Patient Education and Counseling xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Patient Education and Counseling

journal homepage: www.elsevier.com/locate/pateducou

Health Care

The role of disease management programs in the health behavior of chronically ill patients☆

Jane Murray Cramm, Samantha A. Adams, Bethany Hipple Walters, Apostolos Tsiachristas, Roland Bal, Robbert Huijsman, Maureen P.M.H. Rutten-Van Mölken, Anna Petra Nieboer *

Institute of Health Policy and Management, Erasmus University, Rotterdam, The Netherlands

ARTICLE INFO

Article history:
Received 14 March 2013
Received in revised form 11 December 2013
Accepted 23 December 2013

Keywords:
Chronic care
Disease management
Quality of life
Integrated care
Health behavior

ABSTRACT

Objective: Investigate the effects of disease management program (DMP) implementation on physical activity, smoking, and physical quality of life among chronically ill patients.
Methods: This study used a mixed-methods approach involving qualitative (35 interviews with project managers) and quantitative (survey of patients from 18 DMPs) data collection. Questionnaire response rates were 51% (2010; 2619/5108) at *T*0 and 47% (2011; 2191/4693) at *T*1.
Results: Physical activity and the percentage of smokers improved significantly over time, whereas physical quality of life declined. After adjusting for patients' physical quality of life at *T*0, age, educational level, marital status, and gender, physical activity at *T*0 ($p < 0.01$), changes in physical activity ($p < 0.001$), and percentage of smokers at *T*0 ($p < 0.05$) predicted physical quality of life at *T*1. Project managers reported that DMPs improved patient–professional interaction. The ability to set more concrete targets improved patients' health behaviors.
Conclusions: DMPs appear to improve physical activity among chronically ill patients over time. Furthermore, (changes in) health behavior are important for the physical quality of life of chronically ill patients.
Practice implications: Redesigning care systems and implementing DMPs based on the chronic care model may improve health behavior among chronically ill patients.

1. Introduction

Populations are aging, and unhealthy lifestyles and chronic diseases are becoming more prevalent [1,2]. The rapid increase in the prevalence of chronic illness has increased the demand for health care services and constrained the organization and delivery of chronic care [3–5]. Because health care systems have historically been organized around acute care, many organizations are struggling to improve the quality of chronic care delivery and effectively manage the health behaviors of chronically ill patients [6–13]. Health behaviors such as smoking and physical inactivity are important risk factors for many chronic diseases and leading causes of death and disability [14]. While little is known about how to best improve health behaviors of chronically ill patients in the primary care setting [15–19], we do know that effective and high-quality chronic care, including preventive health behavior interventions that actively involve chronically ill patients and improve their quality of life, is needed [20].

Comprehensive system changes, rather than simply implementing sole interventions or adding new features to the existing acute-focused system, are needed to provide effective and high-quality chronic care [9–13]. The chronic care model (CCM) guides quality improvement in chronic care delivery by providing a framework of how primary health care practices can change their care delivery from acute and reactive care to chronic and proactive care that is organized, structured, and planned, through a combination of effective multidisciplinary teams and planned interactions with chronically ill patients [1]. These steps, such as providing self-management support, effective use of community resources, integrated decision support for professionals, and the use of patient registries and other supportive information technology, are expected to result in a stronger provider–patient relationship as well as improved health behavior [1,13].

The application of integrated care models, such as disease management programs (DMPs) based on the CCM, is believed to improve patients' health behavior. In several recent studies,

* Corresponding author at: Institute of Health Policy and Management, Erasmus University Rotterdam, Postbus 1738, 3000 DR Rotterdam, The Netherlands.
E-mail address: cramm@bmg.eur.nl (A.P. Nieboer).

0738-3991/$ – see front matter © 2014 The Authors. Published by Elsevier Ireland Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.pec.2013.12.017

researchers have examined the effectiveness of care delivery based on the CCM and reported promising but inconclusive results [21–24]. Pearson and colleagues [22] found evidence suggesting that the CCM is a useful framework for quality improvement (e.g., positive changes in proactive follow-up, patient registries, capacity to support care management decisions). A meta-analysis conducted by Tsai and colleagues [23] provided strong evidence that the CCM led to significant improvements in process outcome measures (e.g., number of prescribed medications, number tested for hemoglobin A1c level) and clinical outcomes (e.g., number with hemoglobin A1c level $>$ 7%). Other researchers have found indications that programs based on the CCM prevent disease complications [24]. These studies, however, did not report the effects of such programs on patients' health behavior over time. Therefore, this study aimed to investigate the effects of DMP implementation on improved physical activity and smoking cessation among chronically ill patients. Since health behaviors are expected to affect physical quality of life this study additionally aimed to investigate the effects of (changes in) smoking and physical activity on physical quality of life.

2. Methods

We used a concurrent, nested mixed-methods approach to describe DMPs [25]. The data are mixed during the analytical phase to broaden the scope of understanding of the topic examined. As described in our study protocol [26], the results of qualitative and quantitative analyses were compared and contrasted to enrich our interpretive ability.

2.1. Participants

A national program on "disease management of chronic diseases" provided funding for practices planning a redesigning of care based on the CCM. Requirements of the national program were that the practices had to have some experience with the delivery of chronic care and were equipped to implement systems needed for the delivery of high quality chronic care. This resulted in the inclusion of 22 DMPs (out of 38). These DMPs can be considered to be among the leaders of chronic care delivery in the Netherlands. Patients enrolled in these practices receive high quality care. It was not possible to recruit proper control patients from the same practices because implementing a DMP requires redesigning the care delivery structure, which affects all patients in a practice. Also we were not able to find control or comparison groups for all chronic diseases in other regions. This study included patients participating in 18/22 DMPs based on the CCM that were implemented in various Dutch regions. Four DMPs were excluded due to (1) a small sample ($<$15 patients), (2) delayed questionnaire distribution resulting in incomplete data, (3) inclusion of hospitalized patients rather than community-based primary care patients, and (4) slightly different questionnaire content to address a specific mental health condition. The 18 DMPs were characterized as collaborations between care sectors (e.g., between general practitioners and hospitals) or within primary care settings (e.g., among pharmacists, physiotherapists, dieticians, social workers), and by the population targeted: patients with cardiovascular diseases (n = 9), chronic obstructive pulmonary disease (n = 4), heart failure (n = 1), comorbidity (n = 1), and diabetes (n = 3). See the appendix for a detailed overview of the interventions implemented in each DMP.

In 2010 ($T0$), most DMPs had finished developing interventions based on the CCM [e.g., information and communication technology (ICT) systems, training of professionals, care protocols, redistribution of tasks] and had started to enroll patients. The CCM incorporates flexibility in the implementation of interventions; thus, all DMPs incorporated the elements of the CCM in varying contexts and to various extents. The most common interventions aiming specifically to improve the health behavior of DMP participants were: the use of individual care plans with personal goals, tailored interventions for smoking cessation and the improvement of physical activity, patient education, patient training in active participation and self-management, the use of personal coaches/counselors, and the facilitation of self-monitoring.

This study was approved by the Ethics Committee of Erasmus University Medical Center, Rotterdam (September 2009).

2.2. Survey administration

At $T0$, questionnaires were distributed to 5108 patients participating in the 18 DMPs and completed by 2619 respondents (51% response rate). One year later ($T1$), questionnaires were distributed to 4693 patients still participating in the 18 DMPs and completed by 2191 respondents (47% response rate). A total of 1447 patients completed questionnaires at both $T0$ and $T1$.

2.3. Outcomes

Patients' physical quality of life was assessed using the physical component of the Short Form 36 Health Survey [27,28]. Selected items and weights derived from the general Dutch population were then used to score the physical quality of life component [29], with higher scores indicating more positive ratings.

We assessed background characteristics such as age, gender, marital status and education. Patients' educational levels were assessed on six levels ranging from 1 [no school or primary education ($\leq$7 years)] to 6 [university degree ($\geq$18 years)]. We dichotomized this item into low (no school or primary education) or high (more than primary education) educational level.

Physical activity was assessed by asking respondents how many days per week they were physically active (e.g., sport activities, exercise, housecleaning, work in the garden) for at least 30 min. This question comes from the SQUASH instrument (Short QUestionnaire to ASses Health enhancing physical activity). It was developed in the Netherlands and has been validated using an accelerometer. The scores on the SQUASH are considered to be sufficiently reliable and valid to measure the level of physical activity of a healthy adult population [30] and among patients after total hip arthroplasty [31]. Government agencies use this instrument to monitor physical activity of the Dutch population. We used mean physical activity measured in number of days per week in our analyses. In addition, we dichotomized the physical activity scale according to the Dutch Standard for Healthy Physical Activity into 1 (at least 30 min of physical activity at least five times per week)] or 0 (at least 30 min of physical activity less than five times per week) [32], to compare the proportion of physically active patients with the Dutch average. Self-reported current smoking was assessed with a yes/no question.

2.4. Statistical analyses

We used descriptive statistics to describe the study population. Two-tailed, paired t-tests or chi-squared tests were used to investigate improvements in patients' health behavior and physical quality of life over time (difference between $T0$ and $T1$). Changes in patients' physical quality of life and health behaviors were compared among DMPs with different chronic conditions using analysis of variance or chi-squared tests. We employed a multilevel random-effects model to investigate the predictive role of (changes in) health behavior on patients' physical quality of life while controlling for patients' physical quality of life

Please cite this article in press as: Cramm JM, et al. The role of disease management programs in the health behavior of chronically ill patients. Patient Educ Couns (2014), http://dx.doi.org/10.1016/j.pec.2013.12.017

at *T*0, age, gender, educational level, and marital status. SPSS version 20 (IBM) was used for these statistical analyses. In addition, we tested the final full model on imputed data (10 imputed datasets based on approximately 14,470 observations using the Monte Carlo Markov Chain (MCMC) method) using SAS. Results were considered statistically significant if two-sided *p* values were ≤ 0.05.

2.5. Qualitative data collection and analysis

For the qualitative part of the study, semi-structured interviews (see appendix for a topic list) of 45–60 min were held with managers of the 18 DMP projects (four projects were part of a qualitative sub-study and followed a different interview schedule and scheme). Interviews were held at the beginning and end of the project; one project manager declined the follow-up interview, which led to a total of 35 interviews.

The interviews were used to gather information about how the DMPs contributed to healthier behavior among patients. We chose to examine this from the provider perspective because many of the sites implemented changes that were not necessarily seen by patients (such as ICT systems) or were broader than the patient population (such as a community health market). Project managers (providers) were therefore best positioned to indicate what processes were in place through the disease management program (both the work visible to patients and the work often invisible to patients) to improve patient care.

All interviews were recorded with permission and transcribed verbatim. The transcripts were coded inductively and ordered thematically on coding sheets by author BJHW. Each interview transcription, project plan, and document was first read closely to establish general knowledge of the data. Each piece of data was then reread and coded into themes, based on the content. A memo sheet was made for each theme. Our chosen method of inductive analysis provided the opportunity to map the themes back to literature on disease management, ICT systems, and self-management. The quotes selected for this paper were selected by author BJHW and also analyzed by author SA.

3. Results

3.1. Quantitative analysis

Table 1 displays the baseline characteristics of patients who completed questionnaires at both *T*0 and *T*1. Of the 1447 respondents, 47% were female, 38% had a low educational level, and 29% were single. Mean age was 65.48 ± 9.96 (range, 20–98) years.

We compared baseline characteristics of the 1447 participants who completed both questionnaires to those who completed *T*0 only. No difference in physical quality of life, smoking, gender, educational level, or marital status was found. On average, respondents who completed both questionnaires were older (65.48 ± 9.96 vs. 63.94 ± 11.01 years; $p < 0.001$) and more active (4.93 ± 2.05 vs. 4.68 ± 2.24; $p < 0.01$) than those who completed one questionnaire.

Table 1
Characteristics of patients participating in disease management programs at *T*0.

Mean age (years)	65.48 ± 9.96 (20–98)	*n* = 1370
Gender (female)	47%	*n* = 1411
Marital status (single)	29%	*n* = 1435
Low educational level	38%	*n* = 1373
Physical quality of life (SF-36)	42.44 ± 10.10 (11–64)	*n* = 1392
Physical activity	4.93 ± 2.05 (0–7)	*n* = 1207
Percentage of current smokers	25%	*n* = 1402

SF-36, Short Form 36 Health Survey. Data are expressed as mean ± standard deviation (range) or percentage. Analyses included respondents who completed questionnaires at both *T*0 and *T*1 (*n* = 1447).

Table 2
Predictors of physical quality of life (SF-36) at *T*1 (2011), as assessed by multilevel random-intercepts regression analyses (*n* = 931).

	B	SE	*β*	SE
Constant	12.90	1.99	41.67	0.24
Physical quality of life (SF-36) at *T*0	0.75***	0.02	7.78***	0.24
Age at *T*0	−0.07**	0.02	−0.71**	0.22
Marital status (single) at *T*0	0.09	0.51	0.04	0.23
Low educational level at *T*0	0.72	0.47	0.35	0.23
Gender (female) at *T*0	−0.32	0.46	−0.16	0.23
Physical activity at *T*0	0.41**	0.13	0.87**	0.28
Changes in physical activity (*T*1 − *T*0)	0.42***	0.13	0.88***	0.27
Smoking (yes/no) at *T*0	−1.43*	0.60	−0.62*	0.26
Quit smoking	0.95	0.83	0.25	0.25

SD, standard deviation; SE, standard error; SF-36, Short Form 36 Health Survey; *T*0, baseline (2010); *T*1, follow-up (2011). Multilevel analyses included respondents who completed questionnaires at both *T*0 and *T*1 (*n* = 1447). Listwise deletion of missing cases resulted in the inclusion of 931 cases in the multilevel regression analyses.
* $p \leq 0.05$ (two-tailed).
** $p \leq 0.01$ (two-tailed).
*** $p \leq 0.001$ (two-tailed).

Patients' physical activity scores improved significantly from *T*0 (mean, 4.93) to *T*1 (mean, 5.24; $p < 0.001$). The percentage of patients meeting the Dutch standard for healthy physical activity also increased significantly from *T*0 (63.7%) to *T*1 (68.5%; $p < 0.001$), while the percentage of current smokers decreased significantly (25.0% vs. 17.8%; $p < 0.001$). Patients' physical quality of life declined significantly from *T*0 (42.51) to *T*1 (41.78). Changes in patients' physical quality of life ($F_{group} = 0.934$; $p = 0.443$), mean physical activity ($F_{group} = 0.377$; $p = 0.825$) did not vary among DMPs aimed at different conditions. We did find a difference in the percentage of patients that quit smoking across diseases ($p < 0.01$). The percentage of cardiovascular patients that quit smoking was 6% (out of 637 patients), COPD patients 11% (out of 319 patients), diabetic patients 7% (out of 178 patients), heart failure patients 0% (out of 20 patients) and patients with comorbidity 3% (out of 88 patients).

The results of multilevel analyses (*n* = 931) are displayed in Table 2. After adjusting for patients' physical quality of life at *T*0, age, educational level, marital status, and gender, these analyses showed that the mean number of days per week with more than 30 min of physical activity at *T*0 ($p < 0.01$), changes in physical activity ($p < 0.001$), and percentage of smokers at *T*0 ($p < 0.05$) predicted patients' physical quality of life at *T*1. Higher levels of physical activity at *T*0 were related to better physical quality of life at *T*1 ($B = 0.41$), and the addition of 1 day of physical activity between *T*0 and *T*1 improved physical quality of life ($B = 0.42$), assuming that all other factors in the model remained constant. Multilevel analyses on imputed data showed similar results. Results based on imputed data showed that after adjusting for patients' physical quality of life at *T*0, age, educational level, marital status, and gender, physical activity at *T*0 ($p < 0.05$), changes in physical activity ($p < 0.01$), and percentage of smokers at *T*0 ($p < 0.05$) predicted improved physical quality of life at *T*1.

3.2. Qualitative analysis

In agreement with the results of the quantitative analysis, the qualitative research showed that project managers felt DMPs had contributed to healthier behaviors in patients, especially with regard to smoking cessation.

Please cite this article in press as: Cramm JM, et al. The role of disease management programs in the health behavior of chronically ill patients. Patient Educ Couns (2014), http://dx.doi.org/10.1016/j.pec.2013.12.017

3.3. How DMPs contributed to healthier behavior

Most respondents indicated that DMP implementation had changed the form of provider–patient interactions. Professionals within practices made more concrete attempts to engage with the "person" rather than the patient. This change was reflected in small things that might initially seem to be irrelevant to direct care, such as being courteous to patients in the waiting room, but also in the nature of consultation. DMPs made more systematic use of motivational interviewing, leading to the development of more concrete action plans with patients that specified physical activities and clearly defined targets. This shift was described by several project managers:

> "The change from 'doctor knows best' to making an individual care plan and trying to motivate more people to make changes for themselves. That you move away from the idea that there is only one way to effect change. That's what I see as the major shift. It's a different way of thinking." (Project Manager E)

> "At one point it stopped at [general advice]. We gave the advice: you need to lose weight, move more, take certain medications, etc. But then it was up to the patient to figure out the rest and that's where it often went wrong. We noticed that if you came back a year later, the advice had been given but actually nothing had changed. We didn't have what was necessary to support the patient. . . .. [Now we have] a lifestyle advisor, physiotherapist, dietitian and regular quarterly meetings with the patient to see if goals are being met." (Project Manager A);

> ". . . using motivational interviewing techniques, it's the patient who should talk first. If your reaction is that you are concerned about the patient's health if s/he does not lose weight or stop smoking, for example, then you give a direct indication that the patient is doing something wrong. You could almost say that you are blackmailing the patient or backing them into a corner . . . you lose your neutrality in the conversation. I've learned that this is not a good way to help the patient initiate changes in lifestyle." (Project Manager B)

The quotes from project managers E and A reflect a change mentioned by several project managers regarding how clinicians thought about and interacted with patients. Project managers stated that this change in thinking reflected a shift from the provision of general advice to a focus on *patient-centered* and *mutually agreed upon* targets identified by patients, rather than professionals. This was a move, as indicated above, away from one standard approach toward personalized plans to change health behaviors. This not only led to the systematic change that professionals allied to the GP then monitored patients' progress toward achieving these goals, but also to the approach mentioned by Project Manager B that the patient is in the lead and the professional takes a more neutral, assisting position in the efforts to change health behavior.

The aforementioned monitoring process reflects the expansion of communication within DMPs, from a one-on-one provider-patient interaction during an annual check-up to communication among multiple caregivers in regular contact with patients at the individual and group levels. Project managers stressed the importance of group contact because patients could learn from and support one another:

> "I can say that someone needs to stop smoking, but at the point where patients are able to say it to one another, it works much better than with my finger pointing at them. And that's the great part [about the program]." (Project Manager C); and

> "There are also groups that take walks together. If they have an appointment to meet as a group at a certain time, then it makes it more difficult not to go, or to back out. Some people need that to make sure they do go." (Project Manager A).

As the quote from Project Manager A reflects, professionals recognize that social accountability and community involvement also play important roles in the management of chronic diseases. They therefore worked to create such opportunities through the DMPs, which reflected further innovation in communication by also expanding interactions beyond the practice in order to improve patient care.

This means that practices developed new attempts to connect with patients' everyday worlds, for example, through a community meeting with patients and creating opportunities for networking (e.g., with sports clubs, support groups, and community leaders):

> "We are working hard to establish a network with a large group of people in the city who are already involved in sport, diet, physical and manual therapy, but also with other types of interest groups, such as the homeowner's association. (. . .) So we had a network meeting and introduced ourselves as the organizers of a health market. We invited them to join us and divided them into four areas (such as measuring different physical values) that people could visit." (Project Manager E).

Beyond changes in direct communication, the project managers also mentioned aspects of DMPs that may not have been evident to patients. Some practices invested in improving or expanding their ICT systems to improve patient tracking:

> "We were not anywhere close to having a good overview of all the patients. Now we use our information system to send reminders to come in for a check-up. We developed a good coding system and make sure that individual records are coded properly. That way, we can find them more easily, even if they don't notice." (Project Manager D).

ICT systems were sometimes visible in projects, in cases where they were used to improve communication with patients (e.g., through websites or providing patients with access to medical records) and to enable patients to track their behavior, health values, and progress.

In summary, although practices used different strategies, our interviews with project managers confirmed that the projects used the DMPs to "offer more." They changed the nature of conversations with patients in individual and group settings, and improved patient tracking through ICT systems. They also ventured beyond the medical practice into the community to address health behavior changes more comprehensively.

4. Discussion and conclusion

4.1. Discussion

Overall, both the quantitative and qualitative results showed that DMP implementation improved patients' health behavior. These findings are in line with those of Hung and colleagues [33], who found that interventions such as DMPs based on the CCM offer a useful framework for preventive purposes by addressing important risky health behaviors.

The percentages of patient participants meeting the Dutch standard for healthy physical activity (63.7% in 2010, 68.5% in 2011) were higher than the average percentages in the general adult (18+ years) Dutch population (58.1% in 2010, 58.0% in 2011), and reflect a substantial improvement not seen in the general population [34]. The proportion of current smokers (25.0% in 2010 vs. 17.8% in 2011; 7.2% reduction) among chronically ill patients

Please cite this article in press as: Cramm JM, et al. The role of disease management programs in the health behavior of chronically ill patients. Patient Educ Couns (2014), http://dx.doi.org/10.1016/j.pec.2013.12.017

also decreased substantially. The mean prevalence of smoking in the general Dutch population was 25.6% in 2010 and 2011 [35].

There is evidence from large long-term randomized controlled trials that quality of life of chronically ill patients slowly deteriorates over time, especially in the placebo groups but sometimes also in the intervention groups [36,37]. Although physical quality of life also deteriorated among patients in our study, we expect that improvements in health behavior (physical activity and smoking) will prevent or slow down the deterioration of physical quality of life normally seen in a chronic illness population. Qualitative research indicated many of the aspects of DMPs targeted at improving health behavior are expected to have a longer-term impact on quality of life. In a meta-analysis of interventions based on the CCM to improve care for chronic illnesses Tsai and colleagues [23] found that the evidence on quality of life outcomes was mixed. Condition-specific quality of life scales are known to be more sensitive to changes in clinical status compared to generic measures of quality of life such as the SF-36. However, we have chosen the latter, because the generic quality of life measures can be used in a wide variety of diseases, as was the case in our project. Moreover, generic quality of life measures may be more sensitive to long-term benefits of chronic care interventions, especially when life style improvements impact multiple morbidities simultaneously. The sustained ability of practices to "offer more" by incorporating aspects associated with DMPs into regular practice and by expanding activities beyond the care setting and into the community is important in this regard as is the focus on patient-led communication.

The study has several limitations. First and most importantly, this study did not include control groups corresponding to all the different patient groups. Although we found that physical quality of life declined over the 1-year period, we do not know whether this reduction was smaller compared with chronically ill patients not enrolled in DMPs. Worsening of the disease, poor medication adherence or an unhealthy diet may also explain declines in quality of life. Future research should investigate the role of other health behaviors. Secondly, we included only patients' and project managers' reported perceptions, and did not report the effects of DMP implementation on patients' objective health outcomes. Thirdly, respondents who completed questionnaires at *T*0 and *T*1 were on average older and more physically active than were those who completed only one questionnaire, which may have resulted in non-response bias. Physical activity may also be higher compared to patients not responding at all, which limits generalizability of our study findings. Finally, non-response bias at *T*0 may have affected our findings. We did however test the final full model on imputed data which showed similar results.

4.2. Conclusions

DMPs based on the CCM appear to improve physical activity among chronically ill patients over time. Furthermore, this research showed that smoking and (changes in) physical activity were important for the physical quality of life of these patients.

4.3. Practice implications

To improve health behavior among chronically ill patients healthcare providers are advised to:

- Focus on supporting patients to make healthier lifestyle choices by listening to the needs and desires of patients, for example through motivational interviewing or regular meetings with dieticians and specialized nurses;
- Developing systems, including ICT systems, to improve communication between the various clinicians providing care to those with a chronic disease and between clinicians and patients;
- Looking for opportunities to motivate and support patients in the community, whether through targeted outreach (a health market) or supporting existing activities occurring outside the clinic for patients with chronic conditions (walking groups).

Acknowledgements

This research was supported by a grant provided by the Netherlands Organization for Health Research and Development (ZonMw, project no. 300030201). The views expressed in the paper are those of the authors. The authors declare that they have no competing interests and confirm all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story. The authors are thankful to all healthcare workers, patients and project managers that participated in the research.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.pec.2013.12.017.

References

[1] Wagner EH, Austin BT, Davis C, Hindmarsh M, Schaefer J, Bonomi A. Improving chronic illness care: translating evidence into action. Health Aff 2001;20:64–78.
[2] World Health Organization. Global status report on noncommunicable diseases 2010. Geneva: World Health Organization; 2011.
[3] Morbidity and Mortality Weekly Reports. Resources and priorities for chronic disease prevention and control 1994. Morbid Mortal Weekly Rep 1997;46:286–7.
[4] Jacobs RP. Hypertension and managed care. Am J Manag Care 1998;4:S749–52.
[5] Desai MM, Zhang P, Hennessy CH. Surveillance for morbidity and mortality among older adults – United States, 1995–1996. Morbid Mortal Weekly Rep 1999;48:7–25.
[6] Institute of medicine crossing the quality chasm: a new health system for the twenty-first century. Washington: National Academy Press; 2001.
[7] McCulloch DK, Price MJ, Hindmarsh M, Wagner EH. Improvement in diabetes care using an integrated population-based approach in a primary care setting. Dis Manage 2000;3:75–82.
[8] Nolte E, McKee M. Caring for people with chronic conditions: a health system perspective. Maidenhead: Open University Press; 2008.
[9] Norris SL, Glasgow RE, Engelgau MM, OConnor Patrick J, McCulloch David. Chronic disease management: a definition and systematic approach to component interventions. Dis Manag Health Outcome 2003;11:477–88.
[10] Renders CM, Valk GD, Griffin SJ, Wagner EH, Eijk Van JT, Assendelft WJ. Interventions to improve the management of diabetes in primary care, outpatient, and community settings: a systematic review. Diabetes Care 2001;24:1821–33.
[11] Von Korff M, Gruman J, Schaefer J, Curry SJ, Wagner EH. Collaborative management of chronic illness. Ann Intern Med 1997;127:1097–102.
[12] Wagner EH, Austin BT, Von Korff M. Improving outcomes in chronic illness. Manag Care Q 1996;4:12–25.
[13] Wagner EH, Austin BT, Von Korff M. Organizing care for patients with chronic illness. Milbank Q 1996;74:511–44.
[14] National Center for Health Statistics. Healthy people 2010 final review, Hyattsville, MD; 2012.
[15] Koop E. Health promotion and disease prevention in clinical practice. In: Lawrence RS, Woolf SH, Jonas S, editors. Health promotion and disease prevention in clinical practice. Baltimore: Williams and Wilkins; 1996 p. vii–ix.
[16] Green LA, Fryer GE, Yawn BP, Lanier D, Dovey SM. The ecology of medical care revisited. New Engl J Med 2001;344:2021–5.
[17] Kottke TE, Solberg LI, Brekke ML, Cabrera A, Marquez MA. Delivery rates for preventive services in 44 Midwestern clinics. Mayo Clin Proc 1997;72:515–23.
[18] Lewis CE. Disease prevention and health promotion practices of primary care physicians in the United States. Am J Prev Med 1988;4(S4):9–16.
[19] Woolf SH, Atkins D. The evolving role of prevention in health care: contributions of the U S. Preventive Services Task Force. Am J Prev Med 2001;20(S3):13–20.
[20] Lenfant C. Shattuck lecture – clinical research to clinical practice – lost in translation? N Engl J Med 2003;349:868–74.
[21] Estes TS. Moving towards effective chronic illness management: asthma as an exemplar. Chronic Resp Dis 2011;8:163.
[22] Pearson ML, Wu S, Schaefer J, Bonomi AE, Shortell SM, Mendel PJ, Marsteller JA, Louis TA, Rosen M, Keeler EB. Assessing the implementation of the chronic care

model in quality improvement collaboratives. Health Serv Res 2005;40:978–96.
[23] Tsai AC, Morton SC, Mangione CM, Keeler EB. A meta-analysis of interventions to improve care for chronic illnesses. Am J Manag Care 2005;11:478–88.
[24] Adams SG, Smith PK, Allan PF, Anzueto A, Pugh JA, Cornell JE. Systematic review of the chronic care model in chronic obstructive pulmonary disease prevention and management. Arch Intern Med 2007;167:551–61.
[25] Creswell JW. Research design: qualitative, quantitative and mixed methods approaches. Los Angeles: Sage Publications; 2003.
[26] Lemmens KM, Rutten-Van Mölken MP, Cramm JM, Huijsman R, Bal RA, Nieboer AP. Evaluation of a large scale implementation of disease management programmes in various Dutch regions: a study protocol. BMC Health Serv Res 2011;11:6.
[27] Ware JE, Sherbourne DC. The MOS 36-item Short Form Health Survey (SF-36): conceptual framework and item selection. Med Care 1992;30:473–83.
[28] Aaronson NK, Muller M, Cohen PD, Essink-Bot ML, Fekkes M, Sanderman R, Sprangers MA, te Velde A, Verrips E. Translation, validation, and norming of the Dutch language version of the SF-36 Health Survey in community and chronic disease populations. J Clin Epidemiol 1998;51:1055–68.
[29] Ten Klooster PM, Vonkeman HE, Taal E, Siemons L, Hendriks L, de Jong AJ, et al. Performance of the Dutch SF-36 version 2 as a measure of health-related quality of life in patients with rheumatoid arthritis. Health Qual Life Outcomes 2013;11:77.
[30] Wendel-Vos GC, Schuit AJ, Saris WH, Kromhout D. Reproducibility and relative validity of the short questionnaire to assess health-enhancing physical activity. J Clin Epidemiol 2003;56:1163–9.
[31] Wagenmakers R, van den Akker-Scheek I, Groothoff JW, Zijlstra W, Bulstra SK, Kootstra JW, et al. Reliability and validity of the short questionnaire to assess health-enhancing physical activity (SQUASH) in patients after total hip arthroplasty. BMC Musculoskelet Disord 2008;9:141.
[32] Kemper HGC, Ooijendijk WTM, Stiggelbout M. Consensus over de Nederlandse norm gezond bewegen Consensus on the Dutch standard for healthy physical activity TSG 2000;78:180–3.
[33] Hung DY, Rundall TG, Tallia AF, Cohen DJ, Halpin HA, Crabtree BF. Rethinking prevention in primary care: applying the chronic care model to address health risk behaviors. Milbank Q 2007;85:69–91.
[34] TNO innovation for life. Monitor convenant gezond gewicht. Bewegen en eetgedrag van kinderen (4–11 jaar), jongeren (12–17 jaar) en volwassenen (18+ jaar) in 2010 en 2011[[nl]]Eating behavior and physical activity of children (4–11 years), adolescents (12–17 years) and adults (18+ years) in 2010 and 2011. http://www.convenantgezondgewicht.nl/download/131/2011_055_monitor_convenant_gezond_gewicht.pdf [accessed October 2012].
[35] Centraal Bureau voor de Statistiek (Statistics Netherlands). Smoking statistics 2010 and 2011. http://www.cbs.nl/nl-NL/menu/themas/gezondheid-welzijn/nieuws/default.htm [accessed October 2012].
[36] Tashkin DP, Celli B, Senn S, Burkhart D, Kesten S, Menjoge S, et al. A 4-year trial of tiotropium in chronic obstructive pulmonary disease. N Engl J Med 2008;359:1543–54.
[37] Calverley PM, Anderson JA, Celli B, Ferguson GT, Jenkins C, Jones PW, et al. Salmeterol and fluticasone propionate and survival in chronic obstructive pulmonary disease. N Engl J Med 2007;356:775–89.

Please cite this article in press as: Cramm JM, et al. The role of disease management programs in the health behavior of chronically ill patients. Patient Educ Couns (2014), http://dx.doi.org/10.1016/j.pec.2013.12.017