Percentage of Prevalent Patients Waitlisted (PPPW) and Percentage of Prevalent Patients Waitlisted in Active Status (aPPPW) Measures Calculation Descriptions
DRAFT

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Introduction

The *Percentage of Prevalent Patients Waitlisted (PPPW) and Percentage of Prevalent Patients Waitlisted in Active Status (aPPPW) Measures Calculation Descriptions* serves as a complementary document to the *Quality MUC ID #2022-063 Percentage of Prevalent Patients Waitlisted (PPPW) and Percentage of Prevalent Patients Waitlisted in Active Status (aPPPW) Measure Specification Form* to aid in the calculation of the PPPW and aPPPW. These technical notes describe the statistical methods used to calculate the measures, including model details, and can be found on the following publicly available webpage: https://dialysisdata.org/content/MIPS. The model details have already been calculated by the measure developer and are provided to Merit-based Incentive Payment System (MIPS) eligible clinician groups calculating the measures.

Measure Description

The Percentage of Prevalent Patients Waitlisted (PPPW) and Percentage of Prevalent Patients Waitlisted in Active Status (aPPPW) measures track the percentage of patients at a practitioner group practice who were on the kidney or kidney-pancreas transplant waitlist (all patients or patients in active status). These measures are risk-adjusted percentages of waitlist events among dialysis patients in a practitioner group.

Here the adjusted number of patient-months is calculated from a mixed-effects logistic regression model, adjusting for age, patient comorbidities, other risk factors at incidence of dialysis, random effects for transplant centers and assuming the practitioner group-specific event rate equals the population average.

Patient characteristics included in the risk adjustment model as covariates are:

- Age at the end of reporting month

    o Age is included as continuous variable as well as age spline knots at 15, 55, and 70. For example, patients older than 70 will have all four splines included in the calculation (Age, Age-15, Age-55 and Age-70). In contrast, patients older than 55 but younger than 70 will only have three splines (Age, Age-15, and Age-55).

- Diabetes, primary cause of ESRD

- Comorbidities at ESRD incidence (from CMS Medical Evidence Form 2728 Box 16):
    - Congestive heart failure
    - Atherosclerotic heart disease and other cardiac disease
    - Cerebrovascular disease, CVA, TIA
    - Peripheral vascular disease
    - Diabetes other than as primary cause of ESRD (all types including diabetic retinopathy)
    - Chronic obstructive pulmonary disease
    - Inability to ambulate
    - Inability to transfer
    - Malignant neoplasm, cancer
    - Tobacco use (current smoker)
    - Drug dependence
    - No Medical Evidence (CMS-2728) Form
    - At least one of the comorbidities listed

- A set of prevalent comorbidities based on presence of a relevant diagnosis, or relevant Medicare inpatient or outpatient claim from the prior calendar year in the following 64 categories (see Sheet "ICD10 codes" in Files *a/PPPW_ModelInfo.xlsx*):

    - Candidal esophagitis
    - Sarcoidosis
    - Cancer of Liver
    - Cancer of Lung
    - Cancer of Bladder
    - Cancer of Bone
    - Other Neoplasm
    - Non-Hodgkins Lymphoma
    - Multiple Myeloma
    - Myelodysplastic Syndrome
    - Diabetes without complications
    - Diabetes with complications
    - Glucocorticoid deficiency
    - Malnutrition / Cachexia
    - Disorders of urea cycle metabolism
    - Other amyloidosis
    - Other specified disorders of metabolism
    - Sickle-cell Anemia
    - Pancytopenia
    - Neutropenia
    - Substance Related Disorders
    - Opioid Dependance
    - Schizophrenia
    - Peripheral autonomic neuropathy in disorders classified elsewhere
    - Epilepsy
    - Bipolar Disorder
    - Major depressive affective disorder
    - Alcohol Related Disorders

- o Coma
- o Cerebral edema
- o Myocardial Infarction
- o Coronary Atherosclerosis
- o Pulmonary embolism and infarction
- o Primary pulmonary hypertension
- o Pulmonary Heart Disease
- o Cardiomyopathy
- o Atrioventricular block, complete
- o Paroxysmal Tachycardia
- o Atrial fibrillation
- o Atrial flutter
- o Acute Cerebrovascular Disease
- o Peripheral and Visceral Atherosclerosis
- o Venous Thromboembolism
- o Esophageal varices
- o Chronic Obstructive Pulmonary Disease
- o Aspiration Pneumonitis

- o Other Lower Respiratory Diseases
- o Respiratory Failure
- o Cirrhosis of Liver
- o Other Liver Disease
- o Pancreatitis
- o Chronic Skin Ulcer
- o Systemic lupus erythematosus and connective tissue disorders
- o Rheumatoid Arthritis
- o Pathologic Fracture
- o Gangrene
- o HIV
- o Gastrostomy status
- o Other artificial opening of urinary tract status
- o Dependence on respirator, status
- o Below knee amputation status
- o Above knee amputation status
- o Long-term (current) use of insulin
- o Inflammatory polyarthropathy

- Medicare-Medicaid dual eligibility

- Area Deprivation Index (ADI), based on patient residence zip code

- Transplant center characteristics, based on patient residence zip code

   o Weighted SRTR mortality ratio

   o Weighted SRTR transplant ratio

Patient Exclusions

Months in which patients are age 75 or older, admitted to a skilled nursing facility (SNF), or do not have a submitted bill for a dialysis monthly capitation payment (MCP), are excluded from the calculation. Patients who were admitted to a SNF within one year of dialysis initiation according to form CMS-2728 are entirely excluded from the calculation. Patients determined to be in hospice have their months excluded from the month of hospice admission and forward. Patients are excluded if they were diagnosed with dementia in the prior calendar year. The noted exclusions represent conditions for which transplant waitlist candidacy is highly unlikely, and which can be identified readily with available data.

Calculation of the PPPW and aPPPW

In order to calculate the PPPW and aPPPW, you will (1) need to know which of your patients are eligible for this measure each month, (2) if eligible, if they are on the waitlist each month and if their waitlist status is active or inactive, (3) have information on your patients' characteristics that are described above (age, comorbidities, Medicare dual eligibility status, transplant center (or nearest), and zip code), and (4) download the *PPPW_ModelInfo.xlsx* and *aPPPW_ModelInfo.xlsx* spreadsheets. With this information you will be able to do the mathematical calculation for each patient as described above.

The *PPPW_ModelInfo.xlsx* and a*PPPW_ModelInfo.xlsx* spreadsheets include the following information: **Model Coefficients**, **Practitioner Group Effect**, and **Transplant Center Effects**, **National Average Waitlist Rate**, **Txp Center & ADI by Zip Code**, and **ICD10 Codes**. For the purposes of this document, each reference to these model details sheets will be described in **bold** text. An example calculation is provided below.

> The **Model Coefficients** sheet details the PPPW and aPPPW model coefficients' parameter, variable type, and estimate. For example, the PPPW "Cancer" parameter is listed as "Categorical (0 versus 1)," with an estimate of -0.3067 (rounded).

> The **Practitioner Group Effects** sheet provides a single statistic (median practitioner group effect). For example, the PPPW Median Practitioner Group Effect value is 0.9699 (rounded).

> The **Transplant Group Effects** sheet provides the effect values by transplant center code. For example, the PPPW Transplant Center Effect for Transplant Center Code "ALCH" is 0.2151 (rounded).

The **National Average Waitlist Rate** sheet provides a single statistic. For example, the PPPW National Average Waitlist Rate is 0.1953 (rounded).

The **Txp Center & ADI by Zip Code** sheet provides the values for the two weighted transplant ratios, Weighted SRTR mortality ratio and Weighted SRTR transplant ratio, as well as Area Deprivation Index by Zip code. For example, for PPPW, Zip Code "00601" uses the following values (rounded): a Weighted SRTR mortality ratio of 1.0777, a Weighted SRTR transplant ratio of 0.9664, and an ADI of 85.4989.

The **ICD10 Codes** sheet provides the Clinical Classifications Software (CCS) group as well as ICD10 codes and descriptions. For example, "candidal esophagitis" has a CCS Grouper of "1" and ICD10 code of "B3781".

As an example, we calculate the PPPW and aPPPW for a hypothetical practitioner group that treated 12 patients in 2021. Table 1 describes the patients' information needed for the calculation. Apart from those characteristics mentioned in Table 1, all other characteristics are set to be 0. Characteristics are omitted for 7 patients for space.

Table 1. Description of 5 patients at a hypothetical practitioner group for calculation

Patient	#Months with active status on the WL	#Months with inactive status on WL	# Months at risk	Characteristics	Transplant Center	Zip Code
#1	2	2	12	Age=51; diabetic as primary ESRD cause; smoke; at least one incident comorbidity listed	MIBH	48428
#2	3	1	12	Age=70; diabetic, non-primary; at least one incident comorbidity listed	MIUM	48107
#3	1	1	10	Age=63; drug use; at least one incident comorbidity listed	MIHF	48208
#4	3	2	9	Age=66; diabetic, non-primary; heart disease; at least one incident comorbidity listed	MIHH	47955
#5 - #11	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
#12	2	1	12	Age=72; diabetic, non-primary; at least one incident comorbidity listed	MIUM	48103

Step1: Calculate the sum of the number of months on the wait list (both active and inactive status) and the sum of the number of months with active status on the wait list. From Table 1, we can get 18 months on the waitlist and 11 months on the waitlist in active status.

Step 2: Calculate the linear prediction for PPPW and aPPPW using the **Model Coefficients** table in the PPPW and aPPPW Excel files located at https://dialysisdata.org/content/MIPS. Tables 2 and 3 show these details for the example. Note the calculations can be affected by rounding. For this calculation example, we show only four decimal places for ease of display.

Table 2. Calculation of the linear prediction for PPPW for each patient

Patient	Formula	Linear prediction
#1	(Age=51)*(-0.0002)+(51-15)*(-0.0182)+(diabetic as primary ESRD cause=1)*(-0.3737)+(smoke=1)*(-0.6748)+(at least one incident comorbidity listed=1) *(-0.0037)+ (mort ratio=1.0200)*(-0.0474)+ (tx ratio=1.2026))*(-0.1516)+(ADI= 37.2887)*(-0.0079)	-2.2422
#2	(Age=70)*(-0.0002)+(70-15)*(-0.0182)+(70-55)*(-0.0300)+(diabetes, non-primary=1)*(-0.2483)+(at least one incident comorbidity listed=1)*(-0.0037)+(mort ratio=0.8470)*(-0.0474)+(tx ratio=1.1061)*(-0.1516) +(ADI=38.0000)*(-0. 0079)	-2.2249
#3	(Age=63)*(-0.0002)+(63-15)*(-0.0182)+(63-55)*(-0.0300)+(drug=1)*(-0.9355)+(at least one incident comorbidity listed=1)*(-0.0037)+ (mort ratio=0.9588)*(-0.0474)+(tx ratio=0.9966)*(-0.1516)+(ADI=87.0064)*(-0. 0079)	-2.9476
#4	(Age=66)*(-0.0002)+(66-15)*(-0.0182)+(66-55)*(-0.0300)+(diabetes, non-primary=1)*(-0.2483)+(heart disease=1)*(-0.0638)+(at least one incident comorbidity listed=1)*(-0.0037)+(mort ratio=0.9967)*(-0.0474)+(tx ratio=1.0639)*(-0.1516)+(ADI=74.4935)*(-0. 0079)	-2.3830
#5 - #11	*(omitted)*	*(omitted)*
#12	(Age=72)*(-0.0002)+(72-15)*(-0.0182)+(72-55)*(-0.0300)+(72-70)*(-0.2271)+(diabetes, non-primary=1)*(-0.2483)+(at least one incident comorbidity listed=1)*(-0.0037)+(mort ratio=0.8470)*(-0.0474)+(tx ratio=1.1061)*(-0.1516)+(ADI=28.4577)*(-0. 0079)	-2.7010

Table 3. Calculation of the linear prediction for aPPPW for each patient

Patient	Formula	Linear prediction
#1	(Age=51)*0.0192+(51-15)*(-0.0376)+ (diabetics as primary ESRD cause=1)*(-0.4244)+ (smoke=1)*(-0.7017)+ (at least one incident comorbidity listed=1) *(0.0034)+ (mort ratio=1.0200)*(-0.1568)+ (tx ratio=1.2026)*(-0.1590)+ (ADI=37.2887)*(-0.0080)	-2.1428
#2	(Age=70)*0.0192+(70-15)*(-0.0376)+(70-55)*(-0.0238)+(diabetes, no primary = 1) *(-0.2606)+ (at least one incident comorbidity listed=1)*(0.0034)+ (mort ratio=0.8470)*(-0.1568)+ (tx ratio = 1.1061)*(-0.1590)+ (ADI=38.0000)*(-0.0080)	-1.9463
#3	(Age=63)*0.0192+(63-15)*(-0.0376)+(63-55)*(-0.0238)+ (drug=1)*(-0.8851)+ (at least one incident comorbidity listed=1)*(0.0034)+ (mort ratio = 0.9588)*(-0.1568)+ (tx ratio = 0.9966)*(-0.1590)+ (ADI = 87.0064)*(-0.0080)	-2.6675
#4	(Age=66)*0.0192+(66-15)*(-0.0376)+(66-55)*(-0.0238)+(diabetes, no primary = 1)*(-0.2606)+(heart disease =1)*(-0.1061)+ (at least one incident comorbidity listed=1)*(0.0034)+ (mort ratio = 0.9967)*(-0.1568)+ (tx ratio = 1.0639)*(-0.1590)+ (ADI=74.4935)*(-0.0080)	-2.1922
#5 - #11	*(omitted)*	*(omitted)*
#12	(Age=72)*0.0192+(72-15)*(-0.0376)+(Age-55)*(-0.0238)+(Age-70)*(-0.2302)+ (diabetes, no primary=1)*(-0.2606)+ (at least one incident comorbidity listed=1)*(0.0034)+ (mort ratio = 0.8470)*(-0.1568)+ (tx ratio=1.1061)*(-0.1590)+ (ADI=28.4577)*(-0.0080)	-2.4147

Step 3: Using the linear predictors calculated above, together with the median of practitioner group effects and transplant center effects which can be found in the Excel files, compute the probability that each patient is waitlisted and the probability that each patient is waitlisted in active status.

The probability that a patient is waitlisted is calculated as:

$$Probability = \frac{\exp(Median\ practitioner\ effect\ + Tx\ center\ effect + Linear\ prediction)}{1 + \exp(Median\ practitioner\ effect\ + Tx\ center\ effect + Linear\ prediction)}$$

using the Median practitioner effect, transplant center effect, and linear prediction information for the PPPW measure.

Using the Median practitioner effect, transplant center effect, and linear prediction information for the aPPPW measure, the probability that a patient is waitlisted and in active status is calculated similarly.

Tables 4 and 5 show the probability calculations.

Table 4. Calculation of the probability of being waitlisted for each patient for the PPPW

Patient	Linear prediction	Median practitioner effect	Transplant center effect	Waitlist probability
#1	-2.2422	0.9699	0.1229	0.2406
#2	-2.2249	0.9699	-0.1229	0.2013
#3	-2.9476	0.9699	-0.1229	0.1090
#4	-2.3830	0.9699	-0.1229	0.1771
#5-#11	*(omitted)*	0.9699	*(omitted)*	*(omitted)*
#12	-2.7010	0.9699	-0.1229	0.1354

Table 5. Calculation of the probability of being waitlisted for each patient for the aPPPW

Patient	Linear prediction	Median practitioner effect	Transplant center effect	Waitlist probability
#1	-2.1428	0.1776	-0.1041	0.1121
#2	-1.9463	0.1776	-0.3128	0.1109
#3	-2.6675	0.1776	-0.1041	0.0695
#4	-2.1922	0.1776	-0.3128	0.0889
#5-#11	*(omitted)*	0.1776	*(omitted)*	*(omitted)*
#12	-2.4147	0.1776	-0.3128	0.0724

Step 4: Based on the above results, we can calculate the expected waitlist events by adding each patient's waitlist probability each month from Table 4 and the expected waitlist events in active status by adding each patient's waitlist probability each month from Table 5.

$$\textit{Expected waitlist events} = (12 \times 0.2406) + (12 \times 0.2013) + (10 \times 0.1090) + (9 \times 0.1771) + \cdots + (12 \times 0.1354) = 9.6115$$

$$\textit{Expected waitlist on active status events} = (12 \times 0.1121) + (12 \times 0.1109) + (10 \times 0.0695) + (9 \times 0.0889) + \cdots + (12 \times 0.0724) = 5.0399$$

Step 5: Calculate the adjusted sum of months at risk for this practitioner group by dividing the expected events calculated above by the US average and round (represent by [] below) the result to the nearest integer.

$$\textit{Adjusted sum of at risk months on the WL} = \left\lceil \frac{\textit{Expected waitlist events}}{\textit{US average}} \right\rceil = \left\lceil \frac{9.6115}{0.1953} \right\rceil = 49$$

$$Adjusted\ sum\ of\ at\ risk\ months\ on\ the\ WL\ in\ active\ status$$
$$= \left\lceil \frac{Expected\ waitlist\ on\ active\ status\ events}{US\ average} \right\rceil = \left\lceil \frac{5.0399}{0.1240} \right\rceil = 41$$

Step 6: Finally, we calculate the PPPW for this practitioner group by dividing the observed waitlist sum by the adjusted sum of at risk months on the WL.

$$PPPW = \frac{Sum\ observed\ months\ on\ the\ WL}{Adjusted\ sum\ of\ at\ risk\ months\ on\ the\ WL}$$

$$= \frac{18}{49} = 36.73\%$$

We calculate the aPPPW for this practitioner group by dividing the observed waitlist on active status sum by the adjusted sum of at risk months on the WL in active status.

$$aPPPW = \frac{Sum\ observed\ months\ on\ the\ WL\ in\ active\ status}{Adjusted\ sum\ of\ at\ risk\ months\ on\ the\ WL\ in\ active\ status} = \frac{11}{41} = 26.83\%$$