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The long-term effect of community-based health management on the elderly with type 2 diabetes by the Markov modeling

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ABSTRACT

The aim of this study was to assess the long-term effects of community-based health management on elderly diabetic patients using a Markov model. A Markov decision model was used to simulate the natural history of diabetes. Data were obtained from our randomized trials of elderly with type 2 diabetes and from the published literature. One hundred elderly patients with type 2 diabetes were randomly allocated to either the management or the control group in a one-to-one ratio. The management group participated in a health management program for 18 months in addition to receiving usual care. The control group only received usual care. Measurements were performed on both groups at baseline and after 18 months. The Markov model predicted that for every 1000 diabetic patients receiving health management, approximately 123 diabetic patients would avoid complications, and approximately 37 would avoid death over the next 13 years. The results suggest that the health management program had a positive long-term effect on the health of elderly diabetic patients. The Markov model appears to be useful in health care planning and decision-making aimed at reducing the financial and social burden of diabetes.

1. Introduction

Diabetes has become a global health problem. New figures indicate that the number of people living with diabetes is expected to rise from 366 million in 2011 to 552 million by 2030 if no urgent action is taken (International Diabetes Federation, 2011). The prevalence of diabetes in China is increasing at a fast pace. According to the World Health Organization (WHO) Global Burden of Disease Study, the number of people with diabetes in China will rise from 20.8 million in 2000 to 42.3 million by 2030, ranking China second in the world in diabetes prevalence (Wild, Roglic, Green, Sicree and King, 2004). The financial and social burden of the disease is significant. In 2010, 11.6% of the world's health expenditure was spent on prevention and treatment of diabetes (Chinese Diabetes Association, 2011).

As an incurable chronic disease, diabetes management requires a lifetime commitment to healthy behaviors aimed at reducing risks for diabetic complications. Medical care by a physician and medication use are not sufficient to treat diabetes. Effective diabetes management requires individual responsibility; a patient with diabetes must decide daily whether to follow a regimen of diet, exercise, and medication compliance (Oglesby, Secnik, Barron, Al-Zakwani, & Lage, 2006; Schlundt, Pichert, Gregory, & Davis, 2003). A diabetes health management program could motivate individuals with diabetes to realize this objective. There have been a number of studies of diabetes health management (Drabik et al., 2012; Samoutis et al., 2010). In a randomized controlled trial (RCT), Samoutis et al. showed that implementation of a multifaceted quality improvement intervention for diabetic patients in primary health care settings resulted in improvements in blood pressure, total cholesterol, low density lipoprotein cholesterol, and three annual process of care measures (urine protein testing, dilated eye examination, and foot examination) compared with the control group at 18-month follow-up (Samoutis et al., 2010).

RCTs to date have had limitations, such as short follow-up time (generally only a few weeks or months), failure to account for the natural history of the disease, and inability to detect rare events owing to small sample sizes (Hay, Jackson, Luce, Avorn, & Ashraf, 1999). Thus, analyzing data from RCTs will not fully reflect the role of health management on diabetes progression. Appropriate

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scientific mathematical models may be used to compensate for the inherent defects of RCTs. The Markov model has been widely proven to be an effective model to assess the long-term effect(s) of an intervention or treatment (Zhu, Ni, & Sun, 2005).

There have been studies on the long-term effects of diabetes screening, drug treatment, lifestyle changes, and yearly transitions of disability using the Markov model now (Centers for Disease Control and Prevention (CDC), 1998; Palmer et al., 2004; Raîche, Hébert, Dubois, Gueye, & Dubuc, 2012; Valentine, Tucker, Palmer, Minshall, & Silberman, 2009; Zhu et al., 2005); however, very little is known about long-term effects of a diabetes health management program. Assessment of the long-term effects is important prior to implementing a diabetes health management program. This study's aim was to assess the long-term effects of community-based health management on elderly diabetic patients using a Markov model.

2. Methods

2.1. Subjects and data collection

The study was a randomized, parallel-group, controlled trial. It was conducted in collaboration with the Nanjing Community Health Service Center. Nanjing is located in southeastern China; it is the provincial capital of Jiangsu province, one of the most developed provinces in China. We recruited patients with type 2 diabetes from the community health service center from January to July of 2009.

Criteria for inclusion of participants were: (1) age 60 and over, (2) local permanent resident, and (3) diagnosed with type 2 diabetes according to the WHO 1999 criteria (WHO, 1999). The exclusion criteria were: (1) cognitive defect, severe psychological disorder or mental illness; (2) severe chronic diseases, such as heart failure, respiratory failure, liver cirrhosis, renal failure, or need for assistance in living; (3) limitations in physical activity; and (4) participating in or having participated in other trials within the last 30 days. People with these exclusion criteria were excluded either because study participation would be challenging for them, or because their inclusion might bias model predictions (e.g., increased deaths attributable to chronic diseases other than diabetes). One hundred elderly patients with type 2 diabetes eligible for study participation were randomly allocated to either the management or the control group on a one-to-one ratio using a random number table. All 100 patients signed informed consent forms.

2.2. Intervention

The management group participated in an 18-month health management program that included the following components: health evaluation (including dietetic patterns, physical activity, psychological aspects, medication adherence, and self-care for diabetic complications), health management (including dietary advice, psychological counseling, a tailor-made exercise program based on earlier evaluation, education/skills training on diabetes self-management, telephone consultation, lectures on diabetes, distribution of health promoting materials, as well as regular monitoring of blood pressure, blood glucose, and long-term medication use). The components of the intervention were administered at least once per month by specially trained staff of the community health center and related researchers (Fig. 1). The control group received usual care. No study participants were lost to follow-up. After 18 months (December 2010), measurements were performed on both the management and control groups, including fasting blood glucose measurement using the glucose oxidation enzyme method (Ye, Wang, & Shen, 2006).

2.3. Data analyses

Double data entry was performed by two independent operators on different computers using Epidata 3.1 software (http://www.epidata.dk/). General characteristics were compared between the management and control groups with *t*-tests and the chi-square (χ^2) test using SPSS17.0 (SPSS Inc., Chicago, IL, USA), with 0.05 as the required level of significance. A Markov model was calculated in Metlab 7.0.

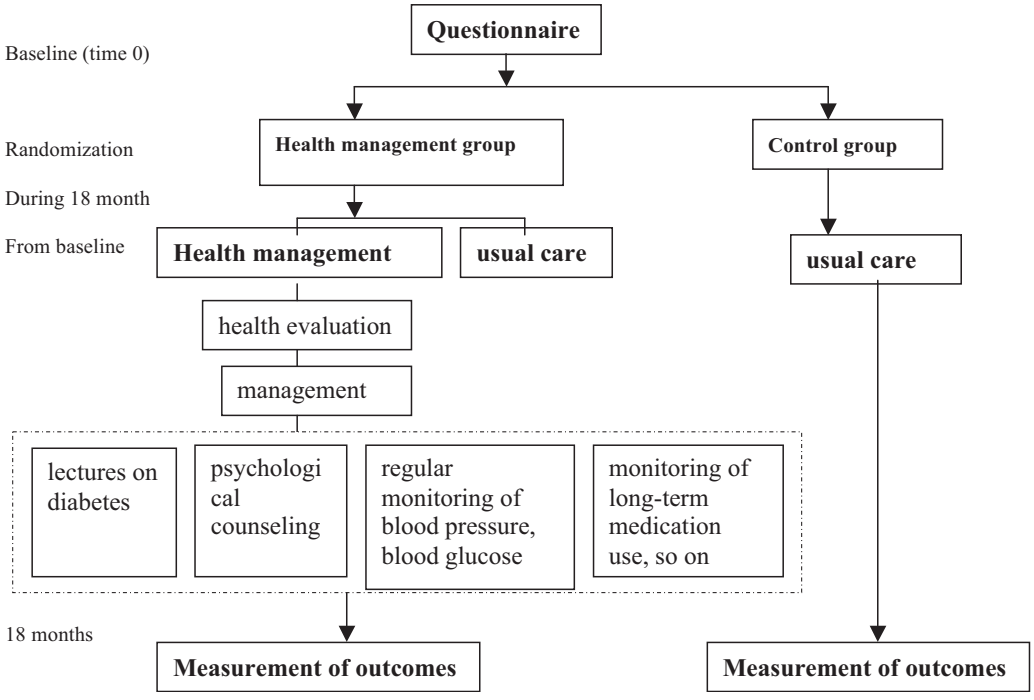

Fig. 1. Graphical depiction of the intervention.