idiopathic pulmonary fibrosis
  - Alpha-1-antitrypsin deficiency
  - Emphysema/chronic obstructive pulmonary disease (COPD)
  - Other
  - Missing
- Heart-Lung
  - Congenital disease
  - Retransplant/graft failure
  - Primary pulmonary hypertension
  - Cystic fibrosis
  - Idiopathic pulmonary fibrosis
  - Alpha-1-antitrypsin deficiency
  - Emphysema/chronic obstructive pulmonary disease (COPD)
  - Other
  - Missing

#### **Recipient Medical Urgency Status at Transplant**

Medical urgency status at the time of transplant is shown for recipients of deceased donor livers and hearts only. Percentages of recipients in each status type are reported.

Beginning on February 27, 2002, candidates for liver transplant were classified by model for end-stage liver disease (MELD) or pediatric end-stage liver disease (PELD) score, not by medical urgency status. However, Status 1 and “temporarily inactive” candidates were still grouped by status. MELD and PELD scores were computed based on candidate laboratory measures at the time of transplant. Groups after February 27, 2002, are: Status 1, MELD 6-10, MELD 11-20, MELD 21-30, MELD 31-40, PELD 10 or less, PELD 11-20, PELD 21-30, PELD greater than 30, and temporarily inactive.

#### **Expanded Criteria Donors (Kidney Only)**

The percentage of donors who meet expanded donor criteria (aged older than 60 years or aged 50-59 years with death from stroke, history of hypertension, or serum creatinine greater than 1.5 mg/dL).

## Section G: Counties Served by the OPO

**Table G1** shows counties served by the OPO, ordered alphabetically within state. For the purposes of this report, counties are those actually served by the OPO and may not reflect CMS assignments. SRTR staff worked closely with OPOs during 2013 to determine correct county assignments. Please contact SRTR at [srtr@srtr.org](mailto:srtr@srtr.org) if any counties appear to be assigned in error. If more than one OPO serves different donor hospitals within the same county, the county is indicated as a shared county and the OPO sharing the county is indicated by OPO code. In the calculations of population density, land area, and death rates shown in Section B, a split county is considered a full member of each OPO serving that county and no attempt is made to subdivide its land area or population.

Possible scenarios for OPO county assignment in Table G1:

- 1) An OPO is assigned to a county if the county is assigned by CMS to the OPO and that OPO served all the donor hospitals in the county.
- 2) An OPO is assigned to a county if the county is assigned by CMS to the OPO and the county has no donor hospitals.
- 3) An OPO is not assigned to a county if the county is assigned by CMS to the OPO but another OPO serves the only donor hospital in that county. The other OPO would be assigned to this county.
- 4) If an OPO serves one or more donor hospitals in a county and another OPO has a waiver to serve one or more donor hospitals in the same county, both OPOs would be assigned to the county.