

Efficacy of community-based physiotherapy networks for patients with Parkinson's disease: a cluster-randomised trial



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Summary

Background Many patients with Parkinson's disease are treated with physiotherapy. We have developed a community-based professional network (ParkinsonNet) that involves training of a selected number of expert physiotherapists to work according to evidence-based recommendations, and structured referrals to these trained physiotherapists to increase the numbers of patients they treat. We aimed to assess the efficacy of this approach for improving health-care outcomes.

Methods Between February, 2005, and August, 2007, we did a cluster-randomised trial with 16 clusters (defined as community hospitals and their catchment area). Clusters were randomly allocated by use of a variance minimisation algorithm to ParkinsonNet care (n=8) or usual care (n=8). Patients were assessed at baseline and at 8, 16, and 24 weeks of follow-up. The primary outcome was a patient preference disability score, the patient-specific index score, at 16 weeks. Health secondary outcomes were functional mobility, mobility-related quality of life, and total societal costs over 24 weeks. Analysis was by intention to treat. This trial is registered, number NCT00330694.

Findings We included 699 patients. Baseline characteristics of the patients were comparable between the ParkinsonNet clusters (n=358) and usual-care clusters (n=341). The primary endpoint was similar for patients within the ParkinsonNet clusters (mean 47·7, SD 21·9) and control clusters (48·3, 22·4). Health secondary endpoints were also similar for patients in both study groups. Total costs over 24 weeks were lower in ParkinsonNet clusters compared with usual-care clusters (difference €727; 95% CI 56–1399).

Interpretation Implementation of ParkinsonNet networks did not change health outcomes for patients living in ParkinsonNet clusters. However, health-care costs were reduced in ParkinsonNet clusters compared with usual-care clusters.

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Introduction

Parkinson's disease is a neurodegenerative disorder that has a severe impact on patients' daily lives.^{1,2} Although pharmacotherapy and deep brain stimulation can provide partial symptomatic relief, many patients remain incapacitated.³ Evidence suggests that allied health interventions provide additional symptomatic relief for patients.⁴ Use of physiotherapy in patients with Parkinson's disease has been studied in detail in clinical trials^{5–7} that have led to evidence-based recommendations for the use of physiotherapy in Parkinson's disease,⁸ with gait, balance, transfers (eg, rolling over in bed or rising from a chair), reaching and grasping, and physical capacity as the main treatment areas.

In the Netherlands and the UK around 54–60% of patients with Parkinson's disease have received physiotherapy at some point during their treatment.^{9,10} However, the quality of current physiotherapy care for patients with Parkinson's disease is insufficient:¹¹ clear indications for referral are missing; physiotherapists often have little or no Parkinson's disease-specific expertise; each therapist treats only a few patients each

year, which is not enough to reach a sufficient degree of expertise; and evidence-based recommendations are poorly implemented in clinical practice.

We introduced the ParkinsonNet system of care in the Netherlands with the aim of improving the quality of physiotherapy for patients with Parkinson's disease.¹² ParkinsonNet consists of regional community networks, each with a small number of physiotherapists trained to treat Parkinson's disease according to evidence-based recommendations.⁸ Physicians within a ParkinsonNet area are encouraged to refer patients to a physiotherapist if they show difficulty with transfers, posture (including neck and back problems), reaching and grasping, balance and falls (including fear of falling), gait, or physical capacity and (in)activity.⁸ ParkinsonNet supports collaboration and communication between the participating health professionals. Our initial experience in the first regional network in the Netherlands suggested that the ParkinsonNet intervention leads to better knowledge and use of evidence-based recommendations.¹²

In this trial we aimed to evaluate the implementation of ParkinsonNet networks across the Netherlands and

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to investigate the effects of ParkinsonNet on health-care costs and health outcomes of patients with Parkinson's disease.

Methods

Participants

The methods of the ParkinsonNet trial have been described in detail elsewhere.¹³ We did a cluster-randomised trial in the Netherlands including 16 clusters. A cluster design was chosen because it allowed us to assess the complete health-care process, including referral patterns, and it reduced the risk of contamination between groups in the trial. Our pilot investigations¹² were done in a region geographically separate from all clusters in the current trial; thus, patients and physiotherapists had no pre-existing knowledge of ParkinsonNet or a system similar to ParkinsonNet in the 16 clusters. Study coordination took place at three university medical centres (Radboud University Nijmegen Medical Centre, VU University of Amsterdam, and Leiden University Medical Centre). Clusters were randomly selected from the clusters in the vicinity of the three participating

university medical centres. Hospitals were invited to participate by MM and BRB. All invited hospitals agreed to participate. Some of the invited hospitals also suggested inclusion of their neighbouring hospital because neurologists were working in both hospitals, or because both hospitals served the same catchment area (figure 1).

In the participating hospitals, health records of all patients with Parkinson's disease were screened to identify eligible candidates. Inclusion criteria were diagnosis of idiopathic Parkinson's disease by a neurologist on the basis of the UK Brain Bank criteria,¹⁴ living independently in the community, ability to complete the questionnaires, and absence of comorbidity that interfered with daily functioning (verified at baseline using the cumulative illness rating scale questionnaire).^{15,16} Exclusion criteria were severe cognitive impairment (mini-mental state examination score <24) and presence of major psychiatric disorders.

Eligible patients received a written invitation to participate in a study evaluating two different systems of physiotherapy in the Netherlands. The specific differences between the two systems of care were not explained in the invitations. We could withhold this information from patients because the intervention affected all patients in that cluster (even if they were not enrolled in the study) and therefore there was very little opportunity for patients to receive care that was different to the care assigned to that cluster. Participants did not know which cluster they were in, and there was minimum risk of contamination.

Within the participating regions, we sent invitations to participate in ParkinsonNet to all physiotherapists from the Dutch Online phone book. On the basis of our pilot experience in the first ParkinsonNet region,¹² we calculated the required number of physiotherapists for each region from: the estimated number of patients within that region (to get a sufficient increase in caseload per therapist); the geographical distribution of physiotherapists within the selected region; and a maximum travel time of about 15 min by car for both patients (to the therapist's office) and physiotherapists (for optional home visits). Enough physiotherapists volunteered in all regions. If there were too many interested physiotherapists in a particular location within the cluster, selection was made on the basis of discussions among the physiotherapists who volunteered or by our project team (MM, MJN, and SHJK) on the basis of motivation of physiotherapists expressed in their response letters.

All patients provided signed informed consent before the baseline assessment. The trial had no independent monitor or monitoring committee. The Medical Ethics Committees of all participating hospitals approved the study.

Randomisation and masking

An independent biostatistician (GFB) who was not involved in recruitment randomly allocated clusters by

For the Dutch Online phone book see <http://www.detelefoongids.nl>

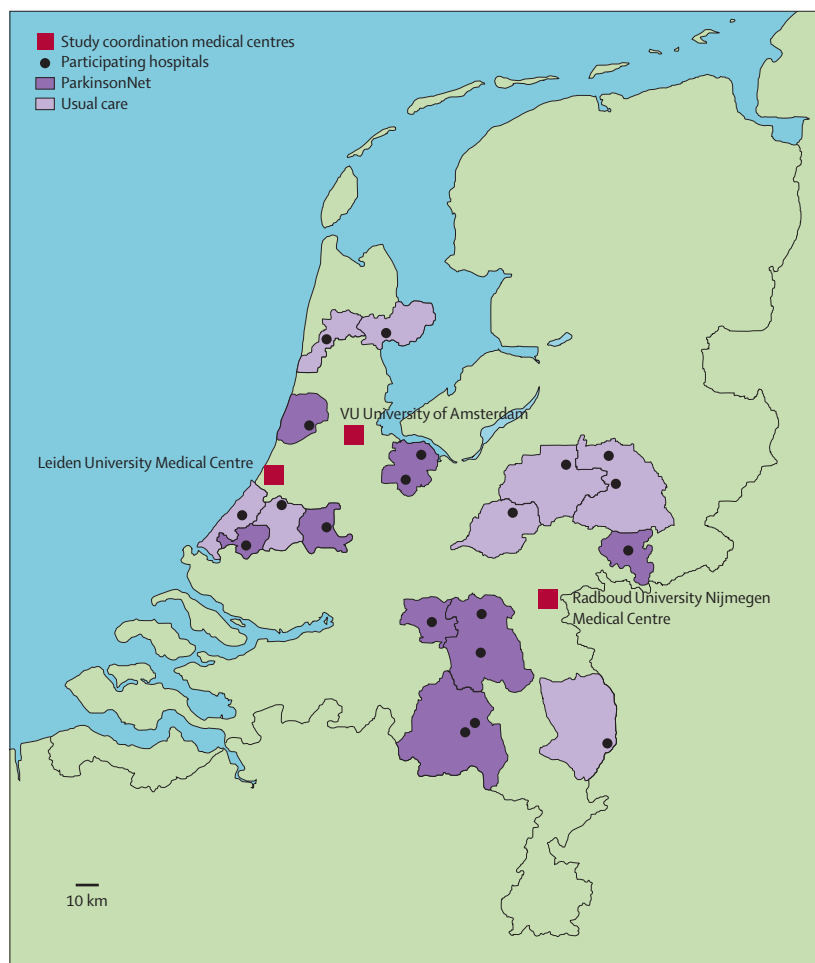


Figure 1: Geographic distribution of the participating clusters in the trial

use of a variance minimisation algorithm with the factors research area (Nijmegen, Leiden, and Amsterdam), area size (number of patients in the hospital catchment area), and teaching status (presence of teaching facilities for neurology residents).

Participants were instructed not to discuss the nature of their physiotherapy with the research assistants who did the assessments. Questionnaires were returned from participants to the assessors in separate, closed envelopes and were opened by a member of the study group (M J E Likumahwa).

Procedures

The active components of the ParkinsonNet intervention have been described.¹² Key elements include the specific training of physiotherapists, structuring of the referral process (to increase the number of patients with Parkinson's disease seen by participating physiotherapists), and optimisation of communication between the participating health professionals (panel).

All physiotherapists followed the basic training programme,¹² and attended at least four of five follow-up educational seminars over the next year. 46 physiotherapists participated in the ParkinsonNet networks (range 4–9 per network). The remaining physiotherapists, referred to here as generic physiotherapists, provided patients with usual care, and did not receive any of the components of the ParkinsonNet intervention (panel).

Outcome was assessed at four time points (figure 2). At baseline and at 16 weeks participants were assessed at home by one of seven trained assessors who were blinded to cluster allocation. Questionnaires were completed by patients at baseline and at 8, 16, and 24 weeks.

The efficacy of the ParkinsonNet intervention was evaluated in two main areas: health outcomes for patients and costs. The primary outcome was the patient-specific index for Parkinson's disease (PSI-PD) at 16 weeks compared with baseline.¹⁷ The PSI-PD covers the five main treatment areas of physiotherapy in Parkinson's disease: gait, balance, transfers, reaching and grasping, and physical capacity.⁸ Preference-based questionnaires such as the PSI-PD have shown higher response rates than some other measures^{18–20} and they are particularly useful for assessing complex interventions such as physiotherapy, for which effects are expected in multiple domains.^{18–20} Secondary health outcomes were functional mobility measured with the modified Parkinson activity scale²¹ at 16 weeks, mobility-related quality of life measured with the mobility domain of the 39-item Parkinson's disease questionnaire mobility subscale at 8, 16, and 24 weeks,²² and costs. Costs were measured with a detailed questionnaire based on microcosting completed by patients and their partners at baseline and at weeks 8, 16, and 24. In microcosting, a unit cost is calculated for each component of a resource to give detailed cost

Panel: Elements of the ParkinsonNet intervention¹²

Selection of a restricted number of motivated physiotherapists

- Include a limited number of therapists within in a circumscribed region, to increase numbers of patients per therapist*
- But include a sufficient number to ascertain geographical coverage of entire cluster

Improving the expertise of the selected physiotherapists

- Baseline training (4 days)
 - Plenary lectures to improve knowledge of Parkinson's disease†
 - Focused workshop to improve specific skills‡
 - Discussion of case reports to improve clinical reasoning
- Provision of a web-based electronic patient record, with decision support to improve clinical reasoning and adherence to evidence-based recommendations

Stimulating communication and collaboration with referring physicians

- Structuring of the referral process by providing physicians with standardised referral forms, including objective referral criteria‡
- Organisation of joint seminars for referring physicians and ParkinsonNet therapists
- Facilitating development of a regional communication plan (eg, agreement about preferred media for interdisciplinary communication)

Promoting visibility of the available expertise for both patients and professionals

- Printed brochures with background information about the ParkinsonNet approach, including names and addresses of all regional ParkinsonNet therapists
- Website with the same information as the printed brochures§

*Attracting more patients helps to improve and maintain experience among the selected physiotherapists. †For example, to explain the rationale behind motor compensatory strategies. ‡According to the Dutch evidence-based recommendations for physiotherapy in PD.⁸ Since 2004, all physiotherapists in the Netherlands have had free online access to these recommendations. §This website became available only after completion of the trial, to avoid contamination.

For the ParkinsonNet website see <http://www.parkinsonnet.nl>

For the the Dutch evidence-based recommendations see <http://www.appde.eu>

information. The questionnaire included questions about medication, physiotherapy, specialist consultation, and costs of care at home over the preceding 8 weeks. To measure indirect costs, productivity loss was estimated for partners of patients. Total costs were calculated in euros on the basis of standardised cost prices for the Netherlands. Indirect costs were calculated with the friction cost method.²³

Tertiary endpoints were: unified Parkinson's disease rating scale motor section score, timed up and go test score, 4x3 m walk test score, nine hole peg board test score, and nine hole peg board test counting task added score at 16 weeks; the self-assessment Parkinson's

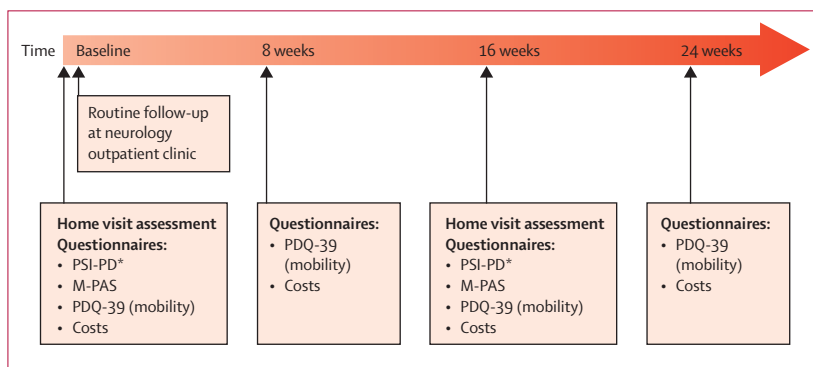


Figure 2: Length of follow-up and ascertainment methods for the various endpoints used in this study
 PSI-PD=patient-specific index for Parkinson's disease. M-PAS=modified Parkinson activity scale.
 PDQ-39 (mobility)=mobility domain of the Parkinson's disease questionnaire. *Primary outcome measure.

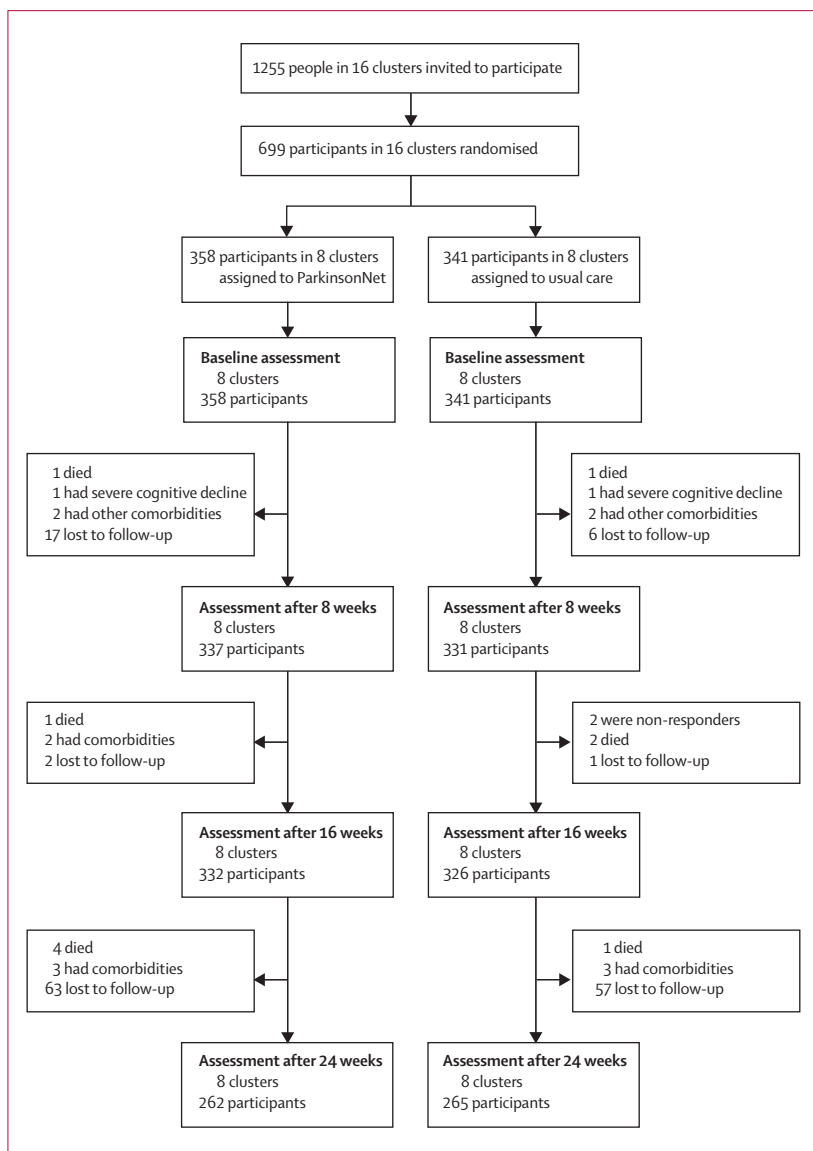


Figure 3: Trial profile

disease disability scale score, Academic Medical Center linear disability score, European quality of life 5 dimensions score, and freezing of gait questionnaire at 8, 16, and 24 weeks; the longitudinal aging study Amsterdam physical activity questionnaire at 16 and 24 weeks; and the number and incidence of falls during 24 weeks (monitored with a falls calculator).

We also asked physiotherapists who had treated the participating patients how many Parkinson's disease patients they had treated in 2006. These physiotherapists also completed the quality indicators for physiotherapy in Parkinson's disease questionnaire, a self-reported measure that assesses adherence to 11 quality indicators.²⁴

Because of the type of intervention (change in the organisation of physiotherapy care), we did not expect to see a change in incidence of adverse events, and thus information about adverse events was not collected systematically.

Statistical analysis

Power calculations were based on a meta-analysis²⁵ and on a pilot study of evidence-based physiotherapy for Parkinson's disease,²⁶ in which we found a standardised effect size (Cohen's *d*) of 0.4 for the primary outcome measure. An effect size of 0.4 can be regarded as medium sized^{27,28} and was thus believed to be adequate for this trial. 16 clusters with 40 evaluable patients each (ie, 640 patients in total), with an intraclass correlation of 0.05, and two-sided testing at a significance level of 0.05 would lead to a power of slightly over 80%. Therefore, to compensate for participants not completing the study, we aimed to include 700 patients.

Continuous variables were analysed by use of a random effects model with random factor (cluster) and fixed variables (baseline value) and cluster size (number of citizens). When a variable was measured several times (eg, Parkinson's disease questionnaire mobility subscale), participant was added as an additional random factor and time as a fixed factor. Analysis was by intention to treat. Binary variables were analysed in a similar model, with Bernoulli distribution and linear link function. A sensitivity analysis with multiple imputation was done to estimate the possible effect of missing values. Patients without any available information during follow-up were excluded. We used SAS 8.2 for statistical analysis.

Role of the funding source

The sponsor had no role in the study design, data collection, data analysis, data interpretation, or writing of this report. MM and BRB had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

In February, 2005, eight clusters were randomly assigned to ParkinsonNet and eight to usual care; the

clusters comprised 20 hospitals. 1255 patients with Parkinson's disease were invited and 699 agreed to participate (figure 3).¹³ 60 neurologists (4–12 per cluster) and 46 physiotherapists (4–9 per cluster) participated. Each cluster had 25–65 participants. Baseline characteristics, including the number of participants, physiotherapists, and neurologists, were comparable between the ParkinsonNet and usual-care clusters (table 1).¹³

262 of 358 participants in the ParkinsonNet clusters and 265 of 341 participants in the usual-care clusters were followed up for the duration of the trial. No adverse events or side-effects were reported in any of the participants.

ParkinsonNet physiotherapists had more than twice as many patients per physiotherapist than did either generic physiotherapists in usual-care clusters or generic physiotherapists in the ParkinsonNet clusters (table 2). A higher proportion of ParkinsonNet physiotherapists (26 of 29) than generic physiotherapists (56 of 165) intended to apply the treatment recommendations on a regular basis.

Physiotherapy was used by 252 (74%) of 341 patients in the usual-care clusters and 265 (74%) of 358 patients in the ParkinsonNet clusters. In the usual-care clusters, none of the patients consulted a ParkinsonNet therapist. Of the patients receiving physiotherapy in the ParkinsonNet clusters, 74 (28%) were treated by specialised ParkinsonNet therapists. The remaining 191 (72%) in the ParkinsonNet clusters were treated by generic therapists.

In both groups, most patients were treated by physiotherapists who were aware of the existence of evidence-based physiotherapy recommendations (table 2). However, the proportion of patients treated by physiotherapists who used the recommendations in daily practice was higher for the ParkinsonNet clusters (95 of 146 patients for whom data were available) than for the usual-care clusters (40 of 118). Total contact time between patients and physiotherapists over 6 months was similar in the ParkinsonNet clusters (mean 15.5 [13.3] sessions of mean 29.3 [16.6] min per patient) and usual-care clusters (15.7 [12.5] sessions; 26.9 [17.3] min per patient).

At 16 weeks there was no difference in primary, secondary, or tertiary health endpoints between the ParkinsonNet clusters and control clusters (table 3). Dopaminergic treatment (measured in levodopa equivalent doses)²⁹ did not differ between patients in the ParkinsonNet clusters (mean levodopa equivalent dose at 24 weeks 403 mg, SD 320 mg) and usual-care clusters (450 mg, 364 mg).

Total costs per person over 24 weeks were €727 lower in the ParkinsonNet clusters than in the usual-care clusters (table 4). The greatest differences in costs were for informal care (€313 difference) and day-hospital rehabilitation (€123 difference).

	ParkinsonNet clusters (n=358)	Usual-care clusters (n=341)
General		
Age (years)	68.8 (7.9)	68.4 (7.5)
Men	215 (60%)	194 (57%)
Time since diagnosis (years)	5.2 (4.5)	5.4 (5.0)
Hoehn and Yahr stage 1*	47 (13%)	30 (9%)
Hoehn and Yahr stage 2*	156 (44%)	171 (50%)
Hoehn and Yahr stage 3*	131 (37%)	112 (33%)
Hoehn and Yahr stage 4*	15 (4%)	19 (6%)
Daily levodopa equivalent dose (mg)	408 (375)	422 (348)
Health measures		
PSI-PD (0–100)	54.2 (20.9)	53.4 (22.2)
M-PAS (0–56)	47.2 (7.6)	46.9 (8.5)
PDQ-39 mobility (0–100)	36.5 (24.7)	38.2 (25.3)
UPDRS III, motor function (0–108)	28.4 (12.3)	28.8 (11.9)
TUG	10.6 (12.3)	10.2 (8.6)
4×3 m walk test	18.4 (9.2)	18.6 (11.8)
NHPB	33.0 (10.9)	34.6 (17.1)
NHPB, CT	50.8 (37.5)	49.0 (27.5)
SPDSS (24–120)	40.8 (12.7)	40.6 (13.3)
ALDS (0–100)	80.5 (12.0)	80.5 (12.0)
EQ-5D (0–1)	0.65 (0.20)	0.65 (0.22)
FOGQ (0–20)	7.0 (5.4)	7.4 (5.6)
LAPAQ (MET)	63.2 (58.0)	70.4 (67.9)
Costs		
Care costs (€)†	1228 (2071)	1460 (2194)

Data are mean (SD) or number (%). PSI-PD=patient-specific index for physiotherapy in Parkinson's disease. M-PAS=modified Parkinson activity scale. PDQ-39 mobility=Parkinson's disease questionnaire subscale mobility. UPDRS III=unified Parkinson's disease rating scale. TUG=timed up and go test. NHPB=nine hole peg board test. CT=counting task added. SPDSS=self-assessment Parkinson's disease disability scale. ALDS=Academic Medical Center linear disability score. EQ-5D=European quality of life 5 dimensions. FOGQ=freedom of gait questionnaire. LAPAQ=longitudinal aging study Amsterdam physical activity questionnaire. MET=metabolic equivalent of task. *Nine patients from each group refused a home visit and so were assessed by telephone interview. †Over 8 weeks before enrolment.

Table 1: Participants' characteristics at baseline

	ParkinsonNet clusters		Usual-care clusters
	ParkinsonNet physiotherapists (n=29)*	Generic physiotherapists† (n=75)	Generic physiotherapists† (n=90)
QIP-PD (0–44)	35.3 (4.3)	22.4 (10.1)	22.6 (7.9)
Number of patients per physiotherapist in 2006	13.6 (7.5)	4.2 (6.1)	6.0 (6.2)
Knows existence of evidence-based recommendations	29 (100%)	61 (81%)	86 (96%)
Applies recommendations	26 (90%)	26 (35%)	30 (33%)

Values are mean (SD) or number (%). QIP-PD=quality indicators for physiotherapy in Parkinson's disease. *17 of the 46 ParkinsonNet physiotherapists were not involved in treatment of patients enrolled in the trial. †Physiotherapists who deliver usual care, and who have not received any of the components of the ParkinsonNet training programme (panel).

Table 2: Characteristics of the participating physiotherapists

	ParkinsonNet clusters		Usual-care clusters		Estimated difference (95% CI)
	n	Mean (SD)	n	Mean (SD)	
Primary outcome					
PSI-PD (0-100)					
16 weeks	313	47.7 (21.9)	302	48.3 (22.4)	-0.7 (-3.6 to 2.3)
Secondary outcomes					
M-PAS (0-56)					
16 weeks	317	48.3 (7.4)	303	47.5 (8.4)	0.4 (-0.4 to 1.2)
PDQ-39 mobility (0-100)					
8 weeks	225	36.6 (24.7)	268	34.4 (24.2)	1.7 (-0.9 to 4.4)
16 weeks	300	34.6 (24.0)	294	35.3 (26.1)	-0.6 (-2.7 to 1.6)
24 weeks	262	34.4 (24.3)	265	35.9 (25.5)	0.1 (-2.5 to 2.6)
Tertiary outcomes					
UPDRS III, motor function (0-108)					
16 weeks	320	30.0 (10.7)	314	30.5 (12.0)	-0.4 (-2.2 to 1.4)
TUG (s)					
16 weeks	317	9.9 (8.4)	310	10.0 (7.7)	-0.4 (-1.4 to 0.7)
4x3 m walk test					
16 weeks	317	18.2 (12.8)	304	18.1 (8.8)	-0.4 (-2.0 to 1.2)
NHPB					
16 weeks	323	34.3 (15.7)	313	33.8 (14.4)	1.1 (-1.0 to 3.2)
NHPB, CT					
16 weeks	318	47.0 (23.0)	306	46.3 (22.0)	-0.1 (-3.1 to 3.0)
SPDSS (24-120)					
8 weeks	222	41.9 (13.2)	269	41.0 (13.6)	-0.5 (-2.1 to 1.1)
16 weeks	302	41.1 (12.8)	296	40.9 (13.9)	-0.4 (-1.7 to 1.0)
24 weeks	262	41.6 (13.1)	265	42.7 (15.3)	-1.0 (-2.7 to 0.7)
ALDS (0-100)					
8 weeks	227	80.1 (12.6)	269	81.3 (11.1)	0.0 (-1.3 to 1.2)
16 weeks	301	81.1 (11.9)	297	80.3 (12.7)	0.8 (-0.3 to 2.0)
24 weeks	262	80.6 (12.7)	265	80.2 (12.8)	0.3 (-0.3 to 2.0)
EQ-5D (0-1)					
8 weeks	221	0.66 (0.22)	260	0.67 (0.20)	-0.01 (-0.04 to 0.02)
16 weeks	295	0.66 (0.20)	294	0.65 (0.23)	0.01 (-0.02 to 0.04)
24 weeks	262	0.68 (0.21)	259	0.66 (0.23)	0.02 (-0.01 to 0.05)
FOGQ (0-20)					
8 weeks	221	7.2 (5.3)	265	7.4 (5.3)	-0.1 (-0.6 to 0.4)
16 weeks	302	7.0 (5.3)	295	7.4 (5.4)	-0.2 (-0.8 to 0.4)
24 weeks	262	7.0 (4.9)	264	7.5 (5.5)	0.2 (-0.5 to 0.8)
LAPAQ (MET)					
16 weeks	301	60.3 (55.7)	293	65.4 (64.9)	-1.0 (-15.5 to 13.6)
24 weeks	262	73.4 (91.9)	265	74.9 (86.4)	4.7 (-12.5 to 22.0)
Falls					
24 weeks	329	0.71*	312	0.65*	0.02 (-0.07 to 0.12)

PSI-PD=patient-specific index for physiotherapy in Parkinson's disease. M-PAS=modified Parkinson activity scale. PDQ-39 mobility=Parkinson's disease questionnaire subscale mobility. UPDRS III=unified Parkinson's disease rating scale. TUG=timed up and go test. NHPB=nine hole peg board test. CT=counting task added. SPDSS=self-assessment Parkinson's disease disability scale. ALDS=Academic Medical Center linear disability score. EQ-5D=European quality of life 5 dimensions. FOGQ=freezing of gait questionnaire. LAPAQ=longitudinal aging study Amsterdam physical activity questionnaire. MET=metabolic equivalent of task. *Incidence.

Table 3: Health outcomes

In a post-hoc analysis of patients who were treated by ParkinsonNet physiotherapists versus those who received standard physiotherapy, mean PSI-PD scores

for patients who received standard physiotherapy were 49.9 (SD 22.5) in the usual-care clusters, 48.1 (22.6) in the ParkinsonNet clusters, and 48.9 (20.9) for patients who received ParkinsonNet physiotherapy.

Discussion

The ParkinsonNet system of care was not associated with a change in health outcome over 6 months for patients living in ParkinsonNet clusters. ParkinsonNet was successfully implemented in eight regions in the Netherlands and was associated with indicators of improved quality of care. Specifically, number of patients per therapist was more than two times higher for ParkinsonNet physiotherapists than for generic physiotherapists in usual-care clusters or ParkinsonNet clusters. The proportion of patients who were treated by a trained physiotherapist who worked according to evidence-based recommendations was higher in ParkinsonNet clusters than in usual-care clusters. We also noted an increase in self-reported adherence of physiotherapists to evidence-based recommendations. However, quality of care involves more than these elements, and other features of the quality of care could have been investigated by monitoring the delivery of care by the participating physiotherapists. We decided against this because monitoring might have influenced the behaviour of physiotherapists in both groups.

The ParkinsonNet system of care could be easily implemented and was also associated with reduced costs compared with usual care. However, implementation of ParkinsonNet was not completely successful. Within the ParkinsonNet clusters, only 28% of patients referred for physiotherapy were treated by a ParkinsonNet therapist. Both the referring physicians and the patients chose their therapist. At the start of the trial, many patients were already being treated by a physiotherapist, and not all patients agreed to change to a ParkinsonNet physiotherapist. There were no signs to suggest that variations across centres (eg, differences in organisation or local preferences) affected the referral rates to ParkinsonNet physiotherapists. Furthermore, low referral rates were not due to inability of the ParkinsonNet physiotherapists to cope with increased demand. Likely explanations are increased travel distance (patients might need to travel further to find a ParkinsonNet therapist) or unawareness of ParkinsonNet availability. To reduce the risk of contamination, we limited the promotion of the ParkinsonNet system of care. Nevertheless, the change in referral pattern for one third of patients is substantial. Our experience in the pilot region¹² shows that implementation continues as the network grows, with a steady increase in referral to ParkinsonNet physiotherapists (by about three additional patients per year) after the first year.

We expected that improved quality of care of patients in ParkinsonNet clusters would be reflected by better health outcomes for patients living in these regions.

However, there were no differences in self-perceived disability, functional mobility, and mobility-related quality of life of patients living in ParkinsonNet clusters compared with patients in usual-care clusters.

Several factors might explain the absence of health benefits for patients. One possibility is that therapy delivered by physiotherapists trained to follow the guidelines used in this study⁸ is not more effective than treatment delivered by generic physiotherapists. Most ParkinsonNet physiotherapists in this trial worked according to evidence-based recommendations, but perhaps more intensive training or longer exposure to large numbers of patients is needed to improve the use of interventions such as cueing^{30,31} and cognitive movement strategies.³² Also, only a third of patients in ParkinsonNet clusters were treated by a ParkinsonNet physiotherapist; thus there was limited contrast between study groups. Post-hoc analyses for the subgroup of patients treated by ParkinsonNet physiotherapists also did not show significantly improved health outcomes compared with patients treated by generic physiotherapy. However, the validity and power of this analysis is limited because it was non-randomised, relied on behaviour of participants after random assignment, and might be subject to bias because it compared a subgroup of patients in the treatment group with an unselected group in the usual-care clusters.

Another explanation for the absence of health benefits could be the short interval between implementation and analysis of ParkinsonNet. We started enrolling patients for the trial immediately after the baseline training of physiotherapists to become ParkinsonNet physiotherapists. This interval might not have allowed enough time for the ParkinsonNet physiotherapists to reach adequate specialisation or to treat enough patients to gain a lasting improvement in skills. Finally, Parkinson's disease progression might have attenuated physiotherapy outcomes. Disease progression might necessitate changes in medication, and possible health benefits in ParkinsonNet clusters could have been masked because the effects of physiotherapy reduced the need to increase the dose of antiparkinsonian drugs. However, our analyses showed no differences in levodopa equivalent doses between ParkinsonNet and usual care.

This trial gives no insight into the possible effectiveness of physiotherapy for patients with Parkinson's disease, because similarly large proportions of patients received physiotherapy in both groups. This finding shows that ParkinsonNet does not promote the use of physiotherapy per se; however, it does create system that offers patients the possibility of referral to an expert therapist.

Health-care costs were lower for patients in the ParkinsonNet clusters than for those in usual-care clusters. However, independent confirmation with a trial focusing on costs is necessary to validate these findings. Although the wide confidence intervals suggest that actual cost savings might have been

	ParkinsonNet clusters		Usual-care clusters		Estimated difference (95% CI)
	n	Mean (SD)	n	Mean (SD)	
Physiotherapy	347	297 (325)	334	310 (306)	-2 (-38 to 34)
Medication	350	921 (1319)	340	1018 (1808)	-30 (-265 to 205)
Consultation	344	104 (101)	332	102 (92)	7 (-13 to 27)
Day-hospital rehabilitation	343	195 (730)	332	345 (1258)	-123 (-263 to 17)
Admission to hospital	344	340 (1455)	332	376 (1554)	-16 (-255 to 224)
Home care (paid services)	343	699 (1888)	332	863 (2512)	-85 (-395 to 225)
Informal care	343	400 (1020)	332	696 (2169)	-313 (-554 to -71)
Productivity loss partner	344	15 (99)	334	24 (119)	-10 (-25 to 6)
Total costs					
24 weeks	326	3007 (3452)	325	3799 (5335)	-727 (-1399 to -56)

All values in euros. For each component, the number of patients is shown for whom cost data were collected. For the total costs, the number of patients is shown that had cost data collected for all components.

Table 4: Cost components and total costs

smaller, we believe that some of the cost reduction is real, because we observed savings for most of the different areas of health-care costs.

Most cost savings were from a reduced need for home care and day-hospital rehabilitation. The improved quality of care delivered by community physiotherapists might have removed the need for home and day-hospital rehabilitation, but this needs further study. ParkinsonNet might shift the emphasis of care to the community setting, such that comparable clinical effects can be achieved but with cheaper forms of care. Thus individual patients might have reached the same clinical level but with cheaper methods and better trained health personnel.

We believe further research should be done on the ParkinsonNet system. Since completion of the trial, we have implemented more than 50 additional regional ParkinsonNet networks in the Netherlands, which shows how ParkinsonNet has been accepted. ParkinsonNet could also be used in other countries where the organisation of health care is different and where other funding models are in place. The ParkinsonNet approach is probably most feasible in densely populated areas, because referral to ParkinsonNet physiotherapists could be unacceptable in rural areas because of long travel times. The amount of funding for allied health care might also prevent implementation, for example if patients must pay for part of the costs themselves.

Another potential way to extend the network is by inclusion of other health-care disciplines. All ParkinsonNet networks in the Netherlands now have a selection of trained occupational therapists and speech-language therapists. ParkinsonNet could also be used as a model for the development of networks for patients with other chronic disorders. Interventions that aim to improve the quality of care for patients with chronic diseases, for example new approaches to management

of diabetes³³ and the chronic care model,³⁴ have been assessed. However, we are not aware of comparable studies with a controlled design that investigated the implementation of networks of specialised health professionals. Finally, the availability of ParkinsonNet networks also has scientific potential, for example to assess the benefits of specific health-care interventions for Parkinson's disease.

Contributors

MM and BRB wrote the grant application and supervised all project staff. MM, MJN, SHJK, GK, HWB, RACR, GFB, and BRB contributed to the research design. MM, SHJK, GK, GFB, SO, and BRB selected health outcome measures. MM and MJN monitored study conduct. MJN contributed to implementation of the ParkinsonNet intervention, took responsibility for the education for physiotherapists, and prepared the data. MJN and SHJK supervised research assistants for data collection and managed and developed databases. SHJK contributed to inclusion of participants. SHJK and GK trained research assistants. MM, MJN, SHJK, and BRB trained physiotherapists. GFB did sample-size calculations and cluster randomisation and devised statistical analyses and presentation of the results. EMA contributed to the selection of economic outcome measures, made economic calculations, and devised presentation of economic results. SO did the data analysis. BRB was responsible for the education of neurologists. MM and BRB contributed to writing of the discussion, MJN and SO to the introduction, methods, and results, and SHJK to the methods. MM, MJN, SHJK, and SO reviewed drafts of the article. MM, MJN, GFB, GK, HWB, RACR, EMA, and BRB reviewed the final draft of the article.

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Conflicts of interest

MM has received grants from ZonMw, the National Parkinson Foundation, the Michael J Fox Foundation, and Stichting Robuust. MJN has received grants from ZonMw, the Royal Dutch Society for Physical Therapy, and Stichting Robuust. SHJK has received grants from ZonMw and the National Parkinson Foundation. GK has received grants from ZonMw, the Royal Dutch Society for Physical Therapy, and the International Parkinson Fund. HWB has received grants from ZonMw, the International Parkinson Foundation, and the Van Alkemade-Keuls Foundation. EMA has received grants from ZonMw. SO is a consultant for and has received speaker's fees and travel expenses from UCB. BRB has received grants from ZonMw, the National Parkinson Foundation, and the Michael J Fox Foundation, and is a consultant for GlaxoSmithKline, Boehringer Ingelheim, TEVA, UCB, and Novartis. RACR and GFB have no conflicts of interest.

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