

# Multidisciplinary Care to Optimize Functional Mobility in Parkinson Disease



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## KEYWORDS

• Multidisciplinary care • Parkinson disease • Functional mobility • Gait • Balance

## KEY POINTS

- Integrating the services of different health care professionals into a multidisciplinary team approach improves the overall management of persons living with Parkinson disease.
- Previous initiatives have shown that a well-organized multidisciplinary collaborative structure has the potential to improve quality of care and health outcomes, while reducing health care costs. However, more work is needed to define which care model is best for which type of health care issue in Parkinson patients.
- Care should be tailored to the individual patient, for example, by using the International Classification of Functioning, Disability, and Health model as a framework.
- Use of health care innovations, such as wearable telemonitoring devices, is likely to facilitate the delivery of multidisciplinary, personalized care for all patients with Parkinson disease in the near future.

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## INTRODUCTION

Parkinson disease (PD) is a highly complex neurodegenerative disorder, resulting in a wide variety of motor and nonmotor symptoms. These symptoms can have a disabling impact on the functional capabilities and quality of life of affected persons.<sup>1,2</sup> Despite optimal medical management, with levodopa as the current cornerstone of most management programs, many motor and nonmotor symptoms improve only partially. Therefore, complementary nonpharmacologic interventions, such as physiotherapy, occupational therapy, speech language therapy, are needed to provide optimal care. There is increasing evidence that demonstrates the added value for each of these professional disciplines, when this is offered as a monodisciplinary intervention.<sup>3</sup> The evidence is most abundant and persuasive for a range of physiotherapy interventions, but there are now also good clinical trials to support the merits of other allied health interventions. There is also growing support (largely practice based, but to a much lesser extent evidence based) that integrating these different health care professionals into a multidisciplinary care team may improve the overall management of PD.<sup>4,5</sup> Multidisciplinary care is to be distinguished from interdisciplinary care. In a multidisciplinary team, each individual team member approaches the patient from their own perspective. The decisions made by all separate team members may be integrated by a team leader, but this is not a prerequisite. In contrast, interdisciplinary care emerges from multidisciplinary care when health care professionals make group decisions about patient care.<sup>6,7</sup> Here, the authors focus on “multidisciplinary care” in its broadest sense, and use that as the overarching umbrella term in the remainder of this article.

In this review, the authors elaborate on multidisciplinary care for persons living with PD, by using gait and balance impairments as an example of a treatable target that typically necessitates an integrated approach by a range of different and complementary professional disciplines. Gait and balance impairments are hallmarks of PD and are reckoned among the most disabling symptoms.<sup>8</sup> Their management is complex because dopaminergic treatment is only partially effective, particularly when the disease progresses.<sup>9,10</sup> Complementary nonpharmacologic interventions are therefore needed to provide optimal care, ideally via a multidisciplinary approach.<sup>11</sup> Here, the authors first discuss that for optimal multidisciplinary care, a mere assessment of symptoms (eg, retropulsion test to test balance correcting steps, or a turning test to provoke freezing of gait) is insufficient, and that it is essential to also assess the functional consequences of balance and gait impairments, in combination with interacting personal and environmental factors. The outcome of such a broader assessment will subsequently determine the focus and content of the multidisciplinary treatment program. Finally, the authors elaborate on the various models to organize multidisciplinary care, and on the new possibilities to improve care by integration of technological innovations.

## ASSESSMENT OF FUNCTIONAL MOBILITY

Gait and balance impairments result in recurrent falls, fall-related injuries, and a secondary fear of falling.<sup>12,13</sup> The impairments in mobility may impose detrimental consequences for participation of affected individuals at home, at work, or within the community. For example, patients may experience a loss of independence or may be unable to continue their work activities as they did before. Hence, gait and balance impairments can have a very negative impact on functional mobility.

To map functional mobility, the International Classification of Functioning, Disability, and Health (ICF) framework can be of help (as was recently outlined by

Bouca-Machado and colleagues).<sup>14</sup> In the ICF framework (Fig. 1), 3 levels of human functioning are identified: (a) body functions and structures (including body impairments), (b) limitations in performing activities, and (c) participation restrictions in daily life.<sup>15</sup> Personal and environmental contextual factors are interconnected with these levels of human functioning.

As shown in Fig. 1, body impairments that influence functional mobility in PD can be subdivided into motor symptoms, nonmotor symptoms, and general risk factors. Hypokinetic gait is one of the motor symptoms that impacts functional mobility. Gait in PD is phenotypically characterized by a reduced step height and length, reduced gait speed, an asymmetrically reduced arm swing, a narrow base of support, and a stooped posture.<sup>16</sup> Additional characteristic paroxysmal motor symptoms in PD are festination and freezing of gait (the feeling that the feet suddenly become glued to the floor despite the intention to walk).<sup>8</sup> Balance-correcting steps (another motor symptom impacting functional mobility) are typically small, or not present at all.<sup>17</sup> Importantly, nonmotor symptoms influence functional mobility as well. For example, orthostatic hypotension influences the ability to rise from sit to stance, and executive dysfunction may hamper the ability to perform a dual task (eg, talking while walking, or carrying a tray while walking). Anxiety is another important nonmotor symptom, which is increasingly recognized as an important provoking factor for freezing of gait.<sup>18</sup> In addition to these motor and nonmotor symptoms, general risk factors, such as polyneuropathy or visual impairments, impact functional mobility as well. For example, visual impairments (which are common in PD, because of the disease itself, medication, or comorbid ophthalmologic conditions)<sup>19</sup> may well hamper the ability of patients with PD to use visual cueing to shift from an automatic to goal-directed control of walking. Similarly, a marked polyneuropathy may interfere with the subject's ability to benefit from tactile cues delivered to the feet.

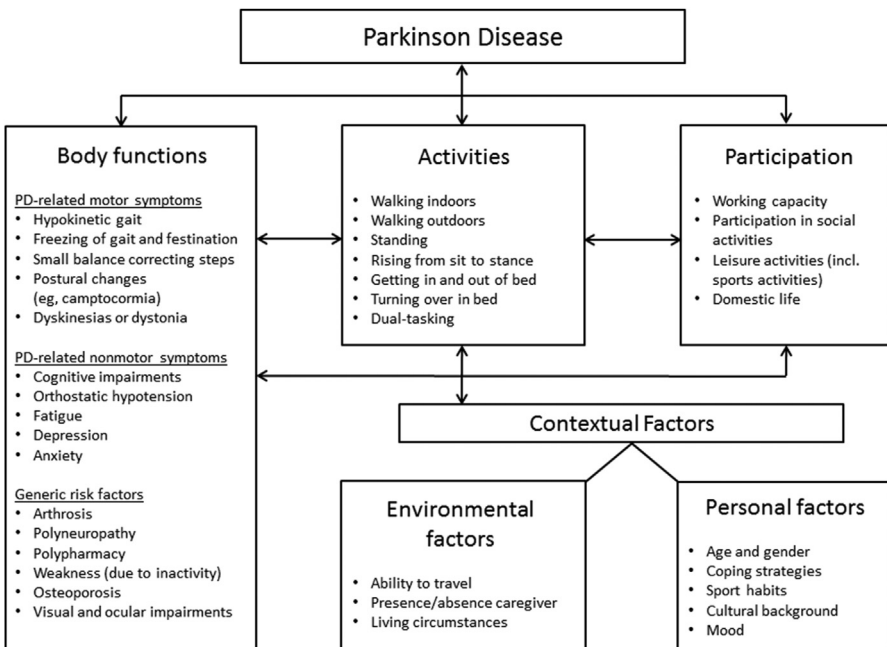


Fig. 1. The ICF framework applied to PD.

These body impairments (because of both motor and nonmotor symptoms as well as general risk factors) influence the activities that a patient is able to perform, and this subsequently impacts their participation in society. For example, the ability to maneuver in crowded places is often difficult for patients because of freezing of gait, and this may hinder their ability to go to a busy marketplace. Another example is the inability to perform a dual task while walking, which may result in an inability to serve coffee to family members.

Assessment of functional mobility is not complete without the evaluation of contextual factors, which can be subdivided into environmental factors and personal factors. The presence or absence of a caregiver aside (eg, proximity to the patient can markedly influence gait), an important environmental factor is represented by the living circumstances. For example, a patient living in an urban area might experience difficulties traveling by subway, whereas a patient living in the countryside may experience difficulties going to the supermarket independently. Knowing that freezing of gait is often provoked by narrow spaces, a home packed with furniture can be detrimental. Personal factors impact functional mobility as well. Coping strategies are an important personal factor: patients may experience difficulties accepting their gait and balance impairments and may feel ashamed to apply cueing strategies that are visible to others. This approach will have a negative impact on their functional mobility. Alternatively, patients may experience difficulties integrating energy-conservation strategies (including an activity-rest balance over the entire day and week) into their daily lives, resulting in an increase of experienced fatigue and a negative impact on functional mobility.

## MULTIDISCIPLINARY MANAGEMENT TO IMPROVE FUNCTIONAL MOBILITY

The outcome of the assessment of functional mobility using the ICF framework will determine the focus of the multidisciplinary treatment. Importantly, the focus of the treatment is also largely dependent on the personal aims of the patient. For example, coping strategies may have a negative impact on functional mobility, but when the patient is completely reluctant to improve these, they should not be the focus of the treatment.<sup>20</sup> Focus is also important because patients with PD often experience a lack of energy, and multitarget therapy not tailored to the individual carries a serious risk of hitting nothing.<sup>21</sup> The purpose of this review article is not to describe all possible treatment options in detail, as this has already been done elsewhere.<sup>11,22–24</sup> Instead, the authors elaborate on 1 treatment modality at each level of the ICF framework. As the levels of the ICF framework interact, these treatment modalities will ultimately influence the overall functional mobility of the patient.

### ***Body Functions: Compensation Strategies to Reduce Freezing of Gait***

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A comprehensive summary of compensation strategies to reduce freezing of gait was recently published.<sup>25</sup> An international group of experts asked patients to videotape self-invented tricks to improve their mobility. From these recordings, 59 unique compensation strategies were identified and classified into 7 main categories (**Table 1**). Importantly, the effect of compensation strategies can differ between patients. For example, a particular form of compensation (eg, visual cueing) may have a spectacular effect on gait in 1 patient, but display no effect on, or even worsen, freezing of gait in another.<sup>26,27</sup> Personal preferences may also play a role; some patients do not mind walking around with earbuds that provide rhythmic auditory cueing, whereas others find this socially unacceptable. In that regard, many patients dislike the social stigma that is associated with most visual cueing strategies, because these

**Table 1**  
**Classification of compensation strategies for gait impairments in Parkinson disease**

| Compensation Strategy                            | Example  |
|--|--|
| 1. External cueing                               | Walking at the rhythm of a metronome                   |
| 2. Internal cueing                               | Focusing on predefined components of the gait cycle    |
| 3. Changing balance requirements                 | Weight shifting in place before gait initiation        |
| 4. Altering the mental state                     | Making movements as if being a Toreador                |
| 5. Action observation/motor imagery              | Watching another person walking before gait initiation |
| 6. Adopting a new walking pattern                | Walking while lifting the knees high                   |
| 7. Other forms of using the legs to move forward | Roller skating   |

Data from Nonnekes J, Ruzicka E, Nieuwboer A, et al. Compensation strategies for gait impairments in Parkinson's disease: a review. *JAMA Neurol* 2019;76(6):718–25.

are very visible to outsiders. In order to identify the optimal compensation strategies for each patient, patients with PD should be educated about the available compensation strategies and receive guidance from an experienced therapist. At present, this usually turns into an ineffective trial-and-error process. Future studies should therefore evaluate whether there are certain patient characteristics that can predict the most effective compensation strategy in an individual patient. Possible predictive patient characteristics may include the presence of on-state freezing of gait, the specific provoking circumstances for freezing of gait (eg, freezing while turning around in the kitchen may require a different strategy than start akinesia), the presence of cognitive dysfunction, comorbidity, and, as indicated before, personal preferences.<sup>28</sup> Further research is also warranted to obtain a deeper understanding of the underlying working mechanisms of compensation strategies for gait impairments in PD. For example, gait is a complex motor function, but it is largely automated. Patients with PD experience difficulties walking in an automatic manner, because of the loss of dopaminergic innervation in the posterior putamen (a region associated with habitual behavior).<sup>29</sup> Compensation strategies likely enable a shift from automatic to goal-directed gait control. This shift may involve the recruitment of additional cortical areas, and it may be that the nature and extent of these cortical networks differ from patient to patient or from compensation strategy to another. Recent technological advances, such as ambulatory electroencephalography measurements, create opportunities to study the precise involvement of cortical compensatory mechanisms, possibly even at an individual level, thus allowing for more focused delivery of personalized rehabilitation strategies.

### **Activity Level: Dual-Task Training**

An example of an intervention at the activity level is dual-task training. Patients with PD often experience difficulties performing dual tasks while walking.<sup>30,31</sup> Compromised dual-task gait in PD correlates with more freezing of gait, an increase in fall risk, and reduced functional mobility.<sup>32–34</sup> The usefulness of dual-task training in PD has been debated in recent years.<sup>30,35</sup> Controversies also surround the most effective method of dual-task training. In the DUALITY trial,<sup>36</sup> the efficacy of a consecutive versus an integrated approach was assessed as well as the possible fall risk of both training methods. In this multicenter single-blinded study a total of 121 patients with

PD (Hoehn and Yahr stage II–III on medication) were randomized to either the consecutive group in which motor and cognitive tasks were trained separately or the integral group in which motor and cognitive tasks were trained concurrently. After 6 weeks of this at-home training program, led by a physiotherapist, significant improvement in gait velocity during dual-task performance was described in both treatment groups. Both training modes had a similar effect on dual-task gait, and the improvements were preserved at 12-week posttraining follow-up in both groups. In addition, the increase in dual-task gait velocity did not increase the risk of falls in both study arms. These findings suggest that dual-task training is safe and advantageous, and that it should be adopted in clinical practice. According to this trial, there is no particular dual-task training approach that is superior.

### ***Participation Level: Job Coaching***

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The authors now move to providing an example of an intervention at the participation level. Gait and balance impairments can have a negative impact on the ability to work (eg, a patient with young-onset PD who is unable to continue working as a waiter).<sup>37</sup> Rates of unemployment and early retirement are high in PD and contribute to disease burden. A retrospective study of an Irish cohort of patients with PD, diagnosed before the age of 65 years, found that unemployment rates for men with PD were significantly increased compared with the general Irish population, with a standardized ratio of 1.6. Interestingly, this discrepancy was not present among women. Median retirement age was 58 years for male patients with PD and 61 years for female patients with PD, compared with 63.5 and 65 years, respectively, in the general population.<sup>38</sup> Internal factors that may influence performance and well-being in the workplace in patients with PD involve symptom severity, daily fluctuations in PD symptoms, and coping strategies and adaptability of the patient. An important positive external factor is the presence of supportive, educated employers and colleagues who enable appropriate adjustments to the professional environment.<sup>39</sup> Therefore, job coaching (eg, by an occupational therapist or an occupational doctor) that targets both these internal and external factors should be an element of multidisciplinary care in patients with PD.

### ***Environmental Factors: Adaptations in the Home Setting and Caregiver Strain***

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A home environment that is not tailored to meet the functional mobility of the patient contributes to falls and is associated with negative health outcomes in PD.<sup>40</sup> Characteristics of the environment can both ameliorate and impede the independence, efficacy, and safety in performing daily activities.<sup>41</sup> Therefore, assessment of the home environment by an occupational therapist, physiotherapist, or Parkinson nurse specialist is essential in patients with gait and balance difficulties. Because persons living with PD generally experience fluctuations in symptoms throughout the day, it is recommended to observe the patient in the home environment during both “on”- and “off” states.<sup>42</sup> Considering this may not be feasible in daily practice, the authors recommend actively inquiring about challenges occurring during the on state or off state at home. Although the necessary adaptations are person and context specific, there is some general advice concerning the home environment. First, creating a free walking and turning route by rearranging furniture and reducing the number of objects present in the room are essential (because freezing often occurs in narrow spaces). Second, potential tripping hazards, such as slippery flooring, doorsteps, loose mats, or electricity cables, should be eliminated. Furthermore, creating support points or seating possibilities during balance-challenging activities, such as getting dressed, should be considered. Because patients with PD with axial symptoms rely more on good vision to compensate for their gait impairments, installing proper

lighting solutions (eg, on the route to the toilet at night) should also receive attention. Last, freezers may profit from applying visual cues in places of importance, such as stripes on the floor on the turning route in front of the wardrobe, or a more 3-dimensional approach, such as a painted staircase illusion.<sup>43</sup>

Having to deal with gait and balance impairments of a person with PD may impose significant strain onto the caregiver. Taking on the role of caregiver, in addition to the role of being a partner, family member, or friend, can be challenging.<sup>44</sup> A deterioration of functional mobility can impact caregivers in multiple ways. For example, caregivers often experience stress if their partner or family member with PD falls frequently. Moreover, as a result of their family member's decreased mobility, caregivers may be forced to take on more responsibilities, for example, by taking over certain tasks in the household. These circumstances can markedly affect the caregivers' lives at a physical, emotional, and psychosocial level and, thereby, affect their quality of life. In a postal survey that was conducted among 123 caregivers of persons with PD,<sup>45</sup> more than 40% of caregivers indicated that their health had suffered as a result of caregiving. In addition, almost half of them had increased depression scores, and more than 60% reported that their social life had been negatively affected. Multidisciplinary care should therefore also pay attention to the well-being of the caregiver. Ideally, caregivers are integrated within the multidisciplinary team. The optimal way to organize this collaboration, however, needs to be established. Thus far, most studies on multidisciplinary care models found no effect, or even a negative effect, on experienced caregiver strain.<sup>46,47</sup> In the IMPACT trial,<sup>48</sup> a nonrandomized controlled trial on integrated multidisciplinary care for persons with PD, 301 patients were included from 6 community hospitals in The Netherlands. Patients in the intervention group were offered an individually tailored comprehensive assessment in an expert tertiary referral center followed by dedicated referrals to a regional network of allied health professionals specialized in PD, whereas patients in the control group did not have access to this infrastructure. As a secondary outcome, caregiver strain was assessed using the BELA-A-k at 4 and 8 months. Although the intervention showed no effect on the overall caregiver strain, the results suggested a higher caregiver strain in the intervention group for the partner bonding subscale of the BELA-A-k, perhaps because the well-intended multidisciplinary approach now opened a "Pandora's box" and made caregivers more aware of the vast complexity of PD. Another explanation is the need for the caregiver to now arrange and supervise the many time-consuming visits to members of the multidisciplinary team. Regardless, this paradoxical effect needs to be addressed in future studies.

### ***Personal Factors: Sport Habits***

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In addition to environmental factors, personal factors, such as sport habits, could also be a target of intervention. An active lifestyle is essential for patients with PD, because there is increasing evidence for a beneficial effect of regular exercise on motor as well as nonmotor functioning.<sup>49,50</sup> Maintaining physical fitness can be challenging for patients with gait and balance impairments, because not all physical activities are feasible or safe for these patients (eg, freezing of gait may lead to falls while playing tennis). Fear of falling especially is a major barrier for physical activity in patients with PD,<sup>51</sup> whereas, on the other hand, fall risk can be reduced by regular physical activity.<sup>52</sup> Many different types of exercise are nowadays available for patients with PD, varying from endurance and strength training to dance, tai chi, and boxing.<sup>3,50</sup> There is accumulating evidence that long-term aerobic-type exercise especially may attenuate PD symptoms<sup>53</sup>; however, recent work also highlights the potential of mind-body exercise, such as mindfulness yoga.<sup>54</sup> Most of these interventions show an overall

benefit, even though it remains unclear what frequency, intensity, and duration of exercise are most effective. The issue of dosing was addressed very nicely in the recent SPARX trial,<sup>55</sup> a phase 2 multicenter randomized clinical trial that examined the feasibility and safety of high-intensity treadmill exercise in patients with de novo PD. In total, 128 patients were randomly assigned to 1 of 3 groups: high-intensity exercise (80%–85% of maximum heart rate), moderate-intensity exercise (60%–65% of maximum heart rate), or wait-list control. The intervention groups performed treadmill exercise 4 days per week for 6 months. After 6 months, the high-intensity group, but not the moderate-intensity group, showed a decreased change in Unified Parkinson Disease Rating Scale motor score compared with the control group. Future phase 3 trials are now warranted to determine whether high-intensity exercise is indeed more beneficial compared with moderate-intensity exercise. The European Guideline for Physical Therapy in PD gives an overview of the different exercise options and advises to choose a combination of different types of exercises based on the patient's preference, barriers, and motivators in order to increase long term adherence.<sup>56</sup> Future research needs to focus on the evaluations of the comparative effectiveness of different types of exercise and the long-term benefits.

### ORGANIZATION OF MULTIDISCIPLINARY CARE

Because of the wide range of motor and nonmotor problems, a multidisciplinary approach is increasingly being recognized as the best way to manage the disease.<sup>5,57</sup> Multidisciplinary care can take many different forms, but there is no template on how professionals should collaborate optimally. Various models have been tested, with variable success. Although multidisciplinary care is generally accepted to be of great value, the few controlled trials on intramural multidisciplinary care in PD produced inconsistent findings; although some care models established a significant improvement in quality of life and motor performance in patients with PD,<sup>58,59</sup> others showed no effect on the same outcome measures.<sup>48</sup> The heterogeneity of these trials, including research design, nature of multidisciplinary interventions, and methodological strength, further complicates the interpretation of results.<sup>57</sup>

Multidisciplinary care can also be organized in networks that extend beyond the walls of the traditional institutions. The Dutch ParkinsonNet is an example of how this can be organized.<sup>60</sup> ParkinsonNet was founded in 2004 and consists of regional networks that provide specialized care, preferably in the community (close to the patient's home). The core elements of ParkinsonNet include (1) professional empowerment, by educating professionals on PD according to evidence-based guidelines and by concentrating care among these specifically trained professionals through preferred referrals; (2) patient empowerment, by informing patients and including them as partners in health care; and (3) team empowerment, by organizing and supporting care into multidisciplinary, regional networks.<sup>61</sup> These community-based networks can be supported by expert clinics within that region. For example, in the authors' own tertiary center, an expert team of a physiatrist, a physiotherapist, and an occupational therapist is available for consultation regarding gait and balance. Based on this consultation, specific treatment advice can be given to community-based therapists. However, this approach is supported by practice-based evidence only, and clinical studies remain warranted to assess the efficacy and cost-effectiveness of this collaborative structure. Moreover, the feasibility of an international implementation of such an approach will be highly dependent on the different national health care systems.

ParkinsonNet has reached full national coverage in The Netherlands, and currently includes 12 different professional disciplines (eg, physiotherapists, occupational



therapists, speech-language therapists, Parkinson nurses) in 70 regional subnetworks.<sup>59</sup> Studies show that ParkinsonNet improves the quality of care, improves health outcomes for patients managed by the network, and reduces health care costs substantially.<sup>61–72</sup> Specifically, a recent analysis of a medical claims database of 4381 patients with PD, spanning an observation period of 3 years, indicated that patients who were treated by a specialized ParkinsonNet physiotherapist experienced fewer PD-related complications (17.3% vs 21.3%) and received fewer physiotherapy treatment sessions (33.7 vs 47.9) as compared with a generically active therapist. Also, specialized physiotherapy was associated with lower annual costs for physiotherapy (\$1019 vs \$1451) and lower total health care costs (\$2245 vs \$2824).<sup>72</sup>

The authors expect that other health care innovations can further improve the delivery of optimal multidisciplinary care. One of these innovations includes home-based monitoring as a way to support self-management. Currently, medical decisions are based almost exclusively on periodic in-clinic evaluations. For a variety of reasons, such “snapshots” are unable to capture the actual impact on the patient’s functioning in their own home environment. When it comes to functional mobility especially, episodic clinic visits are not well suited to detect relevant changes, such as gradual changes in walking speed or declines in physical activity. Also, it is usually very difficult to obtain a reliable impression of falls and their associated consequences during the brief hospital consultations. Consequently, it is challenging to tailor treatment decisions to the actual needs of patients.

Continuous self-monitoring in the home situation has the potential to markedly improve clinical decision making, by offering feedback to both the patient (by providing them with a tool for self-management and decision support as to when professional support is required) and the clinician (to make better informed treatment decisions).<sup>73</sup> Ideally, self-monitoring uses a combination of wearable sensors for noninvasive and continuous passive ambulatory monitoring<sup>74,75</sup> and longitudinal and repetitive digital self-report.<sup>76,77</sup> An example of such a setup includes the use of body-worn sensors or smartphones that can capture physical activity. The data gathered by the sensors can be linked to a smartphone app (feedback loop) allowing patients to receive feedback on their own activity levels. Importantly, the dashboard in the app may also allow patients to add self-reports on physical activity (ie, type and intensity) and on medication use as well the efficacy of the medication. The latter is essential to gain insight into the development and severity of response-fluctuations, which are typical for PD.<sup>78,79</sup> Such approaches can help to detect whether for any individual patient, freezing and falls predominantly occur when the medication effects have worn off, or when the medication is working well, or when the medication leads to excessive involuntary movements. Moreover, when health professionals would have access to these data, this would give them direct information on patient functioning in daily life, which will allow them to tailor their treatment to the individual patient.

Many studies have demonstrated the technological feasibility of this approach and have shown good (long-term) adherence, both for wearable sensors and for digital self-report.<sup>74,79–82</sup> Telemonitoring is expected to provide relevant insights into the patient’s functioning in their own home environment and has the potential to offer a more accurate reflection of the true disability in real daily life. However, many challenges remain to be resolved before this can really be implemented into daily clinical practice.<sup>83</sup> Myriad questions need to be addressed in future studies, such as the optimal number of sensors that a patient should wear, which position (or positions) of the sensor on the body provides the most reliable and useful information, which type of sensor is the most sensitive (eg, smartphone or body worn), as well as a further

refinement and validation of data algorithms for the detection of key outcome parameters. Another critical challenge is to study whether the feedback offered by such telemonitoring systems can lead to a sustained behavioral change (ie, improved quality of the decision making) in both patients and professionals.

## SUMMARY

Integrating different health care professionals into a multidisciplinary care team is needed to tackle the complexity of PD and, even though the evidence is not consistent and more work is needed, is likely to improve the overall management of PD. Such multidisciplinary care should be tailored to the desires and needs of each individual patient. This personalized form of care can be achieved by assessment of the patient at the level of body function, activity, and participation level, while also considering the context of the patient by focusing on personal and environmental factors. The outcome of this assessment will then determine the focus of the multidisciplinary treatment. Although evidence remains conflicting, several initiatives have shown the potential of a well-organized multidisciplinary collaborative structure to improve quality of care and health outcomes, while reducing health care costs in some examples. With the use of health care innovations, such as wearable telemonitoring devices, the path toward multidisciplinary, personalized care for all patients with PD will continue to develop.

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