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Collaborative platform development in nutrition as support for cardiovascular patients' rehabilitation

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Abstract

Introduction. Enrollment of patients with cardiovascular disease in rehabilitation programs may contribute to implementation of a healthy lifestyle, including by promotion of a diet adequate for each patient's profile. In this context, the current study is aimed at creating a traffic light system model allowing to obtain the development, innovation and diversification of menus and to improve the nutritional programs for this category of patients. **Material and method.** Based on the data provided by USDA Food Composition Databases, the composition in terms of different nutritive principles was determined for each ingredient and for each final menu. Comparison of menus depending on each nutritive principle, as well as comparison between menus and nutrient requirements according to indications for patients attending cardiovascular rehabilitation programs was made. **Results.** The traffic light system was developed, using color codes, comparing daily nutrient requirements with preparations' content. **Conclusions.** The major benefit of the traffic light system would reside in the fact that starting from classic menus, an intervention on these can be achieved, and healthier, more nutritionally balanced models can be created, according to healthy nutrition principles. These new menus will be calorically and nutritionally adapted for patients attending cardiovascular rehabilitation programs.

Key words: *nutrition, rehabilitation, traffic light system*,

1 Introduction

Cardiovascular diseases (heart failure, ischemic disease, stroke) have an increasing prevalence (approximately 48% in adults aged over 20 years), in both sexes (1). They represent the first cause of death worldwide (1, 2), involving increasingly higher treatment and rehabilitation costs (1, 3). Without any doubt, an important role in the occurrence and complications of cardiovascular diseases is played by cardiovascular risk factors. Along with smoking, obesity, diabetes mellitus, dyslipidemia, hypertension, sedentary lifestyle, unhealthy diet is one of the most important modifiable risk factors. Certainly, at present, particular emphasis is also being placed on the evaluation of new cardiovascular risk factors (4, 5) and their implication in the progression of cardiovascular diseases (6). The European Guidelines for the Prevention of Cardiovascular Diseases recommend a healthy diet for all individuals, regardless of the presence or not of cardiovascular diseases (7).

According to the report of the American Heart Association in 2019 (1), about 80% of all cardiovascular diseases can be prevented through a healthy lifestyle, including a healthy diet. The data reported by the European Heart Network show that in Europe nutrition plays a primordial role regarding morbidity and mortality of cardiovascular cause (7). This is why, under conditions of an established cardiac disease, the enrollment of patients in cardiovascular rehabilitation programs may contribute to implementation of a healthy lifestyle, including by promotion of a healthy diet adequate for each patient's profile. In this context, the current study is aimed at creating a traffic light system model

allowing to obtain the development, innovation and diversification of menus and to improve the nutritional programs in patients undergoing cardiovascular rehabilitation.

Methodology of the research – Practical development of the traffic light system

The co-authors have strong expertise not only in their specific fields, but also in applying IT&C related knowledge and skills to various medicine areas, as shown by the following works (8-13).

This time we designed a small collaborative environment to support the traffic light related research by using basic ITC tools adapted to non-technical, but comfortable user experience and pre-existing data structure and layout given by Nutritional DB.

In terms of Design Science research (14), our design problem can be formulated as follows:

- We aim to improve collaboration, data processing and analyze support effectiveness...

1. ...by developing a comfortable ITC-based platform...
2. ...that allows the medical staff to design a traffic light system...
3. ...in order to maximize utility for people to make better and informed nutritional choices.

According to the conceptual design depicted in ERD, its relational mapping was first projected in individual sheets via Google Sheets to ensure data sharing and collaborative work among team members spread in different locations.

Preliminary results

STAGE I – based on the data provided by USDA Food Composition Databases https://ndb.nal.usda.gov/ndb/search/list, the composition in terms of different nutritive principles was determined for each ingredient:

1. Saturated and polyunsaturated fatty acids 04:00, 06:00, 08:00, 10:00,12:00, 14:00, 16:00, 18:00, 20:00, 22;00, 24:00;

- Proteins – including 20 amino acids – leucine, lysine, methionine, valine, arginine, histidine;

Carbohydrates – different types, e.g. fiber, fructose, lactose, maltose, sucrose, galactose;

Vitamins – group B vitamins, folates, vitamins A, C, E, D, K, riboflavin; flavonoids;

Minerals – calcium, magnesium, iron, selenium, zinc, copper;

Energy and total amount of lipids, proteins and carbohydrates.

The centralization of these data for each ingredient led to the creation of a database.

STAGE II – determination of composition in terms of different nutritive principles of the final preparations (soups/basic preparations/garnishes) – based on connections established between recipes – ingredients used – amounts – nutritive principles.

STAGE III – comparison of preparations depending on each nutritive principle, as well as comparison between menus and nutrient requirements according to indications for patients attending cardiovascular rehabilitation programs.

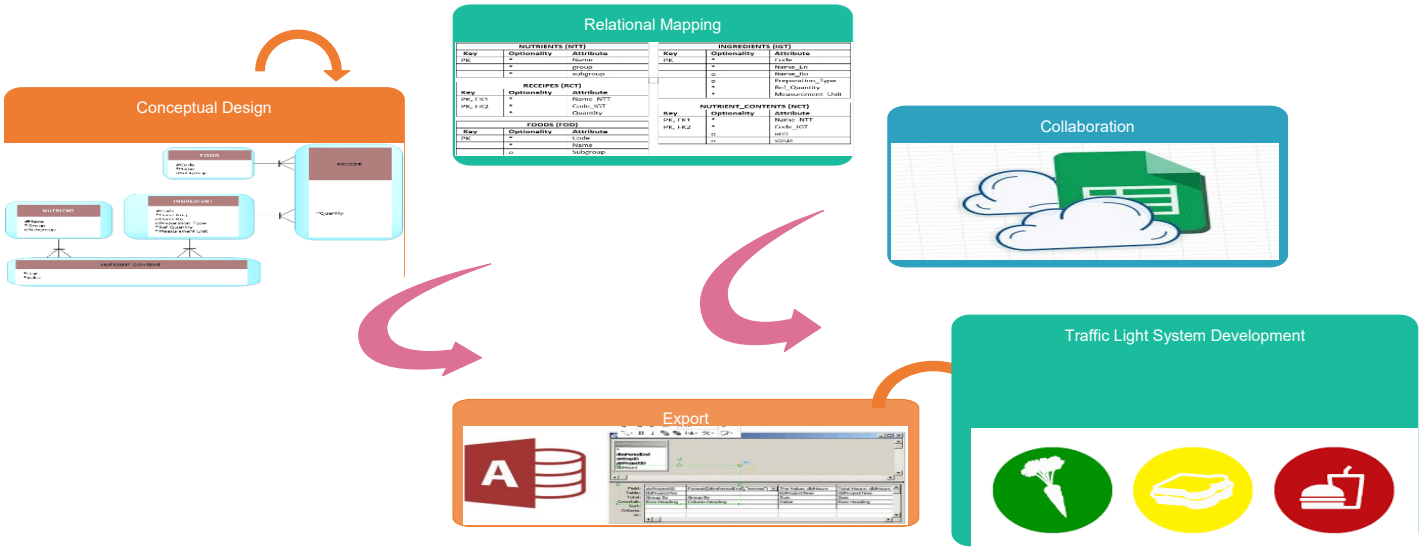
Color codes were used to develop the traffic light system: green – if all daily nutrient requirements were met, yellow – if the studied preparation met more than 60% of the daily nutrient requirements, attention being drawn to the fact that the rest of the daily requirements had to be met by the other preparations consumed, and red – if the amount provided by the studied preparation was less than 60% of the daily requirements. In the case of "unhealthy" nutritive principles (e.g. salt), the system of values was reversed – the preparation being assigned the red color if the value exceeded the limit admitted for the studied age category.

The stages of the development of the traffic light system are presented in Figure 1, and the practical exemplification of the result (for several preparations) is shown in Figure 2.

Discussions

The application of IT&C tools in other areas than the field of computers and particularly in medicine is considered to be promising; modern methods can facilitate both the discovery of new knowledge and the increase in the practical applicability of existing knowledge. They can be included in cardiovascular rehabilitation programs, which during stages I and II are conducted in an organized setting – in hospital or on an outpatient basis (15). The team involved in this program is complex, including, in addition to a cardiologist, nurses, a psychologist/psychiatrist and a kinesiotherapist, a nutritionist.

Fig. 1.– Traffic light system development process flow



Denumire	Riboflavin	Selenium	Sodium	Thiamin	Vitamin A	Vitamin B12	Vitamin C	Vitamin D	Vitamin E	Vitamin K	Zinc
supa crema de linte	2.62	163.29	6350.38	5.23	6045.51	0.00	3.76	0.00	6.24	84.12	10.40
supa crema de mazare	2.77	164.90	6545.21	5.64	8372.22	0.01	43.56	0.00	6.30	134.76	11.24
supa crema de praz si cartofi	2.68	163.95	6378.72	5.24	1609.62	0.06	18.09	17.60	6.72	122.10	9.96
supa crema de rosii cu busuioc	2.66	171.54	7171.03	5.30	8226.19	0.00	68.40	0.00	9.62	127.14	10.32
supa de fasole 400 ml	0.05	0.22	2350.81	0.01	208609.50	0.00	7.94	0.00	2.12	5.27	0.15
supa de pui cu fidea	0.24	28.50	1771.37	0.16	33966.76	0.18	307.95	2.00	3.52	60.80	2.5

Fig. 2. – Traffic light system results – exemplification

Exemplification for: lentil cream soup, green peas cream soup, leek and potato cream soup, tomato and basil cream soup, bean soup, and chicken and noodle soup

After the data population process, the cloud stored file was exported locally, cleaned up, mapped to a database structure, and then analyzed with MS Access tools such as cross-tabs and other various query types. The short time period during which the patient with myocardial infarction treated interventional is hospitalized is extremely important for understanding the cardiovascular risk factors that have led to the development of the disease and for implementing lifestyle changing measures, including those concerning a healthy diet. Next, although rehabilitation is carried out in an outpatient setting (and currently, more and more often at home), the patient should be monitored and evaluated periodically from this point of view as well (16-18). In this regard, creating a "nutritional model" that can be applied to these categories of patients can be of real help.

There are few published studies on the possible uses of various informatics methods in nutrition and particularly among patients enrolled in cardiovascular rehabilitation programs. The great majority of current applications refer to the calculation of the content of lipids + proteins + carbohydrates, provide simple nutritional evaluation methods, without refined analyses and without taking into consideration the particularities and nutritional requirements of the person concerned.

Different types of diets have been studied and assessed regarding their role in the secondary prevention process (19) – Mediterranean diet – in the PREDIMED study - Prevencion con Dieta MEDiterranea (20, 21, 22), Hellenic Heart failure study (23), DASH diet, vegetarian or vegan diets. Controversies related to vegetarian/vegan diets are multiple. The risks of these diets would be nutrient deficiencies (24), lower levels of eicosapentaenoic and docosahexaenoic acids (25-27) – acids involved in cardiovascular disease prevention (24, 28), lower iron stores (24), lower daily intake and serum concentrations of zinc, iodine and vitamin B12 deficiency, decreased vitamin D levels (24,25) with a reduction in bone density, development of osteoporosis, spinal fractures and compression (25). However, a vegetarian diet induces an improvement in the lipid profile, blood pressure values, glycemic

control, a decrease in abdominal obesity (25, 28-33), reduces salt consumption, is rich in potassium, is associated with an increase in the level of physical activity performed (34) and with fewer fatal/non-fatal events in patients with ischemic heart disease (24, 25, 35, 36).

The adaptation of diet to the existing cardiovascular pathology, to the desiderata imposed by the performing of the cardiovascular rehabilitation program (type of physical exercise) and to the subjects' personal characteristics (sex, current weight status, and food preferences) is an extremely sensitive and difficult to achieve process. Current prevention guidelines recommendations are a percentage of trans-unsaturated fatty acids <1% of energy intake, consumption of < 5 g salt/day, limitation of alcoholic drinks and discouragement of sweetened/carbonated drinks (7).

Even if there are studies (pro and con) on the impact that certain nutrients and vitamins may have on cardiovascular pathology (selenium – (37-40), thiamine – (41,42), vitamin C - (43, 44), magnesium – (4-47), zinc (48), monitoring of intake within rehabilitation programs is rarely performed.

The study of food menus and their adaptation to patients' particularities would involve nutritional analysis from the perspective of the recipe and preparation technology, providing information related to the nutritional and energy value of the menus, salt content, fat, saturated fat, sugar and particularly nutrients, vitamins (much more rarely evaluated, as mentioned before). The analysis of menus would identify deficiencies, as well as the possibilities of improvement. At the same time, with the help of specialists in nutrition, menus might be created in accordance with the dietary beliefs of different categories of patients, to reduce nutritional deficiencies and allow effective cardiovascular rehabilitation. Despite seeming an easy process, refined analysis, with the evaluation of micronutrient and vitamin content, is very time-consuming and difficult to perform.

Implementing the traffic light system would allow the development, innovation and diversification of food menus, which would lead to reformulated, personalized menus with practical applicability (by applying knowledge of molecular gastronomy, molecular, nutrigenomic, nutriepigenetic nutrition) for patients attending cardiovascular rehabilitation programs (49-51).

Conclusions

The major benefit of the traffic light system would reside in the fact that starting from classic menus, an intervention on these can be achieved, and healthier, more nutritionally balanced models can be created, according to healthy nutrition principles. These new menus will be calorically and nutritionally adapted for patients attending cardiovascular rehabilitation programs.

Through the collaboration of the cardiologist and the nutritionist, using modern informatics methods, patients will be able to diversify their diet, while respecting the principles of healthy nutrition.

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