The cost-effectiveness of substituting physicians with diabetes nurse specialists: a randomized controlled trial with 2-year follow-up

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Abstract

Aims. To evaluate the cost-effectiveness of an intervention substituting physicians with nurse specialists.

Background. Increasing populations of people with diabetes in most Western countries require creative solutions that give high-quality chronic care while controlling costs. Instigating nurse specialists as a substitute for physicians yields positive results in this area. Research about such interventions in a hospital-based setting is limited.

Methods. This paper is a report of a study of a randomized, non-blinded clinical trial including people with diabetes mellitus types 1 and 2. In the intervention group nurse specialists were the central carers, providing care that conformed to a preset protocol. Patients were included between 2004 and 2007. Costs, quality of life and adverse events were measured, cost-effect ratios and incremental cost-effect ratios were calculated based on health-resource utilization rates, corresponding market prices and national tariffs from 2007.

Results. Health related quality of life scores did not differ significantly between the control and the intervention group. In the intervention group, fewer patients were hospitalized and fewer side effects from drugs were reported compared to controls. Nurse specialists as central care givers generated a modest reduction in costs per quality adjusted life year gained compared to usual care.

Conclusion. Nurse specialists give diabetes care that is similar to care provided by physicians in terms of quality of life and economic value. Instigating a nurse specialist as central carer yields opportunities to generate cost savings. Developing interventions which also focus on prevention of complications is recommended when aiming for long-term organisational cost savings.

Keywords: clinical effectiveness, clinical nurse specialist, diabetes mellitus, economic evaluation, nursing, quality of life
Introduction

It is estimated that in about 20 years, 336 million people will be suffering from diabetes mellitus worldwide. This number represents a relative increase of 187% since 2000 and equals 4.4% of the total human population. This trend affects mostly Western Countries, and can be attributed to ageing and an increased prevalence of obesity and physical inactivity (Wild et al. 2004). The burden of diabetes on healthcare systems and patients is enormous, financially and otherwise, for it involves treatment of a severe chronic condition that is often aggravated by complications. Diabetes deteriorates the physical condition of patients and strongly invades their lives (Massi-Benedetti 2002). Patients must cope with demanding lifestyle adjustments and cooperation with elaborate medical regimens. The costs of care provided have become more important over the years. Healthcare resources are stretched by the ever growing number of chronically ill patients and there is a growing emphasis on economics, marketing strategies and cost control policies in the healthcare sector (Vrijhoef et al. 2001b). Roughly, these costs can be made up of healthcare costs, patient and family costs and costs in other sectors such as productivity losses (Drummond et al. 2005) or direct and indirect healthcare costs and direct and indirect costs from other sectors, according to Oosterbrink et al. (2000).

Further, the classic healthcare system is based on and designed according to the concept ‘cure’, while diabetes is a chronic, often incurable condition which requires ‘care’ in the broadest sense of the word, involving more than purely medical and pharmacological issues (Wagner et al. 1996). Consequently, changes are made and new policies implemented leaving the current healthcare system in a transitional phase. There is room for improvement in terms of the quality of care that is provided, the quantity of time that is spent on actual care and the ability of healthcare providers to attend to issues outside of the core medical treatment. There is a need for creative solutions to improve the allocation of healthcare resources to better attend to the needs of chronically ill patients, to improve efficiency, divide manpower more suitably and to reduce the strain on financial resources (Vrijhoef et al. 2001a,b).

Background

Skill-mix or shared care approaches view the provision of care as a team effort and focus on the available skills and activities that comprise each role in health care, rather than as individual job titles (Buchan & Dal Roz 2002). Provision of care according to a similar approach can prove beneficial in terms of quality improvement, cost containment and skill shortages (Buchan & Dal Roz 2002, Buchan 2005). Instigating nurse specialists as central carers in diabetes care, positively contributes to the quality of enduring illness care in people with diabetes (Katon et al. 2001, Vrijhoef et al. 2001b,c, Buchan 2005, Ubink-Veltmaat et al. 2005, Taylor et al. 2007) within existing budgets (Steuten et al. 2007). The combination of nursing and medical skills offers a service that is more flexible and comprehensive compared to what physicians can give (Venning et al. 2000). Ubink-Veltmaat et al. (2005) investigated task delegation of diabetes care in a primary care setting. The authors report that this structure of care provision may have a positive effect on quality of care and is feasible in general practice. These conclusions are supported by the findings of an intervention study by Houweling et al. (2009). The results from this study demonstrate that nurse specialists are able to give care for people with diabetes mellitus type 2 that is qualitatively similar to usual care, in terms of HbA1c which is an important clinical parameter in diabetes care. The results demonstrate that diabetes nurse specialists, as central carers, give equally adequate care in terms of achieving standards for medical treatment success.

Further, appear to that nurse-led interventions improve control of clinical parameters in patients, such as improved glycaemic control, which in turn contributes to realizing cost-savings (Gray et al. 2000, Wagner et al. 2001, New et al. 2003). Nurses are less expensive than physicians when considering labour costs (Vrijhoef 2002). Considering this evidence and the findings about increased disease control, nurse-led interventions give opportunities to save on costs. Cost-effectiveness of nurse specialists as central carer in enduring illness care has been investigated by several studies, the majority of which confirm this premise (Raftery et al. 2005). In diabetes care, the results of the randomized controlled study of Houweling et al. (2009) demonstrate that the healthcare costs that were generated in the intervention group (receiving care from a nurse specialist) were less and patient satisfaction was higher, compared to usual care.

Nowadays, the nurse specialist is active in several different medical specialities that involve various types of patients. Regardless of their area of expertise, nurse specialists have to deal with challenging and differing needs of patients and their families, the other medical professionals they collaborate with and the diverse institutions in which they are situated (Scott 1999). Flexibility and adaptability characterize this role. It involves coping with all sorts of changes in the healthcare environment (Payne & Baumgartner 1996). Inspite of their possibilities, nurse specialists have not been
able to exploit their full potential in patient care (Katon et al. 2001).

The study

Aim

The aim of this study is to assess the economic value of diabetes nurse specialists as substitutes for physicians in particular areas in diabetes care and the effect of such a centralized role for nurse specialists on the quality of life of patients. It is hypothesized that nurse specialists will give care that is of least equal quality, and care that will not generate significantly higher costs compared to usual care during the 2-year follow-up.

Design

This study is part of a randomized, non-blinded, clinical trial including people with diabetes mellitus types 1 and 2 who were treated by an internist in an academic hospital in Maastricht, The Netherlands. Analyses of the results in this trial were divided into two sections; a cost-effectiveness study that is discussed herein, and a study by Landewe-Cleuren et al. (2010) in which the effect of this intervention on clinical parameters, i.e. HbA1c, blood pressure, lipids and patients’ satisfaction, by means of the quote-diabetes questionnaire were investigated.

Sample/participants

A convenience sample of four Registered Nurse specialists was recruited for this study. All four nurses had extensive experience in diabetes care. The institution involved has a general academic position in a catchment area of 190,000 people. The specialized nurses were doctoral- or Master’s-prepared Registered Nurses and they could be defined as advanced practice nurses who focus on a specific patient population in a specialized area of nursing practice i.e. diabetes mellitus types 1 and 2 (Scott 1999). The population was made up of people with diabetes from the area of Maastricht, who were under the care of five physicians and two resident endocrinologist (residents in training). The total pool of possible participants consisted of approximately 1200 patients. The patients were included in a hospital-based setting, which implies the inclusion of more complex cases than would have been the case if participants were recruited in a primary care setting. People receiving diabetes care in a hospital-based setting require extensive monitoring and specialist care.

Participants were included during September 2004 and June 2006. Inclusion criteria consisted of decisive factors that necessitated inpatient hospital care. Exclusion criteria comprised situations that require physician care or actions that nurse specialists were not allowed or able to give) which are described in Table 1. Patients that did not fulfil the inclusion criteria were referred back to the internist and excluded. At baseline and during follow-up the following data were gathered: age, gender, body mass index, smoking, HbA1c levels and other diabetes specific clinical parameters. Patients who were considered eligible for participation and who gave written informed consent were enrolled in the study by unrestricted randomization, i.e. drawing lots. Participants in the control group received usual care and were cared for by the five physicians participating in this trial. Participants in the intervention group received care by nurse specialists who worked according to a protocol. Thus, carers and participants were not blinded in this trial. Participants that terminated the trial prematurely for reasons unrelated to the intervention, such as migration, incorrect planning or simply not showing up for any apparent reason, were excluded from analysis. Whenever a reason for premature termination of the trial was not clear, or obviously related to the intervention, the patient remained included. The intention to approach was not applied in this study. All other participants that yielded any data were included.

Ethical considerations

Each patient that was considered eligible by the treating internist was informed verbally about the background and objective of the study and by means of a patient information form. It was made clear by means of a letter that an independent physician was available for further consultation.

Table 1 Inclusion and exclusion criteria

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
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<tbody>
<tr>
<td>Required treatment with either insulin or oral blood-glucose medication combined with one or more of the following conditions: inadequate blood glucose, blood pressure, or lipids – regulation</td>
<td>Disturbed renal function (Creatinine &gt; 180 Mmol/L); Pregnant or planned pregnancy; Treated with continuous subcutaneous insulin infusion; Recent cardiovascular event (&lt; 6 months before inclusion); Co-morbidity necessitating treatment from an internist; Active or recurrent foot ulcer(s); Hypertension that requires treatment including more than four medications</td>
</tr>
</tbody>
</table>
If eligible and willing to participate, participants were asked to sign a patient consent form that included a statement that said the patient was allowed to end his/her participation at any moment, without consequences for the relationship with their treating physician. Participants’ privacy was protected by means of a coding system that was used to encode personal information. The primary researcher had access to these data. Participants were randomly allocated to different treatment groups, which inherently carries the risk of one group receiving care of lesser quality than the other group. Therefore, strict in- and exclusion criteria, before and during the trial were implemented. Further, participants were strictly monitored and continuously supervised by an independent physician. Approval was obtained from the Ethical Review Board of the participating hospital.

Data collection

Data were gathered during a 2-year follow-up including several measurements at different time points, starting off with a baseline measurement ($T_0$). The data were divided into three sections, which relate to the main areas of investigation in this study.

For the economic evaluation, quality of life was measured. These data were gathered by means of the EQ-5D generic health index (Jenkinson et al. 1997, Euroqol 2010) at baseline ($T_0$) and after 2 years of follow-up ($T_2$). The EQ-5D provides an indication of the quality of life of the respondent. The questionnaire used in the study comprised five dimensions of health: mobility, self-care, usual activities, pain/discomfort and anxiety/depression, which each consist of three levels; no problems, some/moderate problems and extreme problems (Jenkinson et al. 1997). Costs were calculated retrospectively by means of healthcare resource utilization data and national tariffs for hospital-based care. Data on costs were gathered during and after the trial by means of electronic medical records and were categorized into different categories; direct costs and overall costs. Further details about these categories are discussed in the next section. These data were gathered by means of tallying the number of outpatient visits and diabetes-related clinical admissions in the department of internal medicine (endocrinology) and in all other relevant specialties that were documented in participants’ medical records. Next, the costs of particular resources were multiplied by the number of times each resource was utilized in each group to acquire the total costs per category, per group. The Dutch healthcare system is financed by means of the DBC system. DBC’s are diagnosis treatment codes which form the basis for this system (Oosterbrink 2006). Each code corresponds with a certain tariff, which covers the average care package of one patient including all the activities needed for the treatment of that patient. For example, a regular outpatient visit with a nurse specialist in diabetes care of a patient without complications costs €482 at the time this study was conducted. This price includes all activities and resources used to carry out an outpatient visit. Data on diabetes-related complications were also gathered because this influences the exact price per activity (complications increase the total expenses). Healthcare practitioners bill the expenses per patient by means of these codes (NZA 2007).

The primary outcome consisted of costs directly related to actions and decisions made by the nurse specialist. This category was indicated as ‘direct costs’, not to be confused with ‘direct costs’ as described in the literature (e.g. by Oosterbrink et al. (2000)). Instead, this category comprised costs generated by activities that can be directly attributed to the actions and responsibilities of the responsible carer. Treatment options for nurse specialists were limited compared to physicians; nurse specialists were authorized to schedule their own appointments and referrals, yet only allowed to refer to a dietician, a regular diabetes nurse and an ophthalmologist. Further, diabetes-related clinical admissions in the department of internal medicine were also included in this category. To perform a meaningful comparison, this category did not include costs resulting from actions and decisions the nurse specialist was not authorized to decide on. An example of such exclusion is the cost of an outpatient visit in the department of cardiology resulting from a referral to a cardiologist. If a patient required such specialist care, he would have been referred by one of the participating physicians.

For a more comprehensive evaluation, ‘overall costs’ were calculated. These data included costs generated by the patients’ resource utilization (outpatient consultations and clinical admissions) in all specialties relevant for care of people with diabetes. The specialties considered relevant for this group of patients are: internal medicine, cardiology, dermatology, gastroenterology, general surgery, ophthalmology, rehabilitation and urology. However, since nurse specialists are not allowed to refer patients to these specialties, they are not directly responsible for the costs that are generated as a result. Still, from a clinical and economical point of view these costs are relevant for patients in this setting. To give a more comprehensive idea of the financial consequences of diabetes care in both groups, this category was included.

Adverse events (events that have negative effects for the wellbeing of participants and costs) were registered per patient visit by the participating physicians and nurse specialist. These events include successively: consultation of
a general practitioner by the patient or separate referral of a patient by a general practitioner (possibly indicating lack of monitoring of the patient), occurrence of hypoglycaemic events in participants (possibly indicating lack of control by means of medical treatment), adverse effects of medications, hospital admission of a patient, death of a patient and consultation of an internist in the case of nurse specialists.

Data analysis

For the analysis, SPSS version 15.0 (SPSS, Maastricht, the Netherlands), was used. Participants’ characteristics at baseline were compared by means of independent-sample t-tests (continuous variables) and chi-square tests for independence (categorical variables) (Pallant 2007). Mean EQ-5D scores were compared at baseline by means of an independent t-test. The mean EQ-5D scores were compared between the control group and intervention group over time with a mixed between-within ANOVA analysis. Differences in direct costs and overall costs between groups were analysed by means of an independent sample t-test. The differences in costs and utility between groups were analysed and cost-effect ratios (CER) and incremental cost-effect ratios (ICER) were calculated for both cost categories. The CER reflects the cost per a certain level of utility. The ICER indicate the increase or decrease in costs per quality-adjusted life year (QALY). Adverse events were analysed by using descriptive statistics. In addition, the percentage of participants that developed complications during the trial was calculated for both groups.

Validity and reliability

The study was executed in the Netherlands, thus results with regard to costs in this trial were based on local and national tariffs. The primary outcome, the EQ-5D questionnaire, consisted of a validated and reliable measurement tool. Clinical parameters were similar to the measurements that are taken in usual care. Further, this trial was executed in a hospital-based setting, involving more complex cases of diabetes mellitus compared to cases managed in a primary care setting. The sample of participants consisted of people with diabetes mellitus type I and II. The only requirement for inclusion was treatment with either insulin or oral blood-glucose medication combined with one or more of the following conditions: inadequate blood glucose, blood pressure or lipids-regulation. Participants that experienced more severe complications such as disturbed renal function, continuous subcutaneous insulin infusion, pregnancy, a recent cardiovascular event, severe comorbidity requiring treatment of an internist, active/recurrent foot ulcers were excluded. These criteria were formulated to guarantee a more homogenous study population and to exclude participants that required stricter monitoring than could be provided during the trial, due to the exacerbation of their condition. In a broader perspective, the results are generalizable to enduring illness care, concerning participants that require extensive and regular monitoring in a hospital-based setting. Adverse events with regard to clinical parameters were closely monitored by an independent physician and if exclusion criteria were met, participants were excluded and if in the care of a nurse specialist, referred back to an independent internist.

Sample size and power analysis

A power analysis for this clinical trial was performed based on the primary outcome of the trial; successful treatment defined as the proportion of participants fulfilling certain criteria about the physical state of participants (HbA1c and cholesterol levels, blood pressure) and their satisfaction with treatment. Per study arm, 170 participants were required (balanced design) to reject the null hypothesis of inferiority (id est.: the lower border of the 95% confidence interval of the relative risk excludes 0·60) with a power of 80% and a probability of type I error of 5% (one-sided), assuming a success rate of 30% in the control group (which was based on previous experience).

Results

Participant enrolment and drop-outs

Possible participants were enrolled in September 2004, January 2005 and May 2005 and the trial period was completed after 2 years of follow-up; at September 2006, January 2007 and May 2007, respectively. Based on the total patient pool of 1200 individuals, which consisted of all people with diabetes treated by physicians, 818 patients were found ineligible or refused to participate and 337 were considered eligible. The flow chart depicted in Figure 1 visualizes the inclusion trajectory of the trial. Of the original group of 337 enrollees, 43 participants (12·8%) dropped out due to reasons not related to the intervention and were excluded from analysis. The number of drop-outs is similar in the intervention group and the control group. Out of all the participants in the intervention group, nine participants were referred back to the internist or general practitioner. In the total group of participants, nine died of causes not directly attributable to diabetes mellitus type 2 or cardiovascular...
disease. In total, 294 participants were included for analysis, 145 randomized in the intervention group, and 285 participants (84.5%) completed the follow-up period.

Both groups did not differ with regard to in general characteristics at baseline. Similar mean scores were found for EQ-5D scores, HbA1c levels, body mass index values and age. Both the intervention group and the control group comprised equal numbers of males and females, smokers and non-smokers (Table 2). The percentage of participants with diabetes-related complications was higher in the intervention group (47%) than in the control group (42%).

Outcomes

**EQ-5D scores**
The primary results of the independent t-test showed no statistically significant differences between mean EQ-5D scores in the intervention group and the control group at baseline ($P = 0.14$) (Table 2). Results of the mixed between-within ANOVA analysis demonstrated that there was no statistically significant interaction effect found between the type of intervention (nurse specialist or usual care) and time ($P = 0.37$) (not pictured). EQ-5D scores remained similar over time in both groups demonstrating an equal non-significant decrease ($P = 0.06$) (not pictured).

**Resource utilization and costs**
A total of 1003 outpatient consultations with the nurse specialist were recorded in the intervention group or 224.5 (SD 93.3) minutes of consultation time on average per patient, compared to a total of 769 outpatient consultations with an internist or 85.8 (SD 38.5) minutes of consultation time on average per patient in the control group ($P < 0.05$, not shown).

The incremental cost-effect ratio demonstrates that the intervention yields a €361 reduction in direct costs per QALY gained, compared to usual care. Further, the ratio for overall costs shows a €2034 increase per QALY gained. The cost-effect ratios present rather similar figures, showing minimal differences in costs. These differences proved non-significant (Table 3).

With regard to the direct costs and the overall costs, the exact findings are demonstrated in Table 4. Although absolute differences were found, none of the cost categories proved significantly different between the intervention and the control group.
Cost-effective ratio’s

### Table 3 Costs and effects of the intervention including the CER and ICER cost-effective ratio’s

<table>
<thead>
<tr>
<th></th>
<th>Costs (€)</th>
<th>Effects (utility; QALY)</th>
<th>CER (€/QALY)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direct (€1)</td>
<td>Overall (€2)</td>
<td>€1/QALY</td>
</tr>
<tr>
<td>Intervention group</td>
<td>5861.0</td>
<td>7841.3</td>
<td>0.80</td>
</tr>
<tr>
<td>Control group</td>
<td>5933.8</td>
<td>7430.5</td>
<td>0.82</td>
</tr>
<tr>
<td>Incremental (Δ) costs</td>
<td>-72.84</td>
<td>410.79</td>
<td>0.02</td>
</tr>
</tbody>
</table>

### Table 4 Results independent-sample T-test for the different cost categories

<table>
<thead>
<tr>
<th></th>
<th>Intervention group</th>
<th>Control group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs internal medicine* (£)</td>
<td>4285.5 (2199.9)</td>
<td>4864.6 (2899.8)</td>
<td>0.06</td>
</tr>
<tr>
<td>(outpatient consultations)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct costs* (£)</td>
<td>5861.0 (5635.8)</td>
<td>5933.8 (3299.8)</td>
<td>0.90</td>
</tr>
<tr>
<td>Overall costs* (£)</td>
<td>7841.3 (7430.5)</td>
<td>7430.5 (4506.2)</td>
<td>0.60</td>
</tr>
</tbody>
</table>

*Mean (SD).

### Discussion

The primary goal of this study was to further explore the possibilities of nurse specialists as a central carer in the provision of hospital-based diabetes care. In terms of their economic value and the effect of such an intervention on patients’ quality of life. The hospital-based setting resulted in the inclusion of patient groups that comprise the more complex cases of diabetes, requiring extensive care, in terms of quality of care and costs.

### Limitations of the study

Several methodological limitations of this study need to be acknowledged. Convenience sampling was carried out rather than purposive sampling. Although patients were randomized, only diagnosed patients receiving treatment in this particular hospital were considered. Blinding of participants and carers was practically impossible. However, the researchers were blinded with regard to allocation. The analysis was performed on patient level, possibly indicating level of analysis error, for the intervention also differentiates between the carers involved and type of care made available. The intention to treat approach was not applied; however, this did generate extensive data on non-responders. The study

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Discussion of results

The results of this study suggest that nurse specialists give care comparable to care provided by physicians in terms of quality of care and disease control. Prevalence of diabetes-related referrals to medical specialists by the GP was lower in the intervention group. This indicates that care of sufficient, quality was provided by nurse specialists including adequate diabetes control, making mediation or interference by another healthcare professional redundant. Another explanation could be sought in possible selection bias; however, this can be regarded unlikely considering comparable patient characteristics at baseline. Moreover, the participants’ personal and clinical characteristics did not differ significantly at baseline no serious consequential effects are expected. Therefore, the significance of the results should not be underestimated and can be attributed primarily to the intervention. The follow-up of 2 years yielded comprehensive data, comprising most health-related costs of hospital-based diabetes care including a possible time-lag or accumulation in healthcare resource utilization and the subsequent invoice.

Discussion of results

The results of this study suggest that nurse specialists give care comparable to care provided by physicians in terms of quality of care and disease control. Prevalence of diabetes-related referrals to medical specialists by the GP was lower in the intervention group. This indicates that care of sufficient, quality was provided by nurse specialists including adequate diabetes control, making mediation or interference by another healthcare professional redundant. Another explanation could be sought in possible selection bias; however, this can be regarded unlikely considering comparable patient characteristics at baseline.

In terms of economic consequences of this intervention, there were several categories of costs considered, none of which differed significantly. The intervention group did accumulate higher overall costs compared to the control group. However, delegating tasks to nurse specialists may give opportunities to decrease costs. This could be explained by baseline differences in the prevalence of diabetes-related complications, which were found to be higher in the intervention group hence generating higher healthcare costs. The actual economic value of nurse specialists was expressed in the economic evaluation of ‘direct costs’, representing the direct actions and responsibilities of the nurse specialists, that were spent to gain quality of life. Further, nurse specialists provided quantitatively more care while using fewer financial resources. The results of the evaluation indicate that an intervention with a central role for a nurse specialists generates a small decrease in costs (certainly does not increase costs) per QALY gained compared to usual care. The intervention was not specifically designed to reduce resource utilization and costs, thus this is a satisfactory result.

Economic gain was also achieved due to the difference in reimbursement between nurse specialists and medical specialists. Delegating more patient care to nurse specialists might generate substantial cost savings, while patients have more face-to-face contact with their healthcare provider. Hence more time is available for the development and monitoring of self-management skills and non-medical issues, improving disease control which in the long term can generate cost-savings.

These results complement and strengthen the preliminary results yielded by analyses of clinical parameters in participants (i.e. HbA1c and cholesterol levels, blood pressure) enrolled in this trial (not presented herein) which also demonstrated that diabetes nurse specialists as central carers provided equally adequate care in terms of achieving standards for medical treatment success and were more appreciated by patients, compared to usual care. This indicates that nurse specialists give high-quality care and that they are fully capable as central carer in diabetes care. Previous reports have provided extensive evidence supporting nurse specialists as central carers in enduring illness care in different areas such glycaemic control and monitoring, cardiovascular risk factors, patient satisfaction (Katon et al. 2001, McKee et al., 2006, New et al. 2003, Ramsey et al. 1999, Renders et al. 2001, Scott 1999, Taylor et al. 2007; Thompson et al. 1999, Venning et al. 2000, Wagner et al. 2001, Wagner et al. 2007) and overall quality of care (Ubink-Veltmaat et al. 2005). Few randomized controlled trials about nurse-led interventions included financial aspects of the intervention or calculated cost-effectiveness ratios. In diabetes care, the study of Houweling et al. (2009) previously caregivers similar results during a shorter follow-up period of 12 months in only type 2 patients, with regard to clinical parameters. The authors reported that fewer healthcare costs were generated and increased patient satisfaction was achieved, in the intervention group. Complementary to these results, this study
What is already known about this topic

- Nurse specialists are established members of the healthcare team, especially in standardized chronic illness care.
- The specific capabilities and skills of this group of healthcare professionals create opportunities in terms of a more centralized role with additional responsibilities, contributing to more adequate, high quality chronic illness care.

What this paper adds

- The health-related quality of life of people with diabetes who have a nurse specialist as their primary caregiver is comparable to the quality of life of patients who receive usual care, which is provided mainly by physicians.
- Nurse specialists as central carers give a higher quantity of care, while utilizing no more financial resources. Further, instigating a nurse specialist as a central carer yields opportunities to generate cost savings on the long term.
- Nurse specialists are a cost-effective alternative to physicians in providing hospital-based diabetes care.

Implications for practice and/or policy

- This study underlines the potential of nurse specialists as central carers in hospital-based diabetes care and it emphasizes the additional value of allocating tasks and responsibilities in a way that is more relevant in enduring illness care. Thus, providing policy makers with incentives to explore the possibilities of involving nurse specialists in this particular role.
- The results of this study suggest that comparable initiatives involving nurse specialists as central carers can be expected to be cost-effective, also providing opportunities to achieve further cost reductions in the long term. Hence, stimulating the integration of nurse specialists as central carers in diabetes care practice.

What this study suggests is that nurse specialists are more than capable of taking a centralized role, including more responsibilities, which is reflected by these results.

Conclusion

Increasing numbers of chronically ill people with diabetes strain the current healthcare system require creative solutions and improvements in terms of quality of care. New global recommendations advise a more holistic approach providing care by means of multidisciplinary teams (McGill & Felton 2007). The results of our study suggest that nurse specialists are more than capable of taking a centralized role in these teams, which is in accordance with earlier findings (Vrijhoef et al. 2001b, Vrijhoef 2002, Steuten et al. 2007). Furthermore, instigating a nurse specialist as the central carer provides opportunities to achieve cost reductions. In chronic illness care there appears to be a niche that fits healthcare professionals who are able to give comprehensive, intricate, high-quality care and for which the skills and knowledge of physicians are not necessarily required. These resources could therefore be allocated elsewhere. At the same time, economic considerations demand more attention for cost reductions, not in the least due to the increasing number of patients who are chronically ill. These patients require life-long care, thus they generate high costs. Structural improvements such as substitution by nurse specialists or reallocation of healthcare resources offers realistic prospects in this area. Future research is needed to further explore these possibilities by means of interventions specifically designed for such purposes; optimizing experienced complications and to €6,699 in case of no complications. In order to increase cost-effectiveness of reallocating tasks in diabetes care, it is specifically recommended to investigate cost-reducing effects of similar interventions focusing on the prevention of diabetes-related complications.

Overall, nurse specialists give care of comparable quality that yield similar levels of quality of life in patients with diabetes mellitus type I and II. This is in consensus with the findings in a primary care setting by Vrijhoef et al. (2001b), Steuten et al. (2007) and Buchan (Buchan 2005) and in a hospital-based setting by Houweling et al. (2009) among others. Further, while providing quantitatively more care in terms of consultations and face-to-face contact fewer resources are spent. This potential is not exploited, although current enduring illness care requires the development of initiatives that better adhere to the needs of chronically ill patients. In addition, the training, skills and experience of nurse specialists seem to be appropriate for adequate diabetes control and the safeguarding of high-quality care while fulfilling a centralized role, including more responsibilities, which is reflected by these results.
allocation of available resources to achieve cost reductions, relief of the workload or resolving a shortage in healthcare professionals.

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Conflict of interest

No conflict of interest has been declared by the authors.

Author contributions

EEAA, SANTL, NCS and HJMV were responsible for the study conception and design. EEAA and SANTL performed the data collection. EEAA performed the data analysis. EEAA and HJMV were responsible for the drafting of the manuscript. EEAA, SANTL, NCS and HJMV made critical revisions to the paper for important intellectual content. NCS and HJMV provided statistical expertise. NCS and HJMV provided administrative, technical or material support. NCS and HJMV supervised the study.

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