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Evaluation of the economic efficiency of educational programs for patients with coronary heart disease and dyslipidemia

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Summary
Background: We investigated the economic efficiency of a one-year training program for patients with stable angina of effort and dyslipidemia.
Methods: We examined 117 patients with coronary heart disease (CHD) and dyslipidemia randomly divided into three groups. The first group of 39 participants was enrolled in an individual educational program (Group 1). The second group of 40 participants participated in group training (Group 2), while 38 participants served as the control group and did not receive either individual or group education (Group 3).

All participants were observed for two years. The outcome variables of interest were:

(a) number of days of disability;
(b) number of emergency ambulance calls due to a worsening of CHD;
(c) lipid parameters including total cholesterol (TC), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HLD-C) and triglycerides (TG).

A special methodology was applied to evaluate the economic efficiency of the educational program.
Results: The one-year educational program led to a decrease in both the number of disability days and emergency calls among participants in Groups 1 and 2. These decreases translated into an overall economic efficiency of US $8235.10 for the two groups. Group 3, which did not receive any specific education, suffered economic losses caused by increased disability days and emergency calls. These losses totaled

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US $530.08 for Group 3. Lipid levels improved significantly for those who participated in the educational programs.
Conclusion: Educational programs have a positive economic effect. They lead to a decrease in the number of disability days and emergency calls while significantly improving lipid levels.

Introduction

As in other countries, Kyrgyzstan is witness to a marked and progressive growth in the morbidity and mortality rates of diseases caused by atherosclerosis [1]. Poor patient knowledge about risk factors for CHD as well as inadequate prevention and treatment are cited as reasons for these trends [2]. Furthermore, numerous studies demonstrate that increasing rates of morbidity and mortality from CHD may also be explained by low compliance with therapies and low participation levels in preventive actions [3—5]. Consequently, educational programs, offered in parallel with medical therapy, have been recognised as important components of effective treatment of patients with CHD and dyslipidemia [6].

As with other treatment methods, educational programs require an evaluation of their clinical and economic efficiency. Therefore, our objective was to investigate the economic efficiency of a one-year educational program for patients with CHD and dyslipidemia.

Materials and methods

The study was conducted between September 2001 and September 2003. During the first year, 180 patients with stable angina of effort functional classes II or III (Canadian Cardiovascular Society Functional Classification of Angina, 1976) and dyslipidemia were monitored.

The following exclusion criteria were applied:

(1) age 70 years and older;
(2) angina of effort functional class IV;
(3) heart failure functional class III—IV (NYHA);
(4) acute coronary syndrome;
(5) hypothyroidism;
(6) nephrotic syndrome, chronic renal failure;
(7) biliary tract obstruction;
(8) myeloma.

Dyslipidemia was diagnosed when the following conditions were met:

(1) TC level > 5.16 mmol/L;
(2) LDL > 2.58 mmol/L;
(3) HDL < 1.03;
(4) TG > 1.69 mmol/L.

These levels are the same as those described by the ATP Panel III guidelines of 2001 [7]. Lipid levels were assessed at the outset of the study and then re-assessed every 12 months.

Patients recorded the number of emergency ambulance calls and days of disability (number of days the patient was absent from work) related to a worsening of their CHD in a special diary throughout the 24 months of the study. The total number of emergency visits, days of disability and lipid levels were estimated at the end of the first and second years.

At the end of Year 1, only 118 of the 180 patients agreed to participate in a special educational program during Year 2. The patients completed a brief survey to evaluate their knowledge level prior to starting the education program. The survey consisted of the following 12 questions:

(1) Which TC level is normal?
(2) What are the main risk factors for coronary heart disease?
(3) Describe the symptoms of angina pectoris.
(4) Describe the symptoms of acute myocardial infarction.
(5) What should you do in the event of a heart attack?
(6) What medicines are used to treat angina pectoris?
(7) What blood pressure level is considered as hypertension?
(8) What medicines are used to treat hypertension?
(9) Which foods contain an increased quantity of cholesterol?
(10) Which dairy products are rich in cholesterol?
(11) Which foods are desirable for consumption?
(12) Which medicines to treat hyperlipidemia do you know?

Correct answers were awarded one mark. A score of 11 or 12 marks indicated excellent knowledge. A score of 9 or 10 was considered good, and any score between 0 and 8 was considered fair.

The patients were allocated randomly into three groups. Group 1 consisted of 39 patients (28 men and 11 women), who underwent individual education. Group 2 consisted of 40 patients (27 men and 13 women), who participated in group education. Group 3 consisted of 38 patients (24 men and 14 women) who did not receive any education thus forming a control group.

Patients were instructed by a cardiologist familiar with the special educational program. The educational material included the same content for both Group 1 and Group 2 and covered the following topics:

Class 1	Atherosclerosis and its etiology. Morbidity and mortality of diseases related to atherosclerosis. Understanding of dyslipidemia Classification and normal levels of blood lipids.
Class 2	Risk factors. Focus on obesity (etiology, diagnosis, dietary principles, medical treatment).
Class 3	Smoking and its impact. Methods of smoking cessation.
Class 4	Physical inactivity (definition, positive effects of physical activities, recommended activities, frequency and duration of physical training). Mental stress and its impact. How to control stress.
Class 5	CHD (etiology, clinical manifestation and precipitating factors of angina, understanding and clinical manifestation of angina of effort and myocardial infarction).
Class 6	Treatment of angina. How to respond to an anginal attack. Prevention of anginal attacks. Anti-anginal medications, principles of treatment, side effects. Coronary angiography. Interventional and surgical methods of CHD treatment.
Class 7	Hypertension (definition, clinical manifestation, complications, list of antihypertensive medicines, indications, side effects, and the proper measurement of blood pressure).
Class 8	Understanding of dyslipidemia. Dietary principles, recommended and non-recommended food products, calculation of daily food allowance, caloric content, recommended intake of fat, proteins and carbohydrates.
Class 9	Medical treatment of dyslipidemia, classification of lipid lowering medications, indications and contraindications, and side effects.
Class 10	How to respond to emergencies (angina, acute myocardial infarction, hypertensive crises, arrhythmias).

Training was undertaken five times per week during a two-week period for hospitalized patients, and twice weekly over five-weeks for out-patients. The duration of each class was 1 h.

In Group 1, sessions were conducted with every patient individually and were organized as discussions between the physician and the patient, with basic information provided on a particular theme. The amount of information and emphasis on specific topics depended upon individual patient characteristics, i.e., educational level, duration and character of the clinical course, complications, and presence of risk factors.

In Group 2, the training consisted of classes conducted for groups of 10—20 patients. The composition of these sub-groups remained unchanged. During these sessions, a physician first presented information on a topic before patients were invited to participate in discussions and ask questions. The role of the physician was to correct any misunderstandings related to the topic. Each patient was encouraged to share his or her experience with their disease.

In addition to the class discussions, patients were provided with booklets on the various topics with a special emphasis on a lipid lowering diet, control of CHD risk factors and regimens of physical activities including self-monitoring. We combined both written and oral information to develop lifestyle self-control skills. Textual information was supplemented with visual aids that aimed to reinforce the knowledge received in the classes, strengthen the motivation to change behaviour, and cultivate the precise skills necessary to accomplish such changes.

We also held discussions with the family members of Group 1 and Group 2 participants. During these discussions, we underscored the importance of a low fat diet, smoking cessation, alcohol cessation, physical activity, adhering to doctor-prescribed therapies, self-control and monitoring of progress by relatives.

The goals of the educational program were to have the patient:

- understand that CHD is a disease that can be controlled;

- know clinical manifestations and possible complications of CHD as well as normal lipid levels;
- master planning daily food allowances, calculation of calories by use of tables, and identify recommended and non-recommended food products;
- know the kinds and levels of necessary physical activities and methods of controlling smoking and stress;
- develop skills of blood pressure measurement and interpretation;
- understand the main antianginal, antihypertensive and lipid lowering medications;
- know the initial response to angina, hypertensive emergencies, arrhythmias, dyspnea and heart attack.

A low fat diet aimed to limit daily cholesterol intake to a maximum of 200 mg. This diet also restricted saturated fat, carbohydrate and protein intake to a maximum of 7%, 50—60% and 15%, respectively, of total daily caloric intake. Patients were given illustrated guides on the calculation of cholesterol levels in food products, daily caloric content and accurate planning of daily food allowances. For obese persons (body mass index $\geqslant 30\ kg/m^2$), it was recommended to limit the daily caloric intake to 1200—1800 kcal/day with a suggested 1—2 days of fasting per week.

Physical activity was also recommended, particularly dynamic physical activities (walking, swimming, jogging, therapeutic gymnastics, etc.) for 30—60 min periods, three or four times per week. Attention was drawn to controlling blood pressure and monitoring the frequency of heartbeats and general well-being. Patients who smoked were examined for factors conducive to smoking and methods to control these factors were discussed. Patients with diabetes mellitus were instructed on hypoglycemic diets and patients with hypertension were treated with both pharmacologic and non-pharmacologic interventions. All patients received antianginal therapy (beta-blockers, calcium antagonists, and nitrates) as required.

After six months of training, participants were examined on their level of knowledge. Educational courses continued to be provided during the remaining six months of the second year. Although the second half of Year 2 also consisted of 10 classes, these classes generally covered previous topics and aimed to fill any gaps in the material covered in the previous six months.

All trainees were provided with printed materials on each topic for individual study. Throughout the observational period, patients visited a physician every three months. Changes in their medical and/or non-medical therapies were made as required.

The prime objective of the patient education program was to provide the patients with knowledge and skills that would enable them to lead a healthy lifestyle and independently control their condition. Each patient had a personally tailored non-pharmacologic treatment plan, which included a low fat diet, physical activities, smoking cessation, pharmacological therapy, and techniques of dealing with obesity and high blood pressure.

We evaluated the economic efficiency of the educational program using the methodology proposed by Kulagina [8]. The formula was calculated as follows:

$$Eef = (D1 - D2) \times (0.75 \times (GP + Bsick) + Chosp)$$

where $0.75 \times (GP + Bsick) + Chosp$ represents losses per day of disability per patient; D1 is the average number of days of disability before education; D2 is the average number of days of disability during the second year of follow-up; 0.75 represents the conversion coefficient of calendar days into working days; GP is the value of gross domestic product generated by one worker per day. This value is equal to an average of US $0.90 per working day based on data of the National Statistics Committee of the Kyrgyz Republic in 2002; Bsick represents the amount of sick benefit. This parameter did not exceed US $2.13 according to data of the National Trade Union Committee in 2002; and Chosp represents the daily cost of treatment in hospital of a CHD patient. The daily treatment of a patient with stable angina of effort costs US $7.97 according to the accounting office of the National Center of Cardiology and Internal Medicine at Kyrgyzstan.

Statistical analyses

Data are expressed as means ± standard deviation. p Values of less than 0.05 were considered statistically significant. All analyses were performed using *Statistica* for Windows, Version 5 (StatSoft Inc., 1984—1995).

Results

The groups were matched by sex, age, duration of disease, number of risk factors ($p > 0.05$) Table 1. None of the patients had been receiving lipid lowering drug therapy. According to the survey conducted prior to the training, the average initial

knowledge level was 6.3 ± 0.27. This is considered a 'fair' level of knowledge. After one year of education, the level of knowledge of Group 1 patients increased by 66.3% (from 6.3 ± 0.1 initially, to 10.5 ± 0.23; $p < 0.001$). The knowledge level of Group 2 patients increased 47.8% (from 6.9 ± 0.37 initially, to 10.2 ± 0.16; $p < 0.001$). There was no significant change among Group 3 patients in the control group (6.4 ± 0.36 initially, compared to 6.9 ± 0.28 at follow up).

Lipid levels were measured initially and following the program of education. Initial lipid levels in patients in the three groups did not differ statistically. However, we found a significant reduction in the lipid levels of those patients who had received the education program. In Group 1, the TC level was reduced by 12.9% (6.2 ± 0.92 mmol/L initially, compared to 5.4 ± 0.7 mmol/L, $p < 0.001$). At follow up, the level of LDL-C decreased by 12.8% (4.13 ± 1.03 initially, then 3.6 ± 0.84, $p < 0.001$); TG was reduced by 23.2% (2.41 ± 1.14 initially, then 1.85 ± 0.84, $p < 0.001$); and HDL-C levels increased by 8.3% (0.96 ± 0.1 initially, then 1.04 ± 0.08, $p < 0.001$).

For patients in Group 2, the TC level was reduced by 7% (6.1 ± 0.9 initially, then 5.67 ± 0.6, $p < 0.001$); LDL-C decreased by 13% (4.37 ± 1.08 initially, then 3.8 ± 0.67 $p < 0.001$); TG decreased by 19.1% (2.35 ± 1.12 initially, then 1.9 ± 0.9, $p < 0.001$); and the level of HDL-C increased by 5.4% (0.92 ± 0.18 initially, then 0.97 ± 0.13, $p < 0.001$).

No significant changes were observed in the control group, Group 3 ($p > 0.05$) (Table 2).

The number of emergency ambulance calls made by patients in Group 1 decreased from 3.38 ± 1.72 to 1.43 ± 0.71 ($p < 0.001$), while the number of calls by patients in Group 2 decreased from 3.6 ± 1.7 to 1.4 ± 0.9 ($p < 0.001$). In contrast, the number of emergency ambulance calls made by patients in the control group increased from 3.3 to 3.9 (Table 3).

Table 1 Patient characteristics

Parameters	Group 1 ($n = 39$)	Group 2 ($n = 40$)	Group 3 ($n = 38$)
Mean age	52.2 ± 5.9	51.4 ± 5.5	51.6 ± 5.9
Men	28	27	24
Women	11	13	14
Angina of effort			
CCS functional Class II	12	11	10
CCS functional Class III	27	29	28
History of myocardial infarction	12	15	10
Essential hypertension	18	19	21
Diabetes mellitus	2	2	3
Obesity	11	9	10
Family history of CHD	8	5	10
Smoking	13	15	13
Duration of sickness, years	3.09 ± 2.04	3.12 ± 2.6	3.2 ± 2.4

Table 2 Lipid levels (mmol/L) at baseline and at follow up

Indices	TC	HDL-C	LDL-C	TG
Group 1				
Baseline	6.2 ± 0.92	0.96 ± 0.1	4.13 ± 1.03	2.41 ± 1.14
After training	5.44 ± 0.7*	1.04 ± 0.08*	3.58 ± 0.84*	1.85 ± 0.84*
Group 2				
Baseline	6.13 ± 0.9	0.92 ± 0.18	4.37 ± 1.08	2.35 ± 1.12
After training	5.67 ± 0.66*	0.97 ± 0.13*	3.88 ± 0.67*	1.95 ± 0.91*
Group 3				
Baseline	6.16 ± 0.88	0.97 ± 0.15	4.22 ± 0.83	2.2 ± 0.88
After training	6.15 ± 0.8**	0.96 ± 0.11	4.23 ± 0.75	2.23 ± 0.74

* $p < 0.001$ for levels after training compared to baseline.

Table 3 Number of ambulance calls

	Group 1 (n = 39)	Group 2 (n = 40)	Group 3 (n = 38)
Baseline	3.38 ± 1.72	3.67 ± 1.71	3.25 ± 1.87
After training	1.43 ± 0.71*	1.4 ± 0.9*	2.42 ± 1.43

* $p < 0.001$ for after training compared to baseline.

According to data provided by the accounting office of the Central Station of Emergency Ambulance of Bishkek, the average cost of one call to an ambulance team is US $9.61. Thus, the value of economic efficiency resulting from the decrease in emergency calls is calculated to be US $18.70 per patient in Group 1 [$9.61 \times (3.38 - 1.43)$] and US $21.10 per patient in Group 2 [$9.61 \times (3.6 - 1.4)$]. The total group savings equaled US $729.30 for Group 1 and US $844 for Group 2. Patients who did not receive the education (Group 3) experienced an increase in the number of emergency calls. The economic losses for Group 3 were US $5.76 per patient [$9.6\ 1 \times (3.3 - 3.9)$] giving a total of US $218.80.

The number of days of disability decreased in Year 2 for patients in Group 1 from 19.9 ± 4.23 to 10.7 ± 3.35 ($p < 0.001$). A decrease was also observed among patients in Group 2 from 17.9 ± 4.67 to 10.6 ± 2.93 days ($p < 0.001$). In contrast, the number of days of disability increased for patients in Group 3 from 17.3 to 18.1.

The losses caused by one day of disability are calculated by the following formula: Chosp = $0.75 \times$ (GP + Bsick). In the case of Kyrgyzstan, this value equals US $10.24 per patient [$7.97 + 0.75 \times (0.9 + 2.13)$]. The economic efficiency resulting from a decrease in the number of days of disability translates to US $94.20 per patient in Group 1 [$10.24 \times (19.9 - 10.7)$] and US $74.70 per patient in Group 2 [$10.24 \times (17.9 - 10.6)$]. Economic losses per patient in Group 3 due to the increased number of days of disability equaled US $8.19 [$10.24 \times (17.3 - 18.1)$].

The overall economic efficiency as a consequence of decreases in emergency calls and days of disability equaled US $4403.10 for patients in Group 1 and US $3832.00 for patients in Group 2. The overall economic losses generated by patients in Group 3 equaled US $530.08 per year. Therefore, one-year educational programs led to decreases in both the number of days of disability and emergency calls giving an overall economic efficiency for Group 1 and Group 2 patients (n = 79) of US $8235.10 (see Table 4).

Discussion

CHD remains the main cause of death not only in industrially developed countries but also in developing countries [9]. For the majority of patients, symptoms of angina can be controlled by drug therapy. It is widely known that percutaneous transluminal coronary angioplasty and coronary artery bypass grafting can have advantages over drug therapy alone by decreasing the risk of developing myocardial infarction and sudden death. They also reduce the necessity of chronic antianginal therapy [10]. Therefore, education of patients on CHD risk factor modification may be more economically effective when compared to the costs of medical treatment of an already developed disease. The most economically efficient therapy among those focusing on the modification of risk factors is lipid lowering treatment with statins [11—13]. However, secondary prevention of CHD is incomplete without non-pharmacological treatment. In addition to baseline assessments, secondary prevention programs should include aggressive risk factor management especially hyperlipidemia, hypertension, excessive weight, diabetes, and smoking as well as nutritional counseling, physical activity counseling and exercise training [14]. Clinical trials have provided conclusive evidence of reduced mortality in patients with CHD via the reduction of individual risk factors by pharmacological and non-pharmacological interventions [15]. Our educational program led to significant reductions in lipid levels, the number of emergency calls and days of disability, while knowledge level scores increased.

An active role for patients in the educational process is an essential component of secondary prevention programs. The ability of patients with varying degrees of CHD severity to communicate their experience proved to be of positive significance. This is because the experience of patients attempting to control their disease is often more

Table 4 Economic efficiency resulting from a decrease in the number of ambulance calls (US $)

Economic efficiency (amount saved)	Group 1 (n = 39)	Group 2 (n = 40)	Group 3 (n = 38)
Per patient in one year	18.70	21.10	−5.76
Total per group	729.30	844.00	−218.80

vivid and generates a greater effect on other participants than the recommendations and advice offered by physicians.

Alternate models to the traditional hospital or community center-based setting for outpatient programs have been developed. These models include home-based programs for which a nurse generally serves as case manager. The nurse then facilitates, supervises, and monitors patient care and progress. Alternatively, models have been developed that involve community-based group programs with nurses or other non-physician healthcare providers [16,17]. Electronic media programs provide alternative approaches for home-based comprehensive risk-factor modification education and instruction [18]. In our case, the educational sessions included individual and group methodology for hospitalized and non-hospitalized patients. These programs were provided by a physician. Although the efficiency of both methodologies did not differ significantly, the group method permitted reductions in training time while educating a greater number of patients for a given period.

A challenge in any economic analysis is the transitional nature of the economy in Kyrgyzstan. We used currently valid economic data to demonstrate the apparent savings from preventative efforts that include an educational component. A limitation of our study is the lack of inclusion of costs of the educational programs themselves. However, there is sufficient evidence that educational programs are economically beneficial and permit reductions in expenditures on treatment of CHD patients.

Although there is no significant difference in results obtained through individual or group training, the latter is more appropriate as it produces greater economic efficiency through savings achieved by reduced training time and expenditure. Nevertheless, individual training can still be of benefit when offered to patients who have difficulty in following group discussions.

Economic efficiency plays a critical role in developing concrete solutions in a clinical setting by guiding the type of treatment employed [19—22]. Given the difficult economic times existing in Kyrgyzstan, implementation of educational programs would result in a decrease in expenditure related to the treatment of CHD patients. Other data also demonstrate benefits through reductions in the number of hospitalizations and days of disability [23]. The appearance of a significant number of articles in medical journals devoted to the problems associated with evaluating the economic efficiency of treating cardiovascular diseases is evidence that such considerations are becoming increasingly important to clinical medicine [24].

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