



Phosphate Management in Patients with Chronic Kidney Disease (CKD) on Peritoneal Dialysis (PD)

Elevated Phosphate Levels Are Associated With All-Cause Mortality and Major CV Events in Patients on PD

Global Cohort of Patients on Peritoneal Dialysis (PDOPPS 2014-2017)*

All Cause Mortality[†]
(N=5904, 728 events)

MACE^{††}
(N=4799, 535 events)

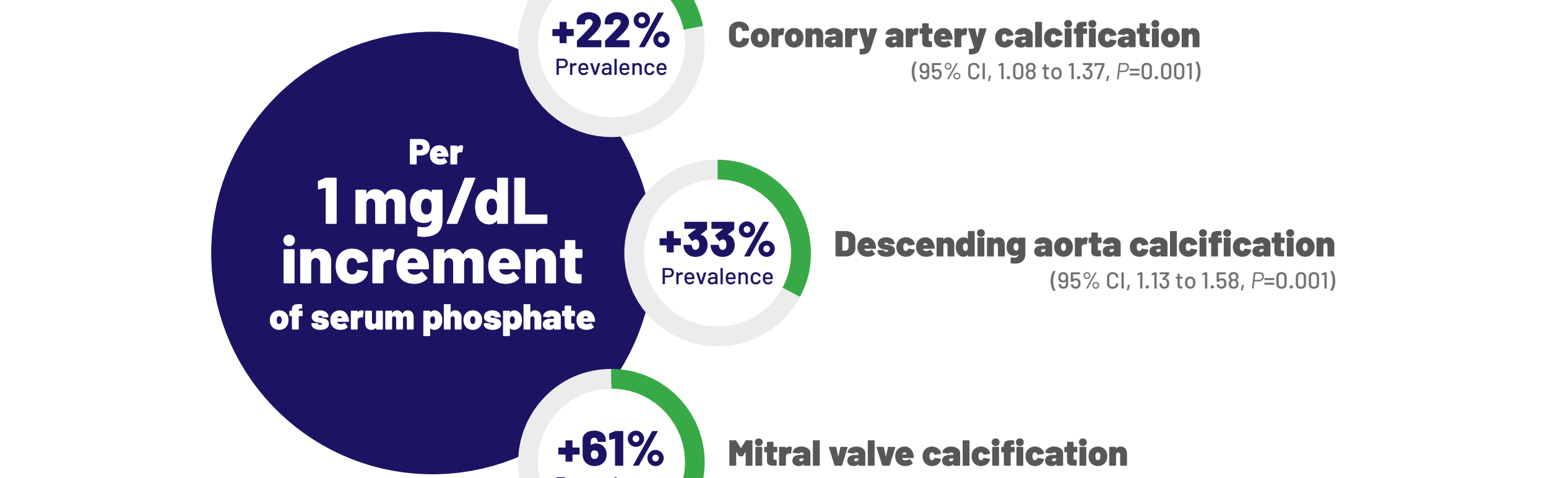
6-Month mean phosphate

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*Data from 7 countries (Australia, Canada, Japan, New Zealand, Thailand, the UK, and the US) in phase 1 of the PDOPPS.
[†]CV mortality + non-fatal angina, myocardial infarction, stroke, and heart failure.
^{††}CV cardiovascular; MACE=major adverse cardiac event; PD=peritoneal dialysis; PDOPPS=Peritoneal Dialysis Outcomes and Practice Patterns Study.

Prevalence of Arterial and Valvular Calcification Increases with Higher Phosphate Levels in Patients with CKD^{2,4,8}

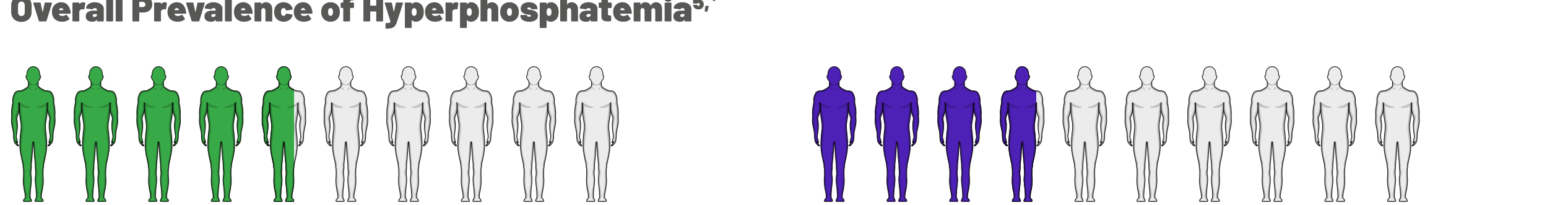


[†]After adjustment for age, race, gender, and kidney function. Community-based cohort of individuals (N=439) with CKD with no clinically apparent cardiovascular disease. 97% of patients had stage 3 CKD. 96% of participants had serum phosphate concentrations ≤4.5 mg/dL.
²CV cardiovascular; MACE=major adverse cardiac event; PD=peritoneal dialysis; PDOPPS=Peritoneal Dialysis Outcomes and Practice Patterns Study.
⁴Similar results have been reported in patients with CKD on PD in recent non-US studies.^{2,4}

Prevalence of Hyperphosphatemia Is Higher in Patients with CKD on PD and in Younger Patients

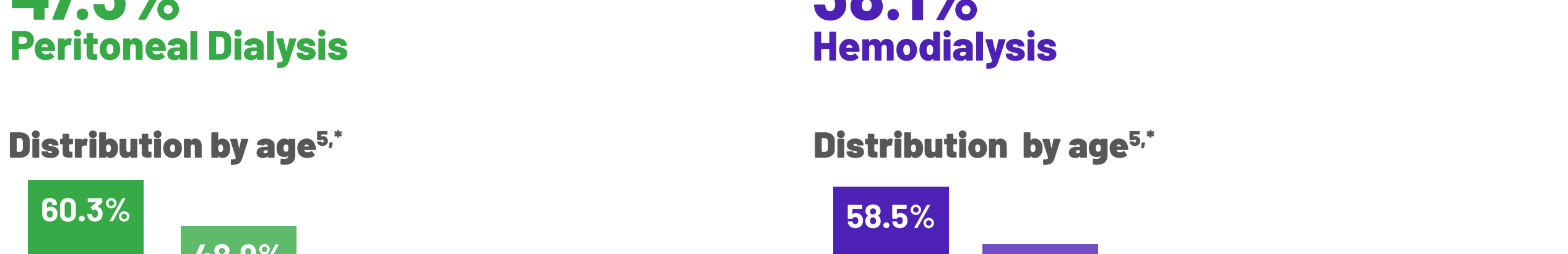
(USRDS 2020)

Overall Prevalence of Hyperphosphatemia^{5*}



Distribution by age^{5*}

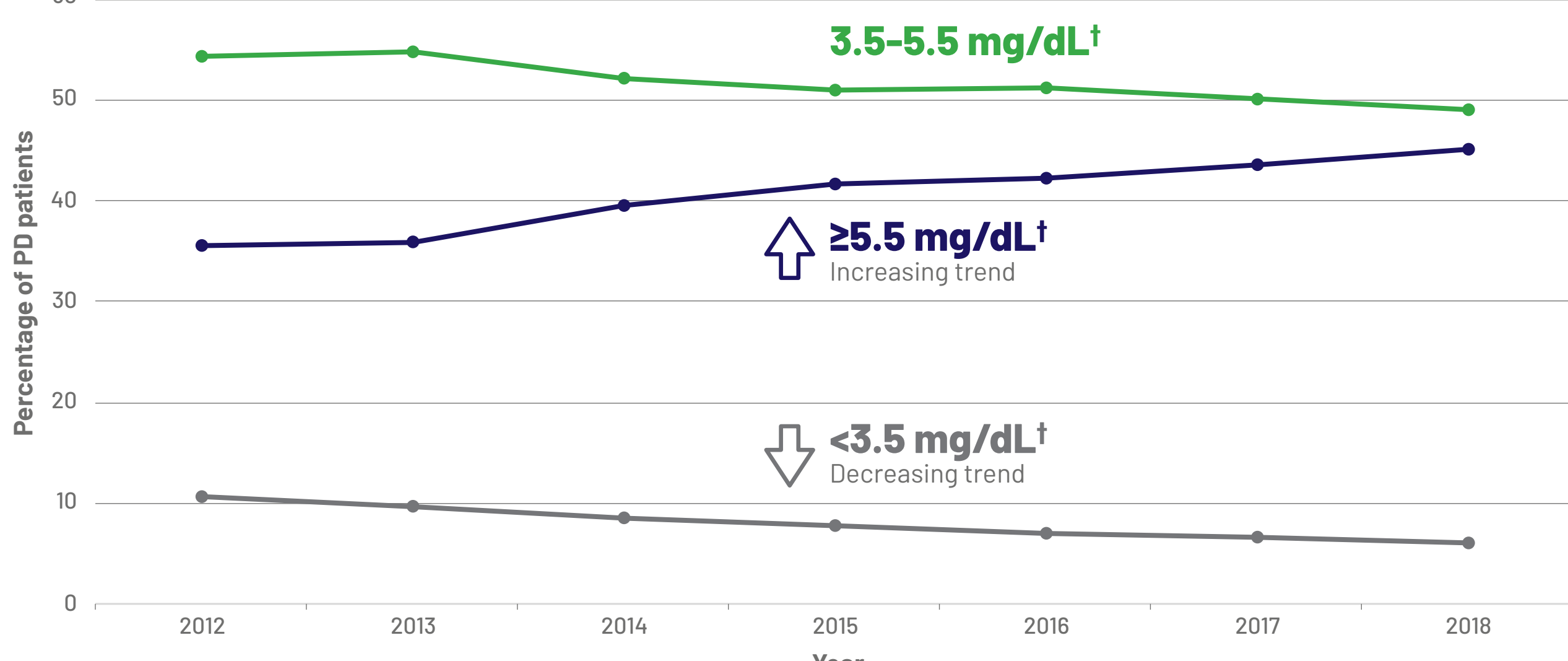
Distribution by age^{5*}



⁵USRDS defined hyperphosphatemia as patients with serum phosphate ≥5.5 mg/dL. Age distribution percentages are calculated from the USRDS data by averaging the 2018 monthly (HD) or quarterly (PD) distribution by age of patients with serum phosphate ≥5.5 mg/dL.
⁶PD=peritoneal dialysis; USRDS=United States Renal Data System; yr=years.

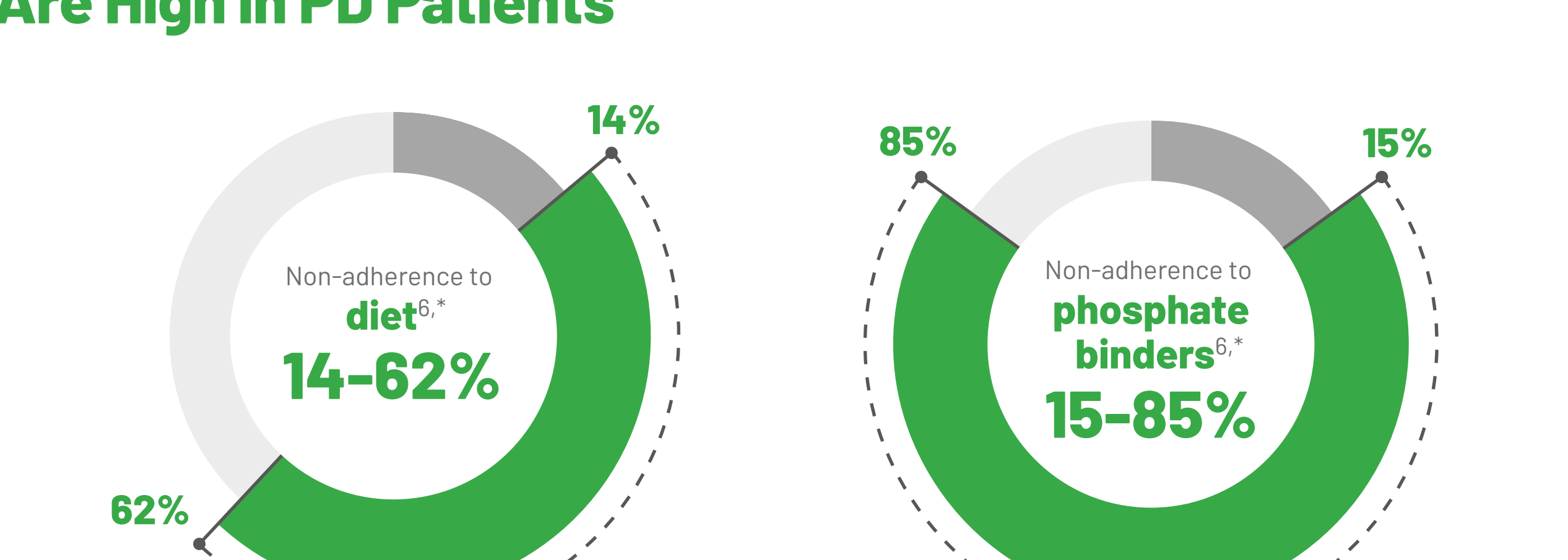
The Prevalence of Hyperphosphatemia Has Been Increasing Over Time

(USRDS 2020)⁶



[†]USRDS defined hyperphosphatemia as patients with serum phosphate ≥5.5 mg/dL. Percentages are calculated from the USRDS data by averaging the 2018 quarterly distribution by serum phosphate level.

Non-adherence to Diet and Phosphate Binders Are High in PD Patients



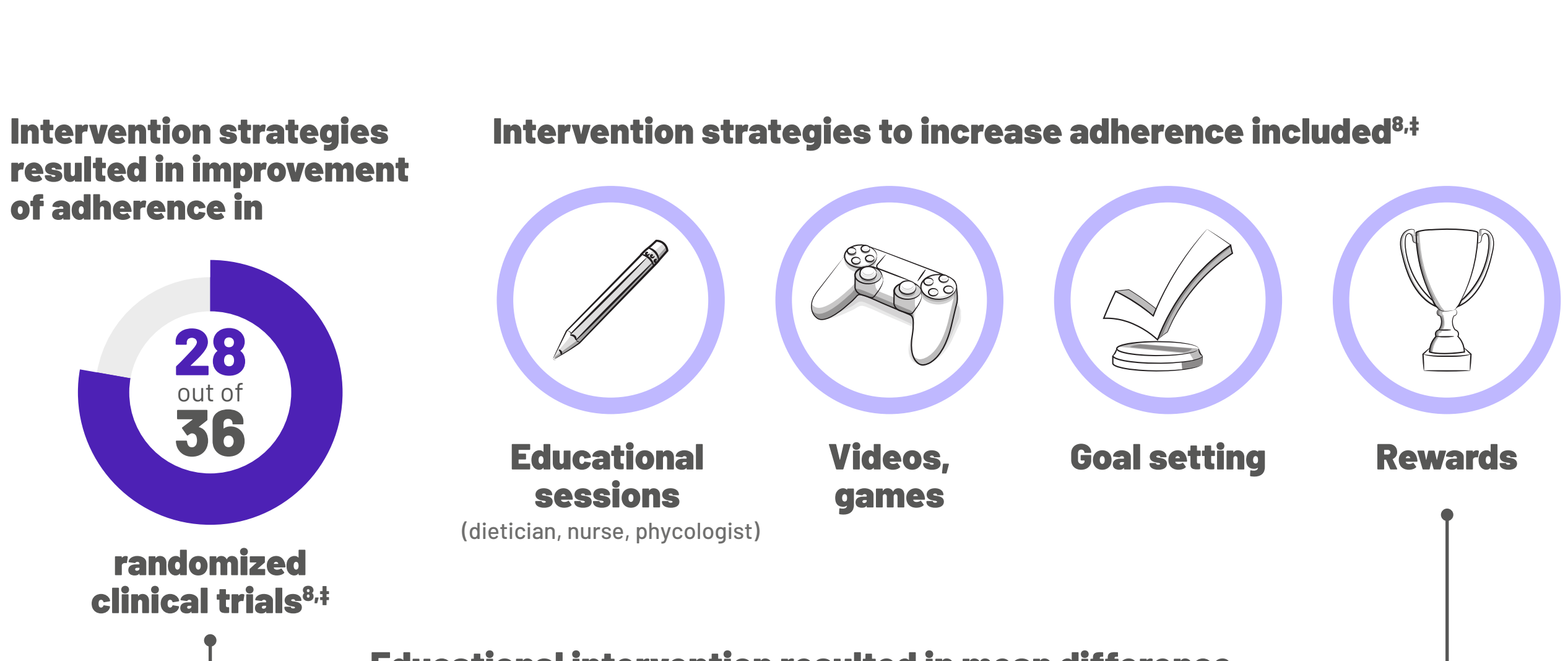
*Patient self-reported data collected using questionnaires in international cross-sectional and prospective studies conducted in Asia and Europe.

Factors associated with non-adherence^{6,7†}

- | Demographic | Socioeconomic | Psychosocial |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> Younger age Male Non-white ethnicity On treatment for a long period of time | <ul style="list-style-type: none"> Employed Low quality of life Lower education levels Inadequate social and family support | <ul style="list-style-type: none"> Low self-efficacy High depression Poor satisfaction with treatment |

[†]Non-adherence data included diet, medication and dialysis (alone or in combination) and it was collected by subjective measures based on patient self-report, objective measures based on pharmacy records, built-in monitoring systems and biochemical indicators. Cross-sectional and retrospective studies conducted in USA, Asia and Europe.

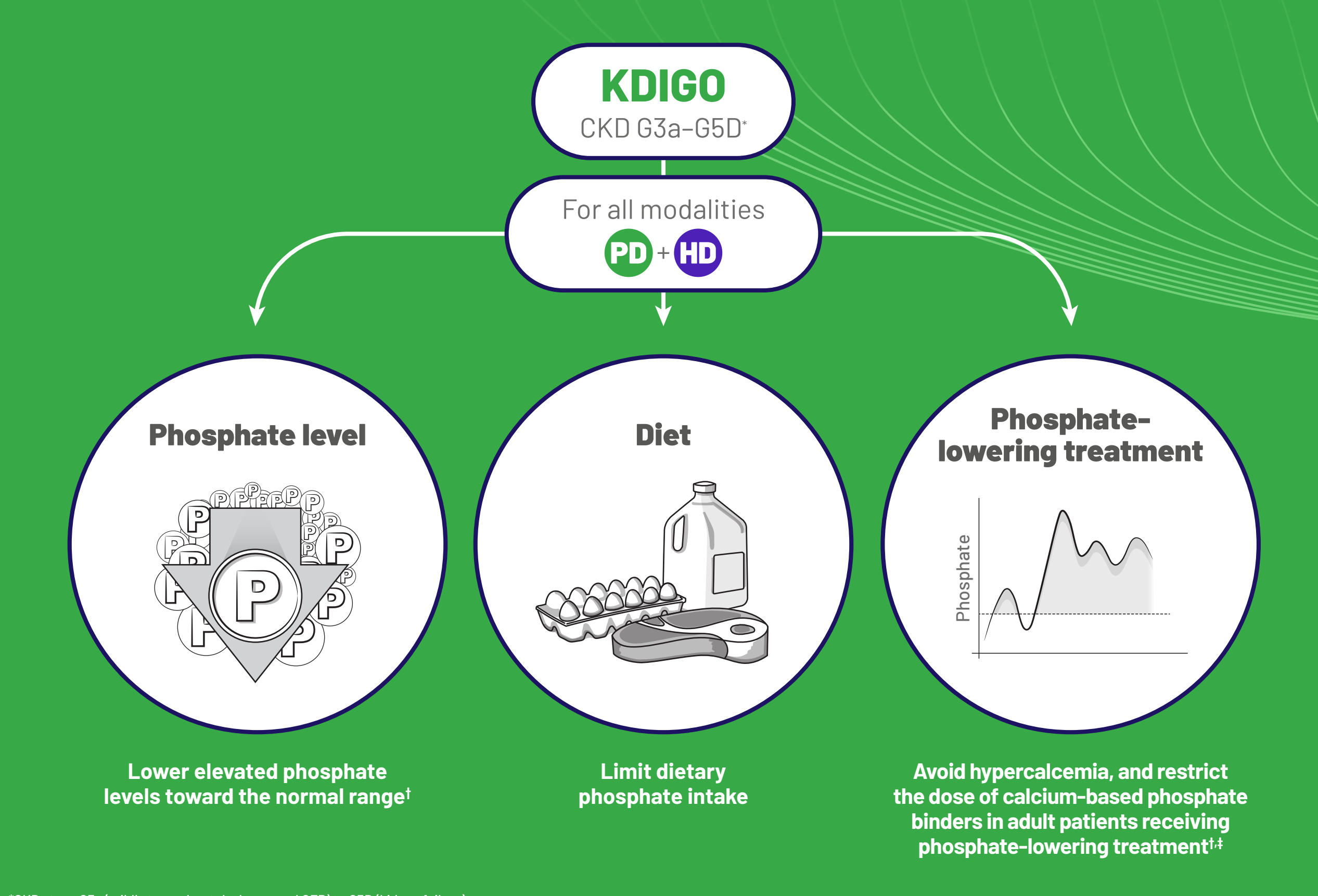
Educational Intervention Improved Adherence and Decreased Phosphate Levels in a Meta-Analysis



⁸Randomized controlled trials employing strategies to improve dietary, fluid, dialysis or medication adherence in HD and PD patients (N=3510). Adherence assessment included self-reported questionnaires, laboratory results, and physical measurements such as weight gain, among others. The PD populations in these trials were small in size, and the trials were heterogeneous with regards to clinical settings, interventions and outcomes. This may limit the applicability of these findings to the PD population.
[‡]Change in phosphate was measured as a surrogate for adherence in 19 studies.

KDIGO Guidelines Do Not Differentiate Between Dialysis Modalities for Phosphate Management

Despite higher prevalence of hyperphosphatemia, some PD patients may be recommended a less strict renal diet due to more frequent dialysis^{9,10}



¹CKD stage G3a (mildly to moderately decreased GFR) to G5D (kidney failure).
[†]Patients with CKD G3a-G5D.
⁹The available evidence does not conclusively demonstrate superiority for calcium-based vs calcium-free phosphate binders.
¹⁰KDIGO=Kidney Disease: Improving Global Outcomes.

References:

- Lopes MB, Karaboyas A, Johnson D, et al. Association of single and serial measures of serum phosphorus with adverse outcomes in patients on peritoneal dialysis: results from the international PDOPPS. To be presented at: ERA-EDTA 2021 (virtual) [abstract FC100].
- Shang D, Xie O, Shang G, et al. Association of serum phosphate with vascular and valvular calcification in moderate CKD. *J Am Soc Nephrol*. 2009;20:381-387.
- Shang D, Xie O, Shang G, et al. Hyperphosphatemia and hs-CRP initiate the coronary artery calcification in peritoneal dialysis patients. *Biomol Res Int*. 2017;2017:2520510.
- Shang D, Xie O, Ge X, et al. Hyperphosphatemia as an independent risk factor for coronary artery calcification progression in peritoneal dialysis patients. *BMC Nephrol*. 2016;16:107.
- United States Renal Data System. 2020 USRDS Annual Data Report: Epidemiology of kidney disease in the United States. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2020. End Stage Renal Disease, Chapter 2.
- Oriva K, Lai AY, Lim HA, et al. Non-adherence in patients on peritoneal dialysis: a systematic review. *PLoS One*. 2014;9(2):e89001.
- Lambert K, Mullan J, Mansfield K. An integrative review of the methodology and findings regarding dietary adherence in end stage kidney disease. *BMC Nephrol*. 2017;18(1):318.
- Murali KM, Mullan J, Roodenrys S, et al. Strategies to improve dietary, fluid, dialysis or medication adherence in patients with end stage kidney disease on dialysis: A systematic review and meta-analysis of randomized intervention trials. *PLoS One*. 2018;14(1):e0211479.
- National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). Eating & Nutrition for Peritoneal Dialysis. <https://www.niddk.nih.gov/health-information/kidney-disease/kidney-failure/peritoneal-dialysis/eating-nutrition>. Accessed 2/15/2021.
- Kidney Disease: Improving Global Outcomes (KDIGO) CKD-MBD Update Work Group. KDIGO 2017 Clinical Practice Guideline Update for the Diagnosis, Evaluation, Prevention, and Treatment of Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD). *Kidney Int Suppl* (2011). 2017;7(1):1-59.