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Delivering Personalized, Goal-Directed Care to Older Patients Receiving Peritoneal Dialysis

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Abstract
Background: An aging population living with chronic kidney disease and progressing to kidney failure, subsequently receiving peritoneal dialysis (PD) is growing. A significant proportion of these patients are also living with multi-morbidities and some degree of frailty. Recent practice recommendations from the International Society of Peritoneal Dialysis advocate for high-quality, goal-directed PD prescription, and the Standardized Outcomes of Nephrology-PD initiative emphasized the need for an individualized, goal-based care approach in all patients receiving PD treatment. In older patients, this approach to PD care is even more important. A frailty screening assessment, followed by a comprehensive geriatric assessment (CGA) prior to PD initiation and when dictated by change in relevant circumstances is paramount in tailoring PD care and prescription according to the needs, life goals, as well as clinical status of older patients with kidney failure. ***Summary:*** Our review aimed to summarize the different dimensions to be taken into account when delivering PD care to the older patient – from frailty screening and CGA in older patients receiving PD to employing a personalized, goal-directed PD prescription strategy, to preserving residual kidney function, optimizing blood pressure (BP) control, and managing anemia, to addressing symptom burden, to managing nutritional intake and promoting physical exercise, and to explore telehealth opportunities for the older PD population. ***Key Messages:*** What matters most to older PD patients may not be simply extending survival, but more importantly, to be living comfortably on PD treatment with minimal symptom burden in a home environment and to minimize treatment complications.

Introduction

With general increases in life expectancy, countries need to ensure that their health systems adjust to meet the demand arising from the demographic shift. A significant proportion of older patients have multi-morbidities

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including chronic kidney disease (CKD) and many progress to kidney failure requiring dialysis. Results from the Dialysis Outcomes and Practice Patterns (DOPPS) study showed that older patients age ≥75 years accounted up to 30% of the dialysis population worldwide [1]. The 2021 United States Renal Data System (USRDS) annual report also observed the highest growth rates of dialysis initiation among those above the age of 75 [2].

The past 3 years of the coronavirus disease 2019 (COVID-19) pandemic has promoted home-based dialysis for patients with kidney failure as it minimized the need to travel to dialysis centers and reduced the risk of contracting COVID-19 infection in dialysis units [3]. Home dialysis, i.e., peritoneal dialysis (PD) and home hemodialysis (HD), has been available for decades. For younger kidney failure patients who are able to manage independently, home dialysis may be a more straightforward option. Home-based dialysis reduces the need for regular travel to dialysis centers and allows more time and opportunities to be spent on other life participation activities [4]. In countries such as the USA, there have been noticeable increases in home dialysis utilization among older adults, suggesting greater recognition by stakeholders that it is a viable treatment option for the older population [2]. In addition to advantages relating to a more flexible lifestyle, increased shielding for older patients receiving home-based dialysis reduces exposure risk to COVID-19. This was especially important during the early phases of the pandemic when there were scarce personal protective equipment resources and a lack of effective preventative therapies. Many older patients living with kidney failure are frail and multi-morbid with an increase incidence of geriatric impairments, requiring extensive support from family members and caregivers to perform home-based dialysis [5]. It is natural that the relative independence of older patients decline with time, occasionally acutely [6]. This necessitates adjustments to the level of support and reassessment of the balance between the burden of therapy and their quality of life (QoL). A multi-disciplinary care approach with regular holistic assessment of required support and assistance is essential in optimizing an older patient's outcomes on home dialysis [7].

There are relative advantages of receiving PD compared to home HD for older patients with motivations to pursue home dialysis. Preserving residual kidney function (RKF) conveys a survival, QoL, and nutritional benefit for all dialysis patients, more so in those receiving PD [8–10]. PD has been recognized as a more plausible option for older individuals, compared with home HD as it obviates the need for vascular access creation. Sustainable vascular access may be challenging in many older patients with vascular disease, leading to increased likelihood of access failure [11]. In addition, PD is associated with more stable hemodynamic control and avoids intradialytic hypotension. For older patients, intradialytic hypotension may result in greater falls risks and worsened post-dialysis recovery [12]. Performing PD exchanges are relatively simpler compared to the preparations required for home HD (access cannulation, setting up the home HD machine, and dealing with home HD complications), which is likely to reduce the burden placed on patients and their caregivers. Increasing utilization of assisted PD allows an opportunity for older patients with relative low levels of independence to be offered PD therapy [13]. Nevertheless, there remain significant knowledge gaps on how to optimize PD therapy in older patients with kidney failure.

In this review, we aimed to evaluate the key components to encompass when delivering PD care to the older population, referencing published experience of personalized, goal-directed PD care approaches as suggested by Kidney Disease Improving Global Outcomes (KDIGO), Standardized Outcomes in Nephrology Group-Peritoneal Dialysis (SONG-PD) initiative, and ISPD practice recommendations in relation to older patients [14–17]. These components include: frailty and comprehensive geriatric assessment (CGA) in older patients receiving PD, employing a personalized, goal-directed PD prescription strategy for older patients, preserving RKF, optimizing blood pressure (BP) control, managing anemia, addressing symptom burden including psychological and social burden for older patients and their caregivers, managing nutritional intake, and promoting physical exercise, as well as exploring telehealth opportunities tailored for the older PD population.

Frailty Screening and Comprehensive Geriatric Assessment in Older Patients Initiating on PD

Frailty is highly prevalent in older patients with dialysis-dependent kidney failure. The prevalence of moderate to severe frailty was estimated to be up to 80% in older patients receiving dialysis [4, 18, 19]. The frailty syndrome is associated with cognitive and functional impairment, risk of falls and fractures, protein-energy wasting (PEW), and multi-morbid status [20]. Frailty increases the risk of mortality and has been shown to display better predictive value for hospitalization compared to age alone [21].

The 2020 International Society of Peritoneal Dialysis (ISPD) prescribing high-quality, goal-directed PD

Table 1. Summary of commonly used frailty screening tools

Frailty assessment tool	Criteria and scoring system
Tools based on physical frailty	
Frailty Phenotype [22]	Measures physiological deficits across 5 domains: (1) weight loss; (2) exhaustion; (3) physical activity; (4) muscle strength; (5) walking speed Scoring based on clinician judgment over previous 2 week period and does not take into account any occurrence of acute reversible illness. Estimated time for test <10 min Robust: 0 deficits (i.e., no deficits) out of the 5 domains Pre-frail: 1 or 2 deficits out of the 5 domains Frail: 3 or more deficits out of the 5 domains
Clinical Frailty Scale [23]	Determines the degree of frailty based on judgment of pictorial and descriptive representations of frailty, and aligning this to the individual assessed at hand. Scoring is based on what is envisaged of the individual 2 weeks prior (takes out effects of any acute reversible illness on an individual's functional state) Was initially constructed as a 7-point scale. Currently, a 9-point global scale ranging from very fit to severely frail to terminally ill. Estimated time for test <10 min Clinical Frailty Scale scoring Very fit: 1 Well: 2 Well, with treated co-morbid disease: 3 Apparently vulnerable: 4 *A score of 5 or above is where an individual is classified as "frail"* Mildly frail: 5 Moderately frail: 6 Severely frail: 7 Very severely frail: 8 Terminally ill (i.e., approaching the end of life. This category applies to people with a life expectancy of under 6 months, which are not otherwise evidently frail): 9
Edmonton Frail Scale [24]	Descriptor of an individual's level of frailty based on 9 components: (1) cognition; (2) general health; (3) functional independence; (4) requirements for social support; (5) medication use; (6) nutrition; (7) mood; 8) continence; (9) functional performance Scoring conducted through clinician observation and interview with the patient. Conventionally conducted in both acute care and community settings. Estimated time for test <10 min Five categories with scoring out of 17 Not frail: 0–5 Vulnerable: 6–7 Mild frailty: 8–9 Moderate frailty: 10–11 Severe frailty: 12 or more
Geriatric 8 [25, 27]	Considers an individual's level of frailty based from 8 questions which evaluates 6 components: (1) malnutrition; (2) mobility; (3) cognition or mood; (4) polypharmacy; (5) general health; (6) age Scoring is conducted through clinician interview with the patient. Conventionally conducted in both acute care and community settings. Initially used within the oncology specialty context, before being applied to other specialties including nephrology. Estimated time for test <10 min Two categories with scoring out of 17 Not frail: >14 Frail: ≤14
Tools based on the deficit accumulation model of frailty	
Frailty Index [26]	This is an index of cumulative deficits where a person is measured in terms of their deficits compared to a pre-determined list. Frailty Index = (number of health deficits present) ÷ (number of health deficits measured) In other words, scoring uses a deficit count and proportion of potential deficits that a person has accumulated. Commonly applied in hospital acute care as well as community settings. Estimated time for test between 20 and 30 min Robust: 0– <0.1 Pre-frail: 0.1– <0.2 Approaching frailty: 0.2– <0.25 Frail: >0.25

practice recommendations suggested employing frailty screening as part of routine assessment in older patients initiating on PD [14, 15]. Frailty assessment screening tools are divided into two conceptualized models: physical frailty (e.g., frailty phenotype, clinical frailty scale [CFS], Edmonton Frail Scale, geriatric 8 screening tool [Geriatric 8]) and the deficit accumulation model of frailty (e.g., frailty index) (Table 1) [22–27]. Some of these frailty assessment tools, namely, the CFS, Geriatric 8, and frailty index, have been shown to display good prognostic value in patients receiving PD [18, 27].

Frailty assessment prior to PD initiation may provide information on an older individual's appropriateness for home PD therapy and the extent of assistance an older individual may require within their home environment to carry out PD treatment [27]. It may also provide information on the potential impact of PD therapy on subsequent physical and functional decline and other clinical outcomes [27]. Identifying frailty from the screening process using tools such as the CFS (i.e., CFS ≥5), which is easy and quick to use within the clinical setting, should further initiate a CGA (Fig. 1). CGA is the gold standard to determine medical, psychosocial, and functional limitations of an older individual living with frailty. The CGA requires a multi-disciplinary team approach (which may include but not limited to clinicians, nursing staff, physiotherapist, dietician, occupational therapist, clinical psychologist, and social worker) to develop an holistic, individualized, goal-based management plan to optimize clinical outcomes for each patient [28]. The CGA is usually led by a geriatrician and is also increasingly applied by nephrologists to identify frailty, functional, and psychosocial limitations in the pre-dialysis phase prior to PD initiation [29]. CGA may be conducted throughout the course of PD treatment to monitor if initial goals are being achieved on PD, and in other instances determine if a change in treatment plan is indicated [15]. Potential interventions following a multi-disciplinary CGA may include exercise intervention programs to address an older adult's strength and balance capabilities and to promote falls prevention strategies. Referral to memory services where cognitive decline is suspected, social worker, and occupational therapist input regarding home adaptations and optimization of support during PD, as well as advance care planning is helpful. More training and appropriate resources should be provided to the nephrology workforce in conducting CGA, alongside a greater focus on fostering interdisciplinary collaborations with geriatricians to deliver personalized PD care to older patients following CGA [30].

The Frail and Elderly Patients on Dialysis (FEPOD) study demonstrated that frailty was associated with poorer QoL outcomes in older PD patients [31]. The recent ISPD guidelines highlighted the need for a person-centered approach with shared decision-making, defining life goals, and to maximize symptom burden control so to improve QoL outcomes of older PD patients living with frailty and multi-morbidities [14, 15]. Similarly, Kidney Disease Improving Global Outcomes (KDIGO) and SONG-PD statements also recommended similar care approaches in all PD patients including the older PD population [16, 17]. Tools to support kidney care, such as "My Kidney Care Roadmap" may be of use in achieving these treatment objectives [32]. It may assist clinicians, older patients, and their caregivers to elicit each patient's life goals, values, and priorities, have greater understanding regarding medical prognosis and available suitable treatment options, and decide on the treatment options that may best achieve an older patient's prioritized goals of care [32]. Continued monitoring of frailty status using screening tools and CGA alongside subsequent interventions if indicated, as well as review and reassessment using tools such as "My Kidney Care Roadmap" may help ensure that the PD treatment delivered remains well-aligned with the patient's life goals as time on PD increases.

Employing a Personalized, Goal-Directed PD Prescription Strategy in Older Patients

For older patients who choose PD, they and their caregivers/family should be actively engaged in a shared decision-making process to decide on the PD modality after receiving education on the different PD modalities (e.g., continuous ambulatory PD [CAPD] vs automated PD [APD], requiring assisted PD or not) (Table 2) [14, 15, 33–48], taking into consideration their health status, individual needs, life goals, psychosocial circumstances, family support, preferences, and home environment (PD membrane characteristics could also be considered as patients with high transporter status would benefit from APD; however, this is not widely used as a main criterion in PD modality decision-making anymore) [33]. Specific assessment should be made on the need for assisted PD.

APD may be more popular than CAPD as it frees up time in performing PD during daytime [34]. APD is also considered to be less demanding compared to CAPD in terms of patient workload. However, APD may disrupt sleeping patterns, cause drain pain, and restrict

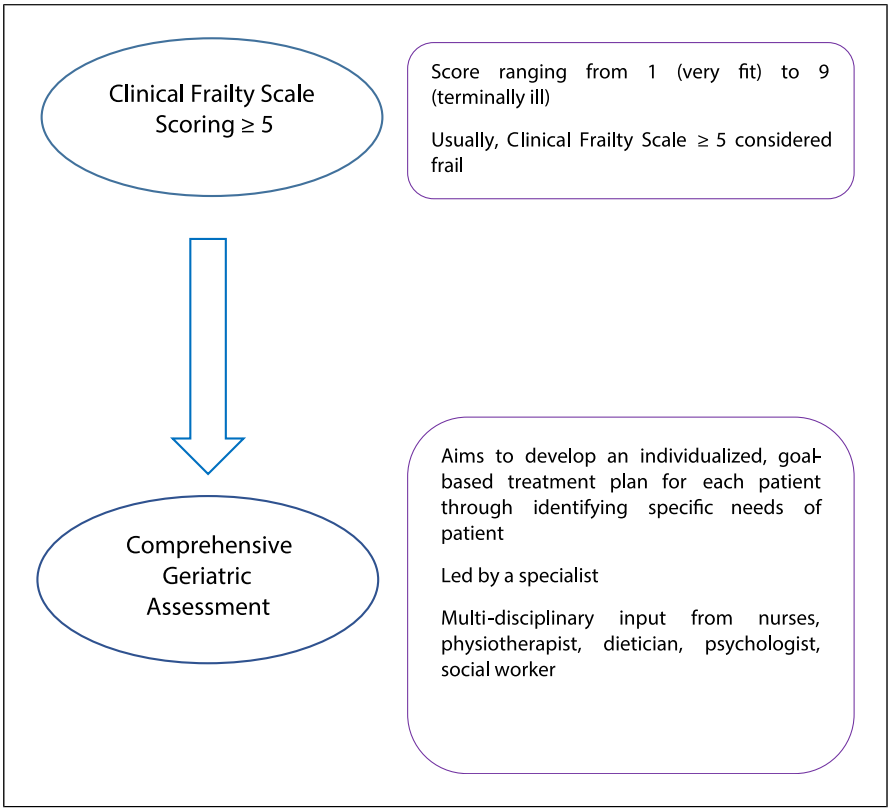

Fig. 1. Frailty screening and comprehensive geriatric assessment in older patients receiving peritoneal dialysis.

movement during nighttime. APD may also be more costly than CAPD in many parts of the world although it has become more accessible over recent years [33, 35]. CAPD may better suit incremental PD prescription for patients with significant RKF. Clinical outcomes such as patient survival, technique survival, and PD peritonitis rates have not been shown to differ between CAPD and APD [36, 37].

A goal-directed, incremental PD prescription strategy may be ideal in older patients with significant RKF to allow greater amount of free time off dialysis. Incremental PD prescriptions will need to be individualized, based on the degree of RKF, overall clearance, BP and volume control, and symptoms of patients. A less than standard "full-dose" PD is initially prescribed in recognition of the value of RKF, where peritoneal clearance would initially be less than the individualized clearance goal but the combination of peritoneal plus renal clearance is expected to achieve or exceed that goal clearance [38, 39]. Regular monitoring of patients' clinical status and degree of RKF are essential for patients receiving incremental PD. They will need to be informed for the need to increase PD exchanges when RKF declines.

Many older patients may need assisted PD from caregivers, family, or nursing home staff [40]. In a cohort study assessing incidence and risk factors of PD peritonitis, there was a greater proportion of patients age ≥65 years receiving assisted PD (64.7%) compared to patients age <65 years (33.6%) [41]. Compared to carrying out PD independently, assisted PD may be associated with better clinical outcomes in terms of PD technique survival (mainly due to reduced risk of peritonitis), and PD-associated mortality [42]. The impact of reduced hand dexterity, visual, or hearing impairments causing PD-associated complications in older patients could be alleviated with assisted PD. Assisted PD requires caregiver or nursing home staff to perform PD exchanges and exit site care for patients either in their home environment or in the nursing home with prompt reporting of any PD-related complications such as peritonitis or exit site infections to the dialysis unit [43]. Assisted PD programs have been implemented worldwide over the past 20 years, with comparable outcomes between the various caregiver set-ups and approaches (such as the different number and frequency of community nursing support) to provide assisted PD for the older patient [42–44]. PD nurse specialists will need to

Table 2. Considerations of delivering a personalized, goal-directed peritoneal dialysis prescription strategy for older patients

Decision on PD prescription strategy	Key considerations
Deciding between CAPD versus APD [33–37]	Selection on whether to proceed with CAPD or APD is usually based upon patient preferences and how they can best fit the chosen option to their lifestyle
Consideration of an incremental PD approach [38, 39]	Treatment with an incremental PD approach is based on one's individualized PD clearance goals, with the ultimate aim to preserve RKF as much as possible
Whether assisted PD is indicated [40–45]	The option of assisted PD would be particularly helpful to support older patients with physical impairment (i.e., such as older patients with reduced hand dexterity, visual, and/or hearing impairments)
Decision on PD fluid prescription [14, 15, 46–48]	The use of icodextrin or fluids with a low concentration of glucose degradation products has been shown to reduce the risk of uncontrolled fluid overload, improve glycemic control, and symptom burden in older PD patients, all while preserving RKF

APD, automated peritoneal dialysis; CAPD, continuous ambulatory peritoneal dialysis; PD, peritoneal dialysis.

provide training and education for caregivers and nursing home staff to perform assisted PD, and to ensure these personnel observe the quality and safety standard in PD-performing techniques [45].

In terms of PD fluid prescription, the use of hypertonic glucose-containing PD solutions should be minimized in older people, due to the potential risk of worsening insulin resistance and glycemic control. Icodextrin is a glucose polymer solution which improves ultrafiltration volume, reduces the risk of uncontrolled fluid overload and symptom burden in PD patients age >65 years, doing so without jeopardizing RKF [46]. Icodextrin also reduces glucose load and metabolic disturbances compared to conventional/hypertonic glucose-containing PD solutions. The 2015 ISPD Adult Cardiovascular and Metabolic Guidelines recommended the use of icodextrin in high transporters and patients with uncontrolled volume overload [47]. In the recent 2020 ISPD guideline, a more relaxed recommendation on icodextrin use was given for better volume management for all patient groups including older individuals [14, 15]. However, icodextrin may not be readily accessible in many parts of the world including many low-income and low-middle income settings. In such scenarios where icodextrin is not available, biocompatible PD fluids of ~pH 7.4 and/or fluids with low concentrations of glucose degradation products are desirable to preserve RKF [48].

Preserving RKF in Older PD Patients

Preserving RKF conveys a survival, QoL, and nutritional benefit among PD and all dialysis patients [8–10]. In addition to using biocompatible PD solutions such as icodextrin as discussed in the previous section, renin-angiotensin-aldosterone system blockade through the use of angiotensin-converting enzyme inhibitors or angiotensin-receptor blocker (ARB) has been shown to be effective in preserving RKF for all PD patients including older people. Previous meta-analyses of 6 open-label studies (257 patients in total) treated with CAPD reported that the long-term use (>12 months) of angiotensin-converting enzyme inhibitors and angiotensin-receptor blocker displayed additional benefits in preserving RKF compared to other anti-hypertensive medications (such as calcium-channel blockers) [49]. Furthermore, high dose furosemide was shown to be beneficial with improving urine volume and but not in the preservation of RKF [50]. Other strategies to preserve RKF may include avoiding nephrotoxic agents such as aminoglycosides and non-steroidal anti-inflammatory agents were possible [51].

Optimizing BP Management in Older PD Patients

PD patients are frequently complicated with hypertension. However, the relationship between BP and mortality is complex for PD patients, in that either extreme in BP may be associated with higher rates of mortality. Elevated pulse BP has been associated with an increased risk of all-cause and cardiovascular death in patients on PD over the medium to long term [52]. Recognition of this characteristic as a predictor of mortality suggests that one aim of anti-hypertensive therapy in PD patients should be to decrease elevated BP [52]. However, it has since been shown that hypotension may have greater implications on mortality compared with hypertension in older PD patients. Evaluating 1,053 PD patients enrolled in the USRDS prospective dialysis morbidity and

mortality study (wave 2 study) and observing them over a mean follow-up of 23 months, Goldfarb-Rumyantzev and colleagues [53] concluded that systolic BP <111 mm Hg in PD patients is associated with a higher mortality risk, while systolic BP >120 mm Hg is associated with fewer days of hospitalization. Another study by Udayaraj and colleagues [54] noted older PD patients with low BP at baseline were more likely to have underlying heart failure and cardiac co-morbidities and this may explain for greater risks of early mortality following PD initiation. In general, BP management in older patients on PD should be individualized, and anti-hypertensive selection should be tailored to minimize risk of falls and symptoms due to postural hypotension [55, 56]. A prospective cohort study by Chan and colleagues [57] found that the number of medications (but not daily pill load) significantly predicted onset and progression of frailty, malnutrition, fall episodes, hospitalization, and mortality in PD patients. Polypharmacy is particularly common among older PD patients, and regular medication reviews is indicated to reduce risks of medication-induced hypotension and other potential adverse effects.

Managing Anemia in Older PD Patients

Anemia is another common complication among older PD patients, given the consequences of untreated anemia on negative morbidity and mortality outcomes [58]. The National Health And Nutrition Examination Survey data recorded almost a doubled increase of anemic patients age >65 living with CKD or dialysis-dependent kidney failure between the 1980s and 2010s [59, 60].

Increased emphasis being put on anemia management through intravenous iron and erythropoietin-stimulating agent (ESA) for the PD population is reflected from Peritoneal Dialysis Outcomes and Practice Patterns (P-DOPPS) data [61]. Current KDIGO guidelines recommend an individualized approach to anemia management for PD patients, with an aim to prioritize their QoL during dialysis [62]. It is suggested that ESA commencement is suitable even when hemoglobin target levels above 10 g/dL were being achieved, if this is symptomatically indicated [62]. ESA hyporesponsiveness may present as an issue for the older PD patient living with kidney failure and other co-morbidities however. Escalating ESA doses to achieve hemoglobin targets is likely to pose greater cardiovascular, thrombotic, and mortality risks in this group [63]. Anemia treatment via hypoxia-induced factor prolyl-hydroxylase inhibitors in the older PD patient can be a novel and exciting option, given the potential benefits it possesses in avoiding requirements for excess iron (by increasing iron absorption and improving functional iron utilization) and ESA administration as well as practical benefits from the ease of orally administered treatment for older individuals [64–66]. Nevertheless, in view of the adverse effects that hypoxia-induced factor prolyl-hydroxylase inhibitors may possess notably its potential cardiovascular risks, these agents are currently either under consideration for regulatory approval or remain not approved for use in numerous countries for dialysis patients.

Addressing Symptom Burden in Older PD Patients

The high symptom burden observed in maintenance dialysis patients is not only comparable to that of patients with cancer and other severe chronic illnesses but also has huge implications on impairing the individual's health-related QoL [67, 68]. It is currently under investigation what clinical assessment tools best measure the various levels of symptom burden in older PD patients. Symptom burden is usually complex, multifactorial, and may be difficult to assess and quantify, as older patients often experience multiple symptoms simultaneously, and the attributes of symptoms may change over time during PD treatment [69, 70]. Symptom burden is also not systematically assessed in most outpatient settings.

Previous systematic reviews describing symptom burden in maintenance dialysis concluded that patients commonly experience multiple symptoms, with at least pain, fatigue, pruritus, and constipation presenting in half of the individuals receiving long-term dialysis [71, 72]. Recently published results from the European QUALity (EQUAL) study, an ongoing, prospective, multicenter study in patients ≥65 years with an incident eGFR ≤20 mL/min/1.73 m^2 highlighted the number of symptoms and severity of symptom burden considerably worsened before dialysis initiation among advanced CKD patients, of which some improvements in cardiopulmonary symptoms, gastrointestinal symptoms, neurological symptoms, emotional symptoms, sleep disorders, and fatigue were observed while sexual symptoms (e.g., "decreased interest in sex" and "difficulties in becoming sexually aroused"), integumentary, and musculoskeletal symptoms worsened following dialysis initiation or did not change at all [73]. Table 3 outlines some of the common symptoms that may be experienced by older PD patients and potential management strategies to address these symptoms [15, 74–81].

Table 3. Management options for common symptoms experienced by older patients during PD

Symptom	Management
Fatigue and lack of energy [15]	• Investigating and treating the factors leading to fatigue and lack of energy, e.g., sleep hygiene, stress, depression, malnutrition as fatigue, and lack of energy most likely a secondary symptoms from a root cause
Depression [15, 74, 75]	• CBT sessions • Counseling with patient and families/caregivers to ensure adequate support while on PD is provided • Encourage regular physical activity • Anti-depressant medications may be required in more severe cases
Poor sleep [15, 76]	• Counseling and advise to generate a sleep schedule • Create a restful environment and remove stressors which may affect sleep • To manage sleep apnea if present • In prolonged insomnia, sleeping pill prescription may be needed
Pain [77]	• Aim for early identification of pain symptoms by families and caregivers as elderly patients may not always be able to communicate their pain symptoms due to cognitive impairment • Review of the catheter position and PD infusion regime as drain and infusion pain are common • Over-the-counter as needed/regular pain relief and opioids may be required
Restless legs [78]	• Dopaminergic therapy (i.e., levodopa or dopamine receptor agonists such as pramipexole) is usually first line • Gabapentin, benzodiazepines, and opioids are suitable alternatives
Pruritus [79]	• Current pharmacological options include antihistamines, opioids, and gabapentinoids • Non-pharmacological options include phototherapy, acupuncture/acupressure, and fatty acid supplementation
Poor appetite [80]	• Use of icodextrin-based PD solutions may improve appetite due to reduced appetite inhibition • Appetite stimulants (e.g., megesterol acetate, cannabinoids, and cyproheptadine) can improve appetite, caloric intake, and nutritional and inflammatory status in patients receiving PD
Constipation [81]	• Rule out secondary causes (e.g., bowel obstruction) • Encourage healthy dietary patterns with more fruits, vegetables, and fiber intake

CBT, cognitive behavioral therapy; PD, peritoneal dialysis.

In the study "Broadening Options for Long-term Dialysis in the Elderly (BOLDE)," sustained caregiver support has been shown to be useful in minimizing symptom burden, decreasing intrusion of illness by PD treatment and depressive symptoms and improving overall QoL in older PD patients [82]. However, sustained caregiver support may lead to caregiver stress and burnout [83–85]. Respite care or having alternative caregiver may be essential in this setting to relieve caregiver stress. Family members of older patients may have full-time employment and taking up caregiver roles and responsibilities additionally may add further stress and become unmanageable for caregivers. It is therefore essential to develop a feasible long-term care plan with shared decision-making for older PD patients and their caregivers together to prevent caregiver overstress and burnout, such as having regular respite care and community nursing support. Digital health technology may facilitate remote patient/caregiver support and may also facilitate PD care [85].

Managing Nutritional Intake and Promoting Physical Exercise in Older PD Patients

PEW syndrome is highly prevalent in older PD patients as a result of multifactorial causes and is shown to predict an increased mortality and hospitalization risk in PD patients. The mechanisms for why older PD patients are more susceptible to PEW is not limited to an individual's genetic and phenotypical features but also contributed by other environmental factors of aging and frailty – increased cellular mitochondrial dysfunction and oxidative stress, inflammation, reduced immunity, lifestyle, psychosocial condition, and invariably kidney failure and dialytic factors (Fig. 2) [86]. Dialysate protein loss (usually around 5 g/day on PD, and further increases with PD peritonitis) predisposes to an increased risk of negative protein balance [87].

It is essential to monitor nutritional status regularly in older PD patients. Key biochemical parameters to monitor for include hypokalemia and hypoalbuminemia. The P-DOPPS showed that hypokalemia may reflect underlying PEW in PD patients and predict peritonitis and

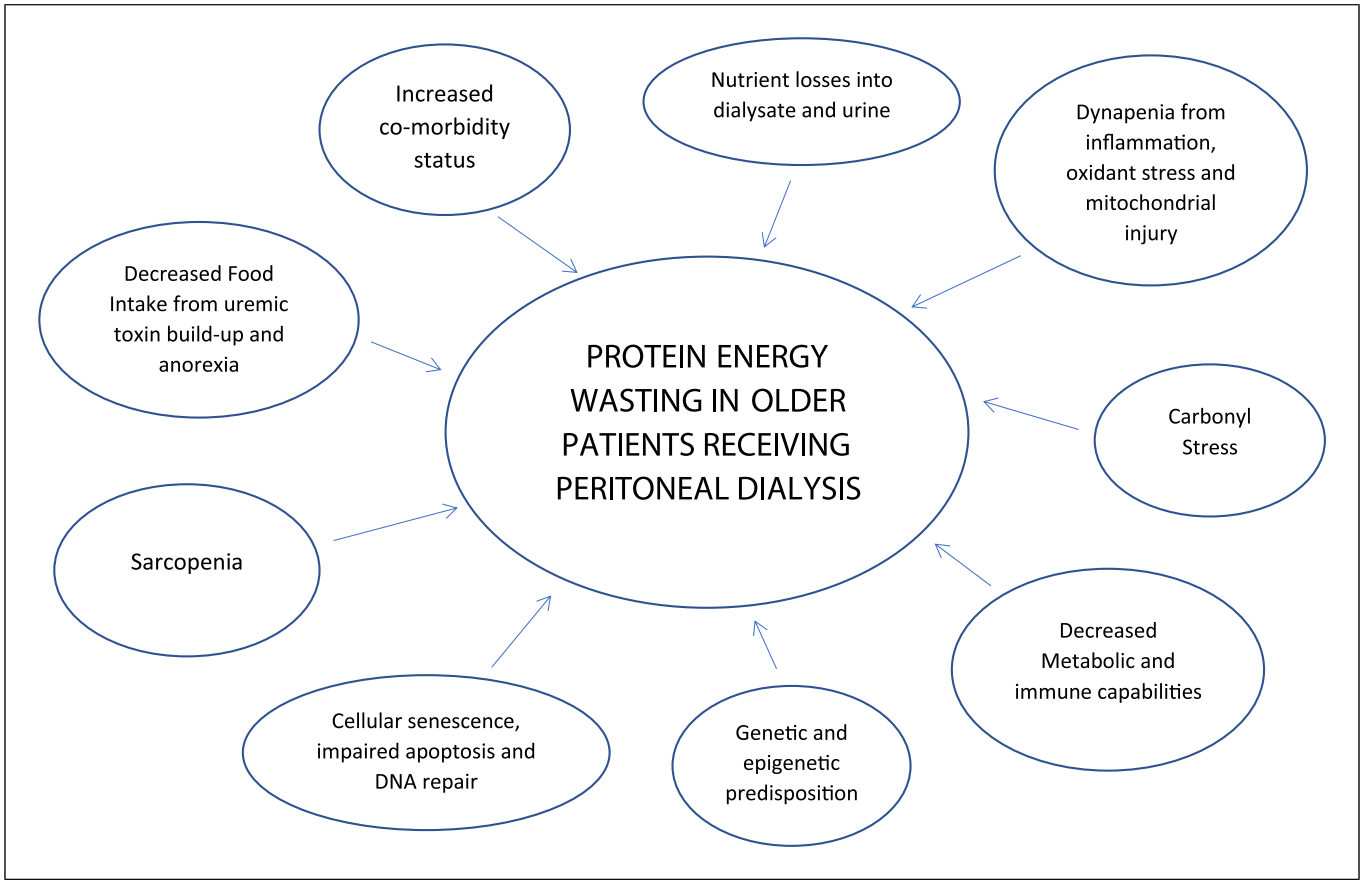

Fig. 2. Pathophysiological mechanisms of PEW in older peritoneal dialysis patients.

mortality risk [88]. Serum albumin alone is not a reliable marker of nutrition status as overhydration may cause hypoalbuminemia and serum albumin is also a negative acute phase reactant. The presence of hypoalbuminemia may reflect the presence of underlying inflammation, co-morbidities, or extracellular volume overload. As suggested by ISPD and International Society of Renal Nutrition and Metabolism (ISRNM) guidelines, older PD patients require regular screening, monitoring, and assessment of nutrition status through a combined evaluation of a patient's appetite, body weight, dietary intake, and physical examination of muscle mass and body fat, supplemented by biochemical tests including potassium, phosphate, and serum albumin [15, 86]. Nutrition management in older PD patients require an individualized, multi-disciplinary approach involving nephrologists, dietitians, and PD nurses to evaluate the causes of PEW and develop a nutrition care plan with or without the need for oral, enteral, or parenteral nutrition support, depending on the causes and severity of PEW [86].

Other than monitoring and improving nutritional status, optimization of physical conditioning is also an important component of PD care for older patients. Being physically active is instrumental for life participation, one of the key prioritized outcomes in the SONG-PD initiative [17]. Sedentary behavior is very common in older people and physical inactivity is especially prevalent in those living with multi-morbidities [89]. Sarcopenia is an age-related process of involuntary skeletal muscle mass loss which adversely impacts physical functioning and mobility in older individuals [72]. Sarcopenia contributes to the frailty syndrome, and may be exacerbated from the presence of multi-morbidities in older PD patients [90]. Objective tools to screen for sarcopenia is currently undergoing further validation [91, 92].

Promoting physical activity may be challenging for many older PD patients. Some of the key perceived barriers to promote physical activity in older PD patients may relate to fatigue symptoms and a lack of energy, sarcopenia with poor muscle function, poor balance with

potential risk of falls in the presence of pre-existing frailty, poor physical functioning, multi-morbidities, poor cardiorespiratory reserves, and tolerability [93]. While there is emerging data to suggest better clinical outcomes with exercise therapy in HD, there is a paucity of randomized intervention trial data on the effect of exercise among PD patients [94, 95]. Several studies have explored the efficacy of exercise programs among older patients with advanced CKD and frailty [96, 97]. Recent initiatives from the Global Renal Exercise Network group such as the "Kidney Beam" program, a digital intervention for self-management of physical activity and emotional well-being, are useful for older PD patients [98]. Physiotherapists, occupational therapists, exercise professionals, and caregiver support groups in the community play important roles in assisting older PD patients to develop an individualized, realistic goal on graduated exercise programs so to gradually improve their physical functioning, balance, tolerance, and cardiorespiratory fitness while minimizing the risk of falls.

Telehealth Opportunities in Facilitating PD Care for Older Patients

Recent advances in telehealth may assist PD care in older people. It enables the setting up of virtual multi-disciplinary clinic consults to facilitate remote monitoring of clinical progress, exit site, nutrition status, BP and volume status, and well-being of older PD patients and minimize their travel needs [99, 100]. However, there are limitations in that virtual consultations may limit the extent clinicians can provide full assessments for their patients. Older patients may not have the literacy and capability to handle the mobile devices required for telehealth consultations and would require caregiver support [101]. Moreover, there are concerns with patient security and confidentiality, as well as socio-economic factors impacting equity of telehealth access in older patients [100]. Creating user-friendly telehealth systems for older people will be important, considering its emerging role in home dialysis care amidst the COVID-19 pandemic. Success in integrating technology into home dialysis care will depend on availability and accessibility to telehealth, older patients' literacy to handle mobile technology, patients and caregiver education on telehealth system. Further study will be required to evaluate the cost effectiveness of telehealth application in caring for older PD patients.

Conclusion

There is a growing burden of an aging population with kidney failure and receiving PD treatment worldwide. Many of these older patients also have multi-morbidities and frailty. Ideally, a multi-disciplinary approach with shared decision making embedded, taking into consideration the individual's life goals, preferences, psychosocial circumstances, clinical status, caregivers support, and home environment will be required in delivering PD care for the older population. Patient-reported outcomes relating to PD care in the older population is generally lacking and remains infrequently reported across most randomized clinical trials and large sample observational studies at present [102]. The international nephrology community will need to provide initiatives in continually striving to address this issue. What matters most for many older patients is living comfortably within a familiar home environment while receiving PD. Many would like to continue pursuing life goals and enjoy life with physical activity, a good appetite, and minimal symptom burden as well as hospitalizations and treatment-associated complications, rather than just surviving. Caregiver support is essential in the management of older PD patients, and the multi-disciplinary team will need to work hand-in-hand with caregivers to optimize outcomes for this patient population.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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