PD Calculator

Instructions for Use and References

Intended Use

The online PD (Peritoneal Dialysis) Calculator is intended for use by clinicians for modeling the dialysis dose (Kt/V) for different peritoneal dialysis prescriptions options. Modeling a PD dose is based on generalized formulas and assumptions derived from patient populations. The output of a modeled prescription is limited in its accuracy and cannot account for the variability seen in individual patients. It is essential that the physician adjusts the prescription according to the individual patient's clinical parameters to ensure the adequacy of the PD prescription.

The calculator is not intended to replace the judgment or experience of the attending physician. The peritoneal dialysis treatment prescription is the sole responsibility of the attending physician.

The PD Calculator is not intended to be used for pediatric patients or amputees.

Important Information

The PD Calculator is a Clinical Decision Support Software (CDSS) tool and cannot address the full range of topics related to a PD prescription that are critical for the overall management and ongoing monitoring of a PD patient. This tool should never be used as a substitute for physician judgement. It is the responsibility of the healthcare provider to independently review the results provided by the PD Calculator and not rely primarily on this tool when making clinical treatment decisions for patients.

The PD Calculator requires patient-specific input information (age, gender, height, weight, transport status, and residual renal function) for predicting Kt/V of a modeled prescription. It is the responsibility of the user to ensure the accuracy of the patient parameters. Incorrect patient data may result in the over- or under-estimation of the predicted Kt/V.

The PD Calculator utilizes the formulas and algorithms provided in the PD Calculator Formulas and References section. It is the physician's responsibility to ensure that these formulas are appropriate for and applicable to their particular patient.

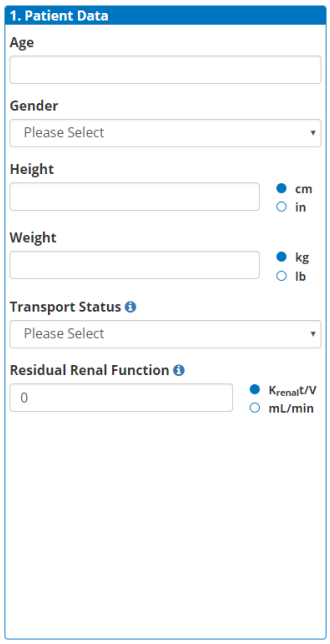
The Fresenius Medical Care Renal Therapies Group has made every reasonable effort to ensure the accuracy of the outcomes provided by the PD Calculator. In no event will FMCNA be liable for any losses or damages arising from or relating to your use of the PD Calculator, whether direct, indirect, incidental or consequential.

Minimum System Requirements

- Internet Explorer 11
- Firefox 56
- Google Chrome 62
- Safari 11
- Android Google Chrome
- iOS Safari

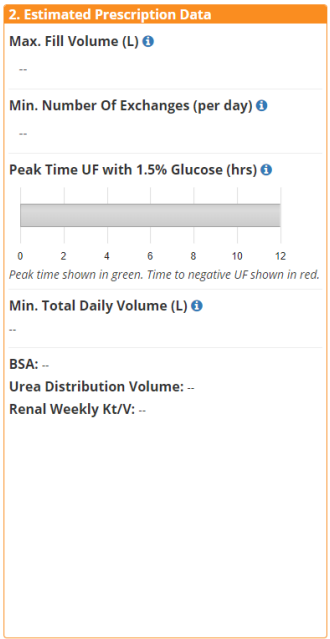
Instructions for Using the PD Calculator

1. Enter patient parameters in the Patient Data section



- Age: Enter the patient's age in years. Age must be 22 – 120
- Gender: Select Male or Female from the drop-down menu
- Height: Enter the patient's height in cm (centimeters) or inch (inches). Choose the correct units from the radio buttons. Height must be 141 – 196 cm (56 – 77 in).
- Weight: Enter the patient's weight in kg (kilograms) or lb (pounds). Choose the correct units from the radio buttons. Weight must be 38 – 160 kg (83 – 352 lb).
- Transport Status: Select the patient's transport status from the drop-down menu.
  - ℹ Transport status indicates how quickly solutes and water move between the dialysate and the patient's blood plasma and is classified as high, high average, low average, or low. If the transport status is unknown, Average can be selected.
- Residual Renal Function (RRF): Enter the patient's RRF as Renal Urea Clearance (mL/min) or Renal weekly Kt/V. Choose the correct units from the radio buttons.
  - ℹ A patient's residual renal function (RRF) can be considered when modeling a PD prescription. However, it is important to ensure that all clinical values are current. Incorrectly entering RRF can lead to over- or under-estimation of Kt/V. The RRF can be entered as renal (residual) Kt/V or renal urea clearance (mL/min). If you do not want to include RRF in modeling predictions, this can be left at 0.

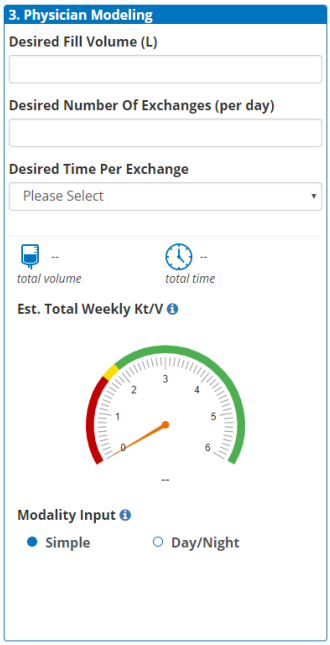
2. Review the information generated in the Estimated Prescription Data section



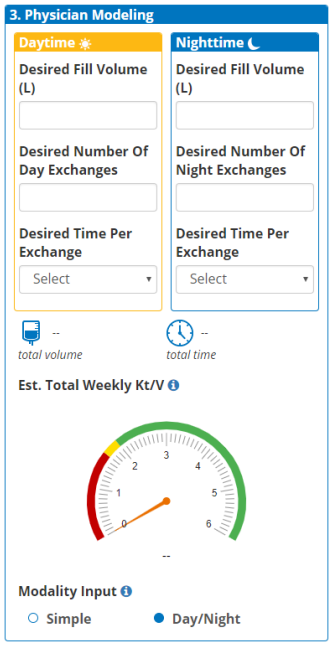
- Max. Fill Volume (L): Estimated maximum fill volume.
  - ℹ Max fill volume is based on body surface area (BSA). In patients who are new or who have just had a catheter placed, appropriate fill volumes may start well below the estimated maximum. The estimated maximum fill volume may not be applicable to extremely large or very small patients.
- Min. Number of Exchanges (per day): Estimated minimum number of daily exchanges.
  - ℹ The estimated minimum number of exchanges a patient would require per day to meet an adequacy goal of 2.0 is based on the patient's transport type, residual renal function, and estimated maximum fill volume. This calculation assumes continuous ambulatory therapy (24 h) with exchange times of 4 hours and 1.0 L of UF daily.
- Peak UF Time with 1.5% Glucose (Hrs): Time, in hours, to estimated peak UF.
  - ℹ The time to peak ultrafiltration (UF) is generally shorter than the time to peak urea clearance. Both are important considerations when determining a patient's optimal dwell time. Optimal dwell times are also highly dependent on transport status. The times presented here are for dwells with 1.5% glucose solutions based on the work of Mujais and colleagues.
- Min. Total Daily Dialysate Volume (L): Estimated minimum daily dialysate volume.
  - ℹ The estimated minimum total dialysate volume is the estimated total volume the patient would need to meet a weekly Kt/V of 2.0 based on the patient's transport type, residual renal function, and estimated maximum fill volume. This calculation assumes continuous ambulatory therapy (24 h), dwell times of 4 hours, and 1.0 L of UF daily.
- BSA: Body Surface Area based on height and weight of the patient.
- Urea Distribution Volume: Volume used to calculate Kt/V based on gender and BSA.
- Renal Weekly Kt/V: If RRF was entered as Kt/V, it is displayed here. If RRF was entered as Renal Urea Clearance (mL/min), this is the calculated renal weekly Kt/V.

3. Enter desired prescription parameters in Simple or Day/Night Modality Input modes to estimate Total Weekly Kt/V.

Simple Mode



Day/Night Mode



- Desired Fill Volume (L): Enter the desired fill volume for the patient.
  Caution: Exceeding the patient's individual appropriate fill volume may put the patient at increased risk of overfill. The patient's individual appropriate fill volume must be clinically determinate by the prescribing physician and may be well below the estimated maximum volume provided by the calculator.
- Desired Number of Exchanges (per day): Enter the desired number of exchanges the patient will perform each day.
- Desired Time per Exchange: Enter the desired time (hours) of each exchange. This time should include dwell time and transit time for fills and drains.
- Total Volume: Total Daily Dialysate Volume based on entered parameters
- Total Time: Total Treatment Time based on entered parameters
- Estimated Total Weekly Kt/V: Predicted total weekly Kt/V based on entered parameters.
  - The KDOQI guidelines recommend a minimum delivered total (peritoneal plus renal) Kt/V of 1.7 per week. Targeting a clearance goal above the minimum requirement (e.g. a Kt/V of 2.0 as indicated in the calculator) may ensure the minimum target is met. For the modeled dialysis dose (Kt/V), the PD Calculator assumes 1 L of daily ultrafiltration.
- Modality Input: Select "Simple" or "Day/Night".
  - In Simple mode, the calculator assumes that all exchanges will be the same volume and dwell time. In Day/Night mode, two different sets of volumes and dwell times can be modeled, one for day time and the other for overnight exchanges. Both modes can be used for manual or cycler-based prescriptions. Note: In "Simple" mode, it is assumed that all exchanges are upright (ambulatory). In "Day/Night" mode, it is assumed that day time exchanges are upright (ambulatory) and night time exchanges are laying down (supine). The patient's position affects distribution of fluid in the peritoneum and therefore impacts clearance and modeled Kt/V.

Support

In the United States, contact the Fresenius Medical Care Renal Therapies Group Medical Information and Communications Office
Phone: 855-616-2309
Email: Medical.Information@fmc-na.com

PD Calculator Formulas and References

The formulas and modeling algorithms used in the PD Calculator are as follows and are based upon the cited references.

Body Surface Area: BSA

$$BSA\ (m^2) = 0.007184 \times Height(cm)^{0.725} \times Weight(kg)^{0.425}$$

Du Bois D, Du Bois E. A formula to estimate the approximate surface area if height and weight be known. Arch Intern Med. 1916;XVII(6_2):863-871.

Estimated Maximum Fill Volume: V_{max}

$$V_{max}(L) = BSA(m^2) \times 1.5 \left(\frac{L}{m^2}\right)\text{, with a maximum of 3.0 L}$$

Durand PY, Balteau P, Chanliau J, Kessler M. Optimization of fill volumes in automated peritoneal dialysis. Perit Dial Int. 2000;20(6):S83-8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11216546.

Urea Distribution Volume: V(L)

Females: $V = -7.73 + (22.72 \times BSA)$
Males: $V = -8.46 + (25.47 \times BSA)$

Diaz-Buxo JA, Gotch FA, Folden TI, Rosenblum S, Zazra J, Lew N, Crawford TL, Youngblood B, Pesich A, Lazarus JM. Peritoneal dialysis adequacy: A model to assess feasibility with various modalities. Kidney Int. 1999;55(6):2493-2501. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10354299.

Renal Weekly Kt/V: Kt/V_{renal}

$$Kt/V_{renal} = \left(\frac{\text{Renal Urea Clearance}\left(\frac{mL}{min}\right) \times 1440\left(\frac{min}{day}\right) \times 7\left(\frac{days}{week}\right)}{V(L) \times 1000\left(\frac{mL}{L}\right)}\right)$$ *-or-* as entered in the patient data section

McCann L. Nutrition Management of the Adult Peritoneal Dialysis Patient. In: Byham-Gray L, Wiesen K, eds. A Clinical Guide to Nutrition Care in Kidney Disease. 1st ed. American Dietetic Association; 2004:57-69.

Estimated Weekly Kt/V: Kt/V_{total}

$$Kt/V_{total} = Kt/V_{renal} + Kt/V_{dialysis}$$

$$Kt/V_{dialysis} = Kt/V_{per\ exchange} \times \#\text{ of Exchanges} \times 7\ (\text{days/week})$$

$$Kt/V_{per\ exchange} = \frac{RT \times (\text{Fill Volume} + QFT)}{V}$$

Simple Mode or Daytime Exchanges (Ambulatory)

$$RT = \frac{QFT + \left[\text{Fill Volume} \times \left(1 - \exp\left(-1 \times \frac{KoA}{DV} \times Te\right)\right)\right]}{QFT + \text{Fill Volume}}$$

$DV = \text{Fill Volume} + QFT$

$Te = (\text{Exchange Time} \times 60) - (5.5 \times \text{Fill Volume})$

$$KoA = \left[\frac{-\ln\frac{5}{9} \times 2.0}{60 \times Pt50Ur} - (0.0037 \times 2)\right] + (0.0037 \times \text{Fill Volume})$$

Nighttime Exchanges (Supine)

$$RT = \frac{QFT + \left[\text{Fill Volume} \times \left(1 - \exp\left(-1 \times \frac{KoA}{MV} \times tc\right)\right)\right]}{QFT + \text{Fill Volume}}$$

$MV = \text{Fill Volume} + (QFT \times 0.5)$

$tc = \text{Exchange Time} \times 60$

$$KoA = \frac{-\ln(0.5) \times \text{Fill Volume}}{60 \times Pt50Ur}$$

Pt50 Urea Defaults:

Transport Type	Pt50 Urea Value
Low	2.80
Low-Average	2.25
Average	1.60
High-Average	1.10
High	0.50

$$QFT = \frac{\text{Exchange Time}}{\text{Total Treatment Time}} \times 1\text{ L (ultrafiltration)}$$

Gotch FA, Keen ML. Kinetic Modeling in Peritoneal Dialysis. In: Nissenson AR, Fine RN, eds. Clinical Dialysis. 4th ed. New York: McGraw-Hill Medical Publication; 2005:385-420.

Total Treatment Time (hrs):

$$\text{Treatment Time}_{simple} = (\#\text{ of exchanges}) \times (\text{time per exchange})$$

$$\text{Treatment Time}_{day/night} = [(\#\text{of exchanges}) \times (\text{time per exchange})]_{day} + [(\#\text{ of exchanges}) \times (\text{time per exchange})]_{night}$$

Total Daily Dialysate Fill Volume (L):

$$\text{Daily Fill Volume}_{simple} = (\text{Fill Volume}) \times (\#\text{ of exchanges})$$

$$\text{Daily Fill Volume}_{day/night} = [(\text{Fill Volume}) \times (\#\text{ of exchanges})]_{day} + [(\text{Fill Volume}) \times (\#\text{ of exchanges})]_{night}$$

Additional References

Burkhart JM. Adequacy of Peritoneal Dialysis. In: Henrich WL, ed. Principles and Practice of Dialysis. 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2009.

Davis ID, Cizman B, Mundt K, Wu L, Childers R, Mell R, Prichard S. Relationship between drain volume/fill volume ratio and clinical outcomes associated with overfill complaints in peritoneal dialysis patients. Perit Dial Int. 2011;31(2):148-153. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21282375.

Durand PY, Balteau P, Chanliau J, Kessler M. Optimization of fill volumes in automated peritoneal dialysis. Perit Dial Int. 2000;20(6):S83-8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11216546.

K/DOQI Clinical practice guidelines for peritoneal adequacy, update 2006. Am J Kidney Dis. 2006;48 Suppl 1:S91-7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16813997.

Mujais S, Childers RW. Profiles of automated peritoneal dialysis prescriptions in the US 1997-2003. Kidney Int Suppl. 2006;(103):S84-90. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17080117.

Mujais S, Story K. Improving cycler prescriptions in peritoneal dialysis through informatic profiling. Adv Chronic Kidney Dis. 2007;14(3):263-268. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17603980.

Mujais S, Vonesh EEF. Profiling of peritoneal ultrafiltration. Kidney Int Suppl. 2002;62(81):S17-S22. Available from: https://www.ncbi.nlm.nih.gov/pubmed/12230478.

Van Biesen W, Williams JD, Covic AC, Fan S, Claes K, Lichodziejewska-Niemierko M, Verger C, Steiger J, Schoder V, Wabel P, et al. Fluid status in peritoneal dialysis patients: the European Body Composition Monitoring (EuroBCM) study cohort. PLoS One. 2011;6(2):e17148. Available from: https://www.ncbi.nlm.nih.gov/pubmed/21390320.

P/N 103701-01 Rev. A 02/2019

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