THE HEALTH FARM CONCEPT IN THE PRIMARY PREVENTION OF CORONARY ARTERY DISEASE

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ABSTRACT

The purpose of the study is as a preliminary outline of the effectiveness of initiating high-risk individuals into the Health Farm concept in the primary prevention of coronary artery disease (CAD).

Thirty-five (35) Army personnel, all male, with risk-factors for CAD were brought together on a Health Farm concept to go through a predesigned ten-day Farm programme comprising CAD risk-assessment, comprehensive medical examination, relevant blood chemistry analysis, physical fitness evaluation, individualised weekly exercise routine, physical fitness workouts, individualised diet, lectures, group discussion and individual counselling.

Description of the participants (as measurements of various relevant parameters) are made at the start and as participant-achievement.

The results show general participant-compliance to the programme which was reflected by significant changes in weight ($p<0.005$), percentile VO_2Max ($p<0.005$), percentile push-ups ($p<0.005$), percentile sit-ups ($p<0.005$) and girth-difference ($p<0.005$).

The study showed that the Health Farm concept is effective in initiating high-risk individuals into lifestyles conducive to the primary prevention of CAD. Sustained results towards primary prevention of CAD can be expected with compliance to a long-term follow-up that has been identified and to which participants have been made aware of.

Other previous intervention studies are briefly discussed.

Keywords: coronary disease, risk factors, primary prevention, health farm (resort).

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INTRODUCTION

Cardiovascular diseases are a major cause of preventable morbidity and premature mortality. Moreover, their human and economic costs are extremely high. At the present time deaths from cardiovascular disease are increasing in some countries and decreasing in others. In developed countries, coronary artery disease (CAD) and cerebrovascular diseases (particularly strokes) are responsible for between 40% and 50% of all deaths[1].

More than forty percent (40%) of persons who succumb to myocardial infarction in the first instance die[2]. The mortality among survivors is 8%-25% in the first year and 3%-5% yearly thereafter[3]. Even without causing myocardial infarction, CAD may cause premature disability in the form of angina pectoris, congestive heart failure and arrhythmias[4].

The Framingham Study identified the following as risk-factors in the causation of CAD[5]: age, sex, hypercholesterolemia, reduced HDL cholesterol, hypertension, left ventricular hypertrophy, diabetes mellitus, and cigarette smoking.

Subsequent studies identified additional risk factors such as obesity, physical inactivity, and family history of premature CAD[6].

The WHO recommends the identification and assessment of an individual's coronary risk from the data available from the individual's medical history and at a routine medical check-up including: age, sex, weight, family history of coronary disease, oral contraceptives use, smoking, hyperglycaemia, habitual physical inactivity, and ECG abnormalities. It also recommends that these individuals need intensive and individualised preventive programmes[7,8]. Physicians in a high-incidence country need a plan for identifying individuals at risk, objectives for their management and a scheme for counselling and follow-up[8].

With regards to prevalence of CAD risk factors in Malaysia, various community surveys show that the prevalence of hypertension is between 14% and 21.5%. Diabetes has been estimated to have prevalence of 4% in Malaysia. While it is estimated that one-third of Malaysian males smoke, Teo et al in their survey of asymptomatic male executives and professionals found that 30.8% of them have cholesterol values above 260 mg/100ml[9].

Several programmes have been written that address CAD risk factors individually and together, so that persons with these risk factors are educated and initiated into a self-care lifestyle conducive to healthier hearts[5, 10-13].

The concept of health-farms where persons book in for short vacations during which they are put through general programmes in health-improvement has been popular in developed countries, and more recently in Malaysia[14,15], while several Primary Prevention Intervention Trials have also been conducted world-wide[16-19].

The author designed a ten-day programme combining the concept of prevention programmes in CAD and the concept of health-farms (Table I).

Such ten-day programmes were conducted by the author for personnel of the Malaysian Armed Forces on three occasions in 1991.

The objective of these health-farms was to make participants *aware* (through a health-education programme) of risk factors in CAD and *initiate* them (through an activity-oriented programme) into methods aimed at changing their lifestyles towards one conducive to healthier hearts.

OBJECTIVE

The purpose of this study is as a preliminary outline of the effectiveness of initiating high-risk individuals into the Health Farm concept in the prevention of CAD.

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Table I - The ten-day programme schedule

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
0700 - 0800	Registration And Medical Examination	Blood Taking for Lab Test	Physical Fitness Work-out			Sports				Fitness Evaluation
0800 - 0900		Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast
0900 - 1000		Opening Ceremony	Lecture: CAD, Angina P & M.I.	Lecture: Nutrition for Health	Own Reading	Sports		Anthropometry		Fitness Evaluation
1000 – 1030	Tea Break	Tea Break	Tea Break	Tea Break	Tea Break	Tea Break	Tea Break	Tea Break	Tea Break	Tea Break
1030 - 1130	Registration And Medical Examination	Fitness Evaluation	Lecture: Prophylaxis & Treatment in CAD Angina	Lecture: Reducing Diet	Own Reading	Lecture: Executive Stress	Lecture: Diet for Hypertension & Diabetes Mellitus	Anthropometry		
1130 - 1230		Fitness Evaluation	Lecture: Exercising for Health	Lecture: Medication for Weight Reduction		Lecture: Living with Diabetes Mellitus	Gp Discussion: Living with Diabetes Mellitus	Individual Counselling	Lecture: Other Methods for Weight Reduction	Final Briefing And Documentation
1230 - 1430	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Closing Ceremony And Lunch
1430 - 1530	Registration And Medical Examination	Individual Exercise Prescription	Lecture: Obesity & Health	Individual Counselling	Lecture: Blood Lipids	Lecture: Living with Hypertension	Individual Counselling			
1530 - 1630		Lecture: CAD Risk Factors	Lecture: Smoking And Health	Individual Counselling	Gp Discussion: Nutrition for Health	Individual Counselling				
1630 - 1730		CAD Risk Assessment	Lecture: Methods for Stopping Smoking	Individual Diet Prescription	Individual Counselling	Sports				
1730 - 1830		CAD Risk Assessment	Physical Fitness Work-out	Physical Fitness Work-out	Physical Fitness Work-out	Sports				
1830 - 1930		CAD Risk Assessment	Gp Discussion: Exercise for Health			Physical Fitness Work-out	Physical Fitness Work-out	Physical Fitness Work-out	Physical Fitness Work-out	
1930 - 2030	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	
2030 - 2130		Gp Discussion: CAD Risk Factors	Gp Discussion: Smoking And Health			Gp Discussion: Executive Stress		Gp Discussion: Living with Hypertension	Gp Discussion: Other Methods for Weight Reduction	

METHOD

Three groups of 30-40 Army personnel, all male, (93 in total) with risk factors for CAD were brought together on three different occasions in 1991 on a Health Farm concept. (Table II).

The risk factors in question were: high blood cholesterol, low-levels of HDL-cholesterol and high levels of LDL-cholesterol, hypertension, diabetes mellitus, lack of physical activity, obesity, cigarette smoking, stress, and family history of premature CAD.

Overview

Essentially, the 10-day programme comprised:

a) computerised CAD risk assessment and advice,
b) a comprehensive medical examination inclusive of electrocardiogram,
c) relevant blood chemistry analysis such as blood cholesterol, triglyceride, HDL-cholesterol and fasting blood sugar.
d) physical fitness evaluation - anthropometry, aerobic capacity, muscle strength and muscle endurance,
e) prescription for individualised weekly exercise routine,
f) guided physical fitness workouts,
g) individualised diet,
h) lectures,
i) group discussions,
j) individual counselling.
k) opportunity for socialising.

The Medical Examination

The medical examination, inclusive of electrocardiogram and relevant blood chemistry analysis, was carried out on the first day of the programme.

Computerised CAD Risk Assessment

Results of the medical examination and information on the participants' past medical history were then fed into a computer programme named CARDIOVASCULAR RISK FACTOR ASSESSMENT[20]. Using the computer programme, participants' risk (individually, as per 1000) of developing CAD over the next 8 years were derived as well as relative risk and risk in ten-years' time.

Participant-risk in the computer programme named CARDIOVASCULAR RISK-FACTOR ASSESSMENT is calculated using the Framingham Equation for Probability, $P=1/(1+e^{-C})$ as explained in Table III[5]. The computer programme, however, takes into account additional risk factors such as obesity, physical inactivity and family history of premature CAD in a similar manner[5,6,20]. As shown in Table III, the coefficient for calculating risk of CAD differs between men and women. Thus, women also have this as an applicable programme although this study only describes all male participants.

Table II - Profile of the 35 participants (Prevalence of risk factors, singly and in combination)

No.	Conditions	No. of Participants
1	Hypertension	12
2	Hypertension & diabetes	2
3	Hypertension & obesity	12
4	Hypertension, obesity & diabetes	2
5	Hypertension & smoking	4
6	Hypertension & raised cholesterol	6
7	Hypertension & reduced HDL cholesterol	10
8	BP systolic > 150 mmHg	2
9	BP diastolic > 90 mmHg (Phase 5 of Korotkoff sounds)	8
10	Cigarette smoking	15
11	Smoking & diabetes	1
12	Smoking & raised cholesterol	12
13	Smoking & reduced HDL cholesterol	9
14	Cholesterol > 220 mg/dl	20
15	Raised cholesterol & diabetes	2
16	Raised cholesterol & obesity	20
17	HDL cholesterol < 40 mg/dl	26
18	Reduced HDL cholesterol & obesity	26
19	Reduced HDL cholesterol & diabetes	5
20	Reduced HDL cholesterol & lack of exercise	15
21	Lack of exercise	22
22	Obesity	34
23	Obesity & diabetes	6
24	Diabetes	6
25	Left ventricular hypertrophy	2

On the second day, physical fitness evaluation was carried out. Parameters of concern were weight, chest circumference, abdominal girth, muscular strength, muscle endurance and cardio-respiratory (aerobic) capacity. Chest circumference was measured at the level of the nipples while abdominal girth was read-off at the umbilical level.

The entire physical fitness evaluation was carried out according to and using Canadian Forces Expres (CF Expres) programme[21].

Since proper equipment for direct measurement of muscular strength was not available, a modified method of measuring muscular strength together with muscular endurance was used. This was done by determining the maximum number of push-up and sit-up exercises that an individual is able to do without visibly straining. Sit-up exercises were done with the feet anchored.

Table III - Coefficients for calculating risk of cardiovascular disease[5]

Variable	Coefficient Men	Coefficient Women
Age (years)	0.3743307	0.2665693
Age x age	-0.0021165	-0.0012655
Serum cholesterol (mg/ml)	0.0258102	0.0160593
Systolic blood pressure (mm Hg)	0.0156953	0.0144265
Cigarette smoking*	0.5583013	0.0395348
LVH by ECG*	1.0529656	0.8745090
Glucose intolerance*	0.6020336	0.6821258
Cholesterol x age	-0.0003619	-0.0002157
Intercept	-19.7709560	-16.4598427

* Yes = 1 No = 0

To obtain the probability that cardiovascular disease will occur in 8 years to a man or woman initially free of cardiovascular disease, multiply the value of the characteristic in the units specified by the coefficient for the variable, sum these products and add the intercept. This provides the coefficient (C) to calculate the probability, $p = 1/(1 + e^{-C})$.

Physical Fitness Evaluation

Method of assessing cardio-respiratory maximal oxygen uptake capacity (aerobic capacity) was as described in the Canadian Aerobic Fitness Test (CAFT)[21]. Percentiles were read-off Percentile Charts for the Canadian population - percentile push-ups, percentile sit-ups and percentile maximal oxygen uptake (VO_2Max).

Exercise Prescription

Based upon results of anthropometry, aerobic capacity and muscle strength-muscular endurance assessed, individual exercise prescription was done for the participants using the CF Expres programme.

For improvement of muscle strength-muscular endurance, individuals were prescribed push-up, sit-up and chin-up exercises. Factors that were considered in such prescription were intensity (ie number of repetitions of the exercise, in terms of sets); frequency (ie number of times per week) and progression (ie redetermining the maximum at 3 weeks and thus increasing the intensity). At the start, participants were prescribed 75% of the maximum for each exercise as intensity. For example, if maximums were 20 push-ups, 24 sit-ups and 8 chin-ups, then one set would be 15 push-ups + 18 sit-ups + 6 chin-ups. Frequency of exercise prescribed was three times per week.

Aerobic exercises prescribed were walking, jogging/running and stationary cycling. The grossly obese (>20% overweight) were advised against jogging/running. Again, factors in consideration were intensity, frequency, progression as well as duration. The Target Heart Rate Zone was prescribed for intensity where beginning intensity Heart Rate was determined by percentages of the ceiling heart rate depending on the number of stages completed by the individual in the Canadian Aerobic Fitness Test. A minimum of three times per week was prescribed in consideration of frequency. Fifteen to sixty minutes was recognised as ideal duration of the exercise, and twenty minutes prescribed as a start.

With regards to progression in aerobic exercising, initial phase (4 to 6 weeks), improvement phase and maintenance phase are recognised. During the initial phase, percentage Ceiling Heart Rates, according to Canadian Aerobic Fitness Test achieved, are expected achievement, while during the improvement phase the ceiling heart rate is the expected achievement, with increase in the duration every 2 - 3 weeks.

Warm-up and cool-down periods and exercises were

emphasised on all prescriptions.

Diet

The participants' meals included breakfast, mid-morning tea, lunch and dinner. The menu was prepared by a nutritionist and five types of diets were provided throughout the ten-day programme:

a) reduction diet for the obese
b) diabetic diet for the diabetics
c) low-salt diet for the hypertensives
d) low-cholesterol diet for those with hyper-cholesterolaemia, and
e) normal diet.

Participants had their diets prescribed individually.

Physical Fitness Workout

Participants did physical fitness workouts daily, either prior to breakfast or prior to dinner. The one-hour workouts were supervised by qualified physical fitness instructors who helped them achieve their prescribed weekly exercise requirement.

Stop-Smoking Programme

A modified version of an available programme[10] to help stop smoking was recommended to participants who smoked cigarettes.

Lectures, group discussions, individual counselling

Lectures on topics relevant to CAD risk factors were given by the author, other registered medical-practitioners and a nutritionist. The lecture topics are as shown in Table I.

Group discussions for participants moderated by the author and other registered medical practitioners were held on selected lecture topics.

In addition, participants had sessions of individual counselling with the moderators so as to help recognise their risk factors and overcome them. Participants was also advised on the need for long-term follow-up and feedback on their progress after leaving the Farm.

Final evaluation

At the end of the ten-day programme, anthropometry and physical fitness evaluation were carried out. Feedback on the usefulness of the programme and general comments were obtained from participants.

RESULTS

Table IV shows the profile of 35 participants in terms of measurement at the start.

The 35 participants were not chosen in any particular manner, except that data on the rest of the participants were lost. Therefore, no bias is intended, or expected. In any case, the author has intended this study to be a descriptive one, preliminary in nature, in consideration of the small number of subjects.

Table V shows a description of the 35 participants in terms of their achievement at the end of the ten-day programme.

DISCUSSION

The objective of this study is to assess the effectiveness of initiating high-risk individuals into the Health Farm concept in the primary prevention of CAD.

Effectiveness may be defined as the ability of a programme in achieving its objective[22]. In the case of our Health Farm, the objective was to make participants aware (through a health-education programme) of risk factors in CAD and initiate them (through an activities-oriented programme) into methods aimed at changing their lifestyles towards one conducive to healthier hearts.

Table IV - Description of the 35 participants (Measurements at the start)

	Variable	Min	Max	Mean	SD
1.	Age (years)	24	42	35.23	4.7
2.	Duration of service (years)	5	21	15.06	4.63
3.	Weight (kg)	68.8	107.4	85.25	10.55
4.	Percent overweight	0	65.6	22.14	15.45
5.	Girth difference[a] (cm)	-5.0	7.0	0.95	3.34
6.	Percentile[b] VO_2Max	40	95	80.14	14.5
7.	Percentile[c] push-ups	5	50	15.86	9.59
8.	Percentile[d] sit-ups	0	45	8.71	11.72
9.	Risk now[e] (per 1,000)	4.0	185.0	56.54	49.02
10.	Relative risk now[f]	0.22	5.50	2.08	1.54
11.	Risk in ten years' time[g] (per 1,000)	0.4	413.0	123.63	105.85

Note:

a. Girth difference is obtained by deducting girth at umbilicus from chest measurement at level of nipples.

b. Percentiles read off Percentile Chart derived from project by Canadian Public Health Association on 5,578 subjects.

c. Percentiles read off Percentile Chart derived from project by Canadian Public Health Association 5,253 subjects.

d. Percentiles read off Percentile Chart derived from project by Canadian Public Health Association on 5,684 subjects.

e. Overall Coronary Artery Disease (CAD) risk over the next 8 years based on risk equations developed by the Framingham Study. Other risk factors for CAD are included that are shown to increase CAD risk but not included in the Framingham equation. (W V Brown and G Assman, 1986).

f. Compared with Average Framingham Risk for Persons of the same age. (W V Brown and G Assman, 1986).

g. Overall CAD risk ten years from date of assessment (W V Brown and G Assman, 1986).

Participant feedback and comments at the end of each ten-day programme were used as a yardstick to measure the effectiveness. These comments were generally encouraging. In retrospect, the author believes that this subjective measure could have been improved by means of a self-administered, multiple-choice type, knowledge-assessment questionnaire at the end of the programme which would have produced more quantitative feedback on the effectiveness, particularly with regards to participant awareness.

It has been pointed out, however, that people may be made aware of their risk-factors regardless of their background of formal education, but this may not necessarily result in appropriate behaviour[23].

Another yardstick that may be used in measuring the effectiveness of such a programme would be a measure of participant compliance. The results in Table V indicate significant changes which in turn indicate general participant compliance to the programme. Such compliance, and the subsequent result, is a direct measure of successful initiation of the participants into healthy lifestyles and an indirect measure of the success of the health-education and awareness part of the programme.

Table V - Description of the 35 participants on their achievement

Variable	Min	Max	Mean	SD	t-test
1. Increase in VO_2Max (ml/kg/min)	-8.80	3.40	-0.94	2.63	p<0.005
2. Increase in percentile[a] VO_2Max	-70.00	15.00	-8.29	20.07	p<0.005
3. Increase in percentile[b] push-ups	-15.00	70.00	18.14	15.77	p<0.005
4. Increase in percentile[c] sit-ups	-15.00	45.00	6.86	11.45	p<0.005
5. Percentile weight loss	0	6.0	2.66	1.45	p<0.005
6. Change in girth difference[d] (cm)	-3.50	12.50	2.91	3.02	p<0.005

Note:

a. Percentiles read off Percentile Chart derived from project by Canadian Public Health Association on 5,578 subjects.

b. Percentiles read off Percentile Chart derived from project by Canadian Public Health Association on 5,253 subjects.

c. Percentiles read off Percentile Chart derived from project by Canadian Public Health Association on 5,684 subjects.

d. Girth difference is obtained by deducting girth at umbilicus from chest measurement at level of nipples.

The participants were clearly informed that the programme would only help them overcome CAD risk factors and that ultimate success in the matter would depend very much on their continuing the healthy lifestyle that they have been initiated into. In addition, they were informed that the Farm would coordinate for them long-term follow-up using computerised record-keeping. They were to periodically (6 monthly/annually) mail to the Farm, parameters (measurement done at peripheral centres) for reassessment of CAD-risk, and advice on return-participation.

Table V clearly describes significant weight loss and consequent improvement in chest circumference/abdominal girth difference. There is clear positive change of muscle strength/ muscular endurance as shown by increase in percentile push-ups and sit-ups.

Decrease in percentile maximal oxygen uptake (VO_2Max) is observed. It must be pointed out that during the ten-day Farm programme, participants were still in the initial phase (4 to 6 weeks) of aerobic exercises prescribed for them. Low-calorie diet and rapid loss of weight may have contributed to this. Increase in maximal oxygen uptake can be expected during the improvement phase (after 6 weeks).

There is a dearth of information on primary prevention intervention trials on CAD done locally. There are several studies done in developed countries, the most famous of which are the Multiple Risk Factor Intervention Trial (MRFIT) and the Lipid Research Clinics Coronary Primary Prevention Trial (LRC-CPPT).

Results from the MRFIT, analysing mortality rates from CAD in 12,866 high-risk men aged 37 to 57, are disappointing in the sense that there was no significant difference in the mortality rates between those assigned to a special intervention programme and those assigned to their usual sources of health-care in the community[4,16].

It should be pointed out here, however, that the MRFIT only addressed 3 out of all the risk factors implicated in CAD viz, hypertension, cigarette smoking and blood cholesterol level[5,16], although these are generally considered the more important. Moreover, the method of intervention only utilised a physician at the initial phase of the intervention. Subsequent phases of intervention were done by a team that did not include physicians. Neither does the intervention appear to have been intensive enough[16].

It must be pointed out again that myocardial infarctions from CAD occur earlier in Asians as compared to Caucasians[9] and hence mortality rates can be expected to be significantly higher among Asians.

Importantly, lack of exercise and physical inactivity as a risk factor appears to have been omitted in the MRFIT[16].

Other studies show that the effect of exercise may be an important mechanism by which habitual exertion protects against cardiovascular disease[24,26]. Increased exercise leads to lower concentrations of triglycerides, VLDL-cholesterol, and LDL-cholesterol while increasing concentrations of HDL-cholesterol[24-26]. Although increased maximal oxygen uptake is a handy yardstick for measurement of physical fitness achieved by exercise, its correlation with HDL is said to be unclear[24].

Exercising adequately to achieve fitness has many beneficial effects: it increases maximal oxygen uptake, slows the heart, lowers blood pressure slightly, decreases ventricular ectopic activity, increases the myocardial capillary-to-fibre ratio, enlarges the bore of the coronary arteries, increases cardiac output and increases physical work capacity. Less established findings are that exercise improves mood, thought and behaviour[24].

The influence of exercise on cardiovascular fitness is at least partly independent of other risk factors. Exercise carries the added benefit of influencing these factors directly by reducing weight, lowering blood pressure slightly and discouraging the wish to smoke. Moreover, exercise has been shown to increase insulin-sensitivity by 30% or more and so it may be useful in the management of insulin-resistant states such as obesity and adult-onset diabetes which are risk factors of CAD[24].

Although the broadest application of exercise is for the achievement and maintenance of physical fitness, there is growing evidence of its importance to secondary prevention of heart attack[24]. This, however, is beyond the scope of this study.

Results from the LRC-CPPT are more encouraging. The study, which tested the efficacy of cholesterol-lowering in reducing risk of CAD in 3,806 asymptomatic middle-aged men with primary hypercholesterolaemia, indicates that the intervention group (cholestyramine vs placebo) experienced a 19% reduction in risk ($p<0.05$) of the primary end point - definite CAD death or definite non-fatal myocardial infarction - reflecting a 24% reduction in definite CAD death and 19% reduction in non-fatal myocardial infarction[17].

In addition, the LRC-CPPT results indicated that a 19% reduction in CAD risk was also associated with each decrement of 8% in total cholesterol or 11% in LDL-cholesterol ($p<0.001$)[18].

CONCLUSION

Cardiovascular disease, in particular coronary artery disease, is a major cause of preventable morbidity and premature mortality. Their human and economic costs are extremely high. It is well recognised that prevention of CAD can be attempted in different phases of the natural history of the disease. The primary prevention approach which involves the prevention of CAD in people having risk factors and which relies largely on the evidence that modification of risk factors reduces the occurrence of CAD is most suited to a community physician. This approach

has in fact been tested in celebrated intervention trials.

This study lends preliminary evidence that the Health Farm concept is an effective means of implementing the primary prevention approach. Individuals in Malaysia with CAD risk factors are by no means scarce. The author hopes to apply the Health Farm concept on a broader scope when the opportunity arises so that more data will be available for a more in-depth study.

It has been admitted that there is much to learn about motivating change in behaviour to control risk factors, and that approaches to prevention of CAD include public health measures to alter the ecology in favour of cardiovascular health, preventive medicine directed at highly vulnerable candidates and hygienic measures adopted by an informed public on its own[27]. The Health Farm concept illustrates the second approach mentioned.

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