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Cognitive approach to nutrition in a patient-centered approach: implementing tailored nutrition advice for oncology patients

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Abstract

This theoretical overview stresses the importance of a personalized approach to the study of the relationship between nutrition and prevention by the use of a cognitive approach. An adequate nutrition program should play a fundamental aspect of patient-centered care, but also is the best prevention strategy in disease-free subjects. We argue that an integrated methodology, based on a patient-centered and tailored approach, must assess all the factors involved within individual food choices in order to recognize values, beliefs and needs related to food intake, both in cancer patients and in disease-free patients. An integrated approach is advocated, since the tailoring process requires both biological and psychological data in order to appraise the individual's needs and promote adequate action plans. This process of integrating information delivered from different sources is what we call a "cognitive approach" to nutrition.

Keywords

Behaviour, choice, clinical decision-making, genomic medicine, habit, health promotion, individualized care, interactive games, nutrition cognition, oncology, P5 approach, patient-centered care, person-centered medicine, psychosocial factors, quality of life,tailored care, wellbeing

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Introduction

In 1953, an American biologist by the name of James Watson (1928-), with the collaboration of Francis Crick (1916-2004), elucidated the structure of DNA. The 2 scientists were immediately hailed as the discoverers of the "secret of life." This was the first step towards a new approach to the human being and the study of disease. In fact, the human genomic project represents the official date of birth of genomic medicine which, since the end of the Human Genome Project (HGP) in 2003, when the DNA sequence was finally completed, has become an important predictive tool for many chronic diseases.

Genomic research has allowed the development of highly effective predictive techniques and has encouraged the adoption of tailored therapeutic treatments according to the phenotypic and genotypic characteristics of the patient. Genomic medicine uses the information provided by genomes, RNA, proteins and metabolites to support and to organize clinical decision-making. This approach has led the origin of personalized medicine, also called *p*-medicine. Personalized medicine is based on pharmacogenomics, which predicates the mutual interaction between genes and drug reaction and provides a tailored treatment to the individual characteristics of the patient. Personalized medicine employs genomic studies to improve preventive healthcare programs and drug treatment in 2 specific ways: before the disease occurs and in its early stages.

The fundamental aims of p-medicine are to improve treatment action; enhance genetic screening and prevention behavior in healthy populations and to support clinical and patient decision-making about care in the face of multiple options. Hence, a cornerstone of personalized medicine is to understand which gene mutations causes the onset of disease and how. More specifically, genetics-related studies have led to the identification of several loci that are used for genetic screening and preventive treatment programs [1]. By way of example, let us consider the predisposition to breast and ovarian cancer. During the last 2 decades, 2 gene mutations have been identified as responsible for breast cancer 1 (BRAC1) and breast cancer 2 (BRAC2). Specifically, accumulated data indicate that out of 215,000 people who have developed breast cancer, 7% relate to hereditary factors and of these, 84% are related to genetic mutations [2].

This particular approach to prevention has resulted in important health-related outcomes. First, it has improved

the tests aimed at evaluating the individual's genetic risks, which are linked to the family's health history and the genomic information connected with gene mutation. Secondly, it has allowed more effective treatment action for overt disease, as well as for the early stages of disease. Thirdly, it has supported the creation of treatment models tailored on the individual, that is, based not only on epidemiologic data but also on genotypic and phenotypic characteristics.

Personalized nutrition

Until the discovery of the genomic approach, action in nutrition was exclusively based on epidemiological data. Today, the personalized approach is applied to nutrition, in order to analyze individual reactions regarding different diets at the genetic, protein and metabolite levels [3]. These developments have encouraged a biological approach to diet assessment and, at the same time, favored a tailored intervention method to change food-related habits. In this sense, an integrated approach is advanced, since the tailoring process requires both biological and psychological data in order to appraise the individual's needs and promote adequate action plans.

This process of integrating information derives from different sources and demonstrates what we call a "cognitive approach" to nutrition. Indeed, cognitive science has a special interest in the analysis of knowledge organization with the aim of supporting innovative tools in various fields.

In fact, genetic nutrition consists of 2 main research areas: nutrigenetics and nutrigenomics. Nutrigenomics shows how dietary components influence gene expression, while nutrigenetics is based on individual genetic characteristics, relating them to diet, individual predispositions and environmental aspects [3]. We argue that a shifting towards implementing a cognitive approach to the nutrition issue is necessary.

The P5 approach and personalized nutrition

Tastes and consequently food-related choices are established both by physiological factors (gene mutations, olfactory and gustative sense features) and by cognitive aspects that give rise to a hedonistic evaluation of nutrients (likings *vs* dislikings). Also, environmental, cultural and lifestyle habits are significant factors in food-related choices.

At a physiological level, smell and taste are primarily responsible for "flavor perception". Smell guides individual food preferences, while the sense of taste determines the final decision about the intake of food or its rejection. After the perceptive level, cognitive processing provides a tailored flavor (liking or disliking). Both smell and taste are mediated by transduction receptors, which transform chemical stimuli *via* electric signals. These electric signals arrive at the primary gustatory cortex and produce a cognitive elaboration of subjective flavor [4]. Smell and taste are linked with the thalami and amygdali and for this reason they are correlated with memory and emotional factors. Though smell and taste are linked to genetic variability, there is a clear learning during the first years of life.

We argue that an integrated methodology, based on a patient-centered approach, must assess all the factors involved within individual food choices in order to recognize values, beliefs and needs related to food intake, both in cancer patients and in disease-free individuals.

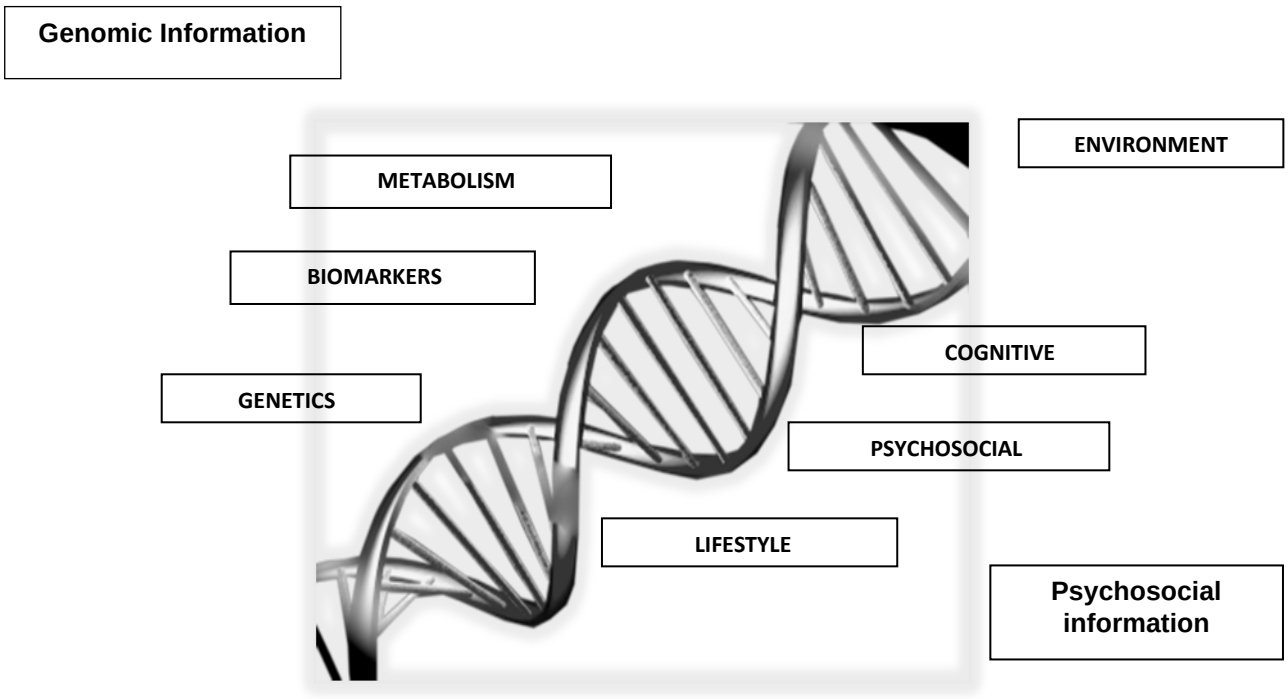
The "Fifth P", or P5 approach, is moving in this direction, to the extent that it could be considered a cornerstone of modern nursing practice. The traditional approach to personalized medicine involves 4 physiological characteristics. Indeed, we often use p-medicine expression in order to remind ourselves of the 4 basic characteristics of the clinical model: personalized, predictive, participative and preventive [1]. Though these qualities are related only to genetic factors, we observe that to empower a cancer patient a personalization model is required which involves, also, other individual dimensions. The importance of behavioral, psychological and cognitive aspects has been emphasized by cognitive scientists. In personalized medicine, these parameters are fundamental to evaluate cancer patients and chronic diseases and also to assess patients' coping strategies, participation and involvement in the decision-making process, compliance and tolerance with therapy [5].

The patient-centered approach and nutrition

There is a bi-directional correlation between the patient-centered approach and personalized medicine. This expression was first articulated by the Institute of Medicine (IoM) in 2001. Specifically, the patient-centered approach is based on the identification of values, beliefs and the needs of each patient. Consequently, a clinical decision is the result not only of the physician's view, but also of the whole of the patient's requirements; in other words, it is a synthesis of clinical evidence and individual needs. According to this model, doctors and patients must work together to define a decision model where clinical considerations as well as values and preferences are included in the care process. This approach supports the personalization of care, improving patient satisfaction, quality of life (QoL), compliance and better chronic disease management [6].

Accumulated scientific evidence has stressed the importance of nutrition habits in preventing chronic diseases. At the same time, diet and food-related choices are considered an important issue for cancer survivors. In fact, cancer has become in a considerable number of cases a controllable and survivable disease, thus creating a steadily increasing group of survivors. The increase in the survival rate derives from cancer screening, progresses in technology applications to detect cancer and therapies and also health programs. Survivorship is a condition with particular needs. Indeed, cancer treatment has long term effects on individuals (physical health, cognitive and

Figure 1 The cognitive approach to personalized nutrition: a combined approach to personalized nutrition, showing information tailored on each human being



emotional wellbeing and socio-economic status). Survivors often live with the uncertainty of cancer recurrence, the so-called "Damocles Syndrome" [7]. For this reason, survivors need methods and tools that enable them to monitor all possible conditions and avoid behaviors that may have a negative impact on their quality of life and even possibly favor recurrences.

The personalized nutrition approach is based on the awareness that energy consumption should be adapted to the individual's biological, physiological and psychosocial features. The advantages of a personalized diet for the patient and the survivor involve 2 main areas of the individual's wellbeing: (i) physiological wellbeing: promoting a healthy diet improves the clinical conditions of the patients, helps cancer patients to adjust to the side effects of therapies and contributes in preventing recurrences and (ii) psychological wellbeing: a proper nutrition may have a relevant impact on QoL, both directly, as a consequence of the effect of a healthy diet on mood and cognitive performances and, indirectly, as a secondary effect of the improving of physical health. Also, the capacity to change negative habits improves psychological wellbeing.

The use of standardized suggestions (e.g., based on epidemiologic data) and general tools do not permit a complete assessment of patients' demands. Addressing this issue involves finding proper methods and instruments, both to monitor and also to educate patients. Indeed, a cancer diagnosis is often defined as being a "teachable moment", where new horizons may be experienced. From this perspective, even a severe diagnosis might be seen as an opportunity for change. Although we still know little about how to exploit this opportunity, we may argue that a personalized approach should also help health personnel to pursue this important goal.

A fundamental step for implementing a personalized approach is the analysis of needs. It is both necessary to collect data about the dietary habits of patients and to find the cognitive, psychological and social background of these habits. In order to analyze individual needs, a physician should be able to use brief instruments focused on: psychological demands, health beliefs and myths, psychosocial context and cognitive profile.

A personalized approach toward nutrition promotes a patient-centered approach, but also a way to the patient's empowerment. Empowerment, which is a critical step for a patient, involves several dimensions: (i) awareness of the consequences of inadequate food habits; (ii) awareness of the disease and its future consequences; (iii) improving cooperation in the treatment steps (before, during and after) & (iv) improving commitment.

Using a personalized approach requires the adoption of methods and strategies which enable the ability to tailor interventions on individuals [5,8]. This aim requires taking into consideration specific demands, needs and personal values as part of the contextual factors of clinical practice. We suggest that in order to help individuals to opt for a healthier diet that would enhance his/her quality of life, it is fundamental to create a personalized process to assess habits, attitudes and behaviors. The more we know about the personal world of each subject, the better we will be able to identify strategies to improve healthy food choices.

Cognitive characteristics of food-related choices

Subjects that adopt unhealthy food intake tend to fall into a cognitive trap called 'optimistic bias', an effect similar to that observed in tobacco addiction. Individuals tend to represent unrealistically their health condition, while changing their attitude towards other people. In others words, the optimistic bias implies judging personal risk less than the risk of other people [9]. For instance, subjects that habitually eat a lot of fat can think that their diet has a poor fat intake per day. In this case, the subject is not unaware of the cardiovascular risk related to his/her diet habits. Raats and Sparks noted that subjects involved in their experimental protocol reported a lower fat intake than the average individual. This attitude has been observed in other nutrition-related risk factors, for example, those involving blood-cholesterol level [10,11] and those caused by eating red meat and sweets, drinking alcohol, *etc*.

Tools

In order to implement a truly personalized and patient-centered approach, we need to identify first-person tools, that is, instruments that a patient may use day-to-day, hence enriching both personal experience and a shared knowledge within the medical setting. In this sense, the personalization of medicine and, in particular, of behavioral interventions, requires individuals not only to take their own responsibilities, but also a specific, idiosyncratic perspective. To enable this process, it is necessary to develop and implement instruments and tools characterized by their being interactive, portable and easy to use. In particular, nutrition tools should be developed as part of more general personal health records aimed to track the individuals' health history and to improve their behavior, both to prevent diseases and to enhance quality of life.

Interactive tools

A new strategy exploited at improving a personalized nutrition advice is based on the development of instruments. This approach is being empowered by the technological development of electronic, portable devices with high usability, real time features and interactive interfaces. The combination of technological tools and personalization is a strong strategy to achieve patient empowerment. For instance, in one clinical trial it has been observed that personalized newsletters exert a significant effect on behavior and may lead to a permanent lifestyle shift in terms of physical activity and healthy eating [12]. Only in this way will a patient be actually empowered, because he/she will have the possibility to monitor his/her food intake behavior, interacting with health personnel in real time, thus obtaining automatic or 'on demand' feedback to adjust behavior and modify bad habits. Additionally, physicians would be able to monitor the ongoing situation, with respect to dietary behavior, using simple applications by computer or other already available devices.

In real clinical settings, such instruments can be used without the interviewer's intervention; beside this, they can also be used at home. Brug and collaborators have implemented an interesting experimental protocol [13]. In their research, a computer-based personalized nutrition program was used. The program followed 3 steps:

- A *screening tool to evaluate energy balance*: it included a questionnaire composed of 121 items aimed at formulating a tailored nutrition diagnosis. The tool was divided into 2 sections: the first section was composed of 30 items that evaluated fat, fruit and vegetable intake per day; while the second section evaluated psychosocial factors involved in food choice (attitude, social support or influence and self-efficacy). The screening tool is important because it allows measuring the degree of awareness about personal risk and the increase in nutritional awareness is an important clinical target. Within the program, the individuals were divided according to personal food consumption (dietary habits, makeup meal and so on) awareness levels and personal beliefs [13].

- *Feedback*: the program predicted a personalized feedback of the screening score; the goal was to reduce fat intake and increase fruit and vegetable intake per day. Moreover, communication was personalized to fit with personal beliefs and awareness. For instance, different feedbacks were delivered to subjects who made unrealistic assessments of their own fat habitual intake and for subjects with realistic self-assessments [13].

- Finally, the participants received personalized nutrition advice aimed at changing and improving dietary habits.

In 2000, an interactive CD-ROM for screening and monitoring food intake in the American population was developed by the Food and Nutrition Service of the Department of Agriculture. The tool was based on 4 principles. First, the subjects could choose their own specific focus of interest; second, they must receive an on-time tailored feedback; third, the message must be related to the awareness of the need to change and fourth, the nutritional advice must be related to an individual's goal setting [14]. Two modules composed this CD-ROM: one module was related to fat consumption, while the second one was related to fruit and vegetable intake per day. The total score (concerning individual fat, fruit and vegetable intake) was compared to nutritional guidelines. After the screening a personal feedback was sent, which highlighted the nutritional deficit and the way to change an unhealthy diet. The program asked users to identify various aspects of their lifestyle and was programmed to propose issues with respect to that lifestyle [14].

Another program is the so-called FRESH START program, financed by the National Institutes of Health for cancer survivors. It is directed at cancer survivors, particularly, breast and prostate cancer patients. Cancer survivorship is a specific condition, which implies the need to monitor recurrence risk and the developing of comorbidity, for instance, cardiovascular disease and diabetes. As already discussed, a cancer diagnosis may be a "teachable moment", often leading survivors to make constructive changes in eating habits and lifestyle [15,16]. For this reason, survivors have a higher degree of interest and have high motivation to appraise healthy behaviors and monitor their clinical condition.

FRESH START includes a personalized workbook and a newsletter. For each unit of the workbook, the diet habits of the patient are compared with a healthy behavior and the subject is invited to change bad habits. The workbook also includes cancer-related information, other than advices for physical activity, fruit and vegetable intake and promoting a diet with low fat consumption.

The program works as an interactive game, in which patients may give rise to a personal testimonial (a sort of avatar) with some specific characteristics related to patients' habits and data (age, weight and like that). Participants have as their goal the need to change this testimonial so as to achieve a healthier status. During the entire program, participants received 6 tailored e-mails. These e-mails contained information about personal goals, barriers to change, individual progress, future goals and an analogical information carrier, the testimonial of the patient indicating the ongoing situation in at-glance representation [17,18]. Combining verbal and analogical information may help achieving the goal, activating both the emotional and cognitive appraisal of the situation while in addition improving data understanding. Data collected showed that FRESH START enhanced lifestyle shifting, especially increasing physical activity and energy expenditure, intake of fruits and vegetables, reducing consumption of fat of participants (prostate and breast cancer patients).

Other applications that can be used for nutrition monitoring are interactive games. These tools are particularly important in health education, even though little research is available in the field of patient empowerment. For instance, Lieberman [19] employed the game titled "Bronkie the Bronchiasaurus" to help the self-management of asthma in young patients.

IGs are useful and flexible tools to emphasize awareness and shifting in dietary habits. They allow a patient to be involved in stimulating tasks, where participants can experiment a diet management program. The foremost outcome is that IGs provide subjects personalized advice, but also the possibility to experience the consequences of their food choice using a trial and error approach. According to previous research, IGs increase motivation and attention [19].

An interactive game titled *Right Way Café* by Peng [20], has recently been developed at The University of Michigan, USA. In this game, participants acquire an avatar and have the possibility to choose meals and experiment with different diet styles. Each avatar is developed with reference to the individual characteristics of the player (age, gender, weight, height and so on). This interactive game assesses energy intake and simulates weight gain or loss. So, the individuals will learn to choose healthier food and to use strategies to achieve a correct dietary balance. The storyboard is based on a reality TV show [20]. When the players choose food they have the possibility to monitor nutrition labels by clicking the image of the food on a screen. Using a trial and error approach, individuals may experience each consequence of a food choice.

We may describe at least 10 major upshots of the IG-based health programs: an increase in accessibility, dissemination, compliance, cooperation and empathy; data personalization; variability reduction; low literacy requirements; a decreasing of violation rates [21]. Another example of IG tailored to dieting patients' needs is the *Patient-Centered Assessment and Counseling Mobile Energy Balance* (PmEB). It is a mobile application that is able to elaborate caloric balance, caloric consumption and caloric expenditure day-per-day [22].

A cognitive model of a patient-centered tool

The need for time- and cost-effective lifestyle, with particular reference to diet, is evident in recent approaches to healthcare which emphasize the need to tailor lifestyle counseling messages to individual patients. Individual desires and needs are increasingly becoming the method of choice in research. However, this is not yet the standard procedure in 'real' clinical settings. The effectiveness of interventions can be increased by tailoring counseling to individuals' levels of knowledge, awareness and motivation [23-25]. Furthermore, excluding unmotivated individuals from counseling programs can save general practitioners considerable amounts of time.

Kahn [26] formulated the optimal matching theory as the expectation that positive effects would be maximized when the kind of support offered was congruent with the requirement of the situation and the needs of the person. Tailoring the frequency, types, sources and media of social and cognitive support to individual patients may, therefore, retain its promise for the future. Even though there are a number of ways to build up a patient-centered tool aimed at promoting better food-related choices, we argue that a theoretical scheme should be followed. In particular, a socio-cognitive approach should be integrated into an Interactive online tool, so that a person could experience control over the process of change. A similar tool should be aimed at developing trust in the information given, empathy, motivation, fidelity and confidence.

To use a socio-cognitive approach as the basis for counseling, it is necessary accurately to assess individual readiness to change. In the research field, this is often achieved using single question or multiple-item algorithms that are completed by patients. In practice, the use of these algorithms is limited and it is reasonable to assume that physicians often act upon their perception of patient

readiness to change. The use of a first-person tool should contribute to the overcoming of this bias, that often leads physicians to wrong judgments, for instance, overestimating patients' readiness to change dietary habits.

The importance of an accurate assessment of motivation for lifestyle change is evident, as inaccuracy would lead to referral of unmotivated patients. A socio-cognitive nutrition intervention can increase the rate of movement from intention to action stage of dietary change. Over the past 2 decades, numerous programs aimed at improving health and preventing disease through promotion of more desirable fat consumption patterns have been developed and evaluated [23,27-34]. These programs are likely to be more effective if they are based on both the theory and practice of changing health-related behaviors, adapting them to real clinical settings through adequate interactive tools. Several theories are commonly used in understanding and predicting such human health behaviors as the reduction of fat intake. The terms used for the psychosocial determinants of behavior differ for the various theories. Nevertheless, there is substantial overlap among the underlying constructs [35-42]. The constructs most commonly used are attitude, self-efficacy, subjective norm (also known as perceived social support) and health threat (or susceptibility). Numerous studies have shown the importance of these determinants in relation to intention to change behavior and current or future behavior [43,44].

Most contemporary social psychological models of human behavior emphasize the conscious nature of behavior choice [45-47]. It is argued, however, that repeated activities (e.g., food choice, fat consumption) become habitual, rather than conscious and rational [46,48]. They are therefore less likely to be controlled solely by the behavioral determinants involved in conscious decision-making. This led Triandis in 1977 to include 'habit' as a determinant in a behavior model for the first time [49]. Since then, the importance of habit for the prediction of current or future behavior has been shown several times [46-48,50,51]. However, it is still questionable whether previous behavior influences subsequent behavior directly, or through feedback that influences attitudes, self-efficacy, subjective norm and health threat [45-47,51]. Hence, the socio-cognitive approach strongly suggests that the best way to promote a safer diet in patients is to gain a detailed knowledge of their habits, values and psychological characteristics in order totailor an intervention based on a calibrated feedback system. The only way to implement this system easily is to build up fully usable electronic tools.

We argue that it would be advisable to integrate a dietary monitoring tool within a general electronic personal health record. In this way, both physicians and patients could have at a glance a picture of the whole situation, suggesting possible interventions in real time and with little effort. These tailored tools could be very important in enhancing the quality of life of both cancer patients and survivors, separate from and in addition to promoting a healthier lifestyle in the general population. These tools could play an important role both in primary prevention and in secondary prevention. In primary prevention, personalized tools can help promote healthy behavior (nutrition, smoking cessation and physical activity) within the whole population. Also, they could contribute to the support and development of correct knowledge of better health practice, helping subjects to overcome cognitive distortions and limits (e.g., memory failures).

For example, for an individual who wishes to eat healthily (a correct portion per day of fat, fruit and vegetables), it is very important to have a portable tool which assesses energy consumption and expenditure, evaluates caloric intake, portion and the composition of each meal. Additionally, these tools enable subjects to check for errors and to indicate false beliefs about food-related choices, potentially modulating attitudes and behaviors.

However, the personalization process must be the chief aim within nutritional education. The more we know about the personal world of each person, the better we will be able to identify strategies to improve healthy food choices.

In conclusion, we argue that a physician must recognize nutritional needs of patients and could orient towards healthier nutrition choices. But in order to practise this patient-centered approach, physicians must have proper methods to measure and monitor the nutritional needs of a patient and adequate instruments to implement on-time interventions.

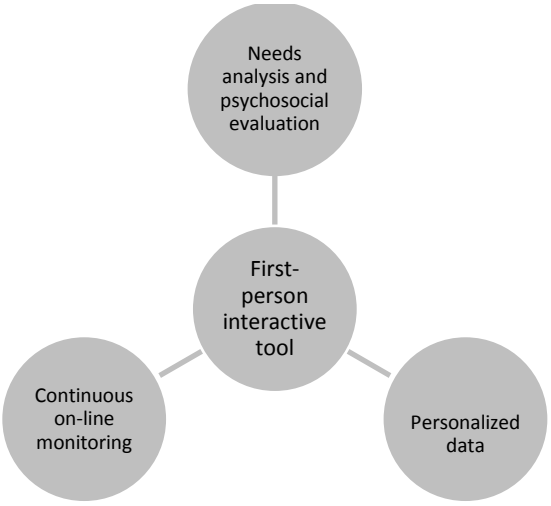
Conclusion

The clinical decision-making process in healthcare is a complex process which involves medical, ethical, individual, social and cultural factors. The progress of this approach will be accelerated by technological development in electronics, in particular portable devices with high usability, real time applications and interactive interfaces. Nowadays, due to technological improvement in research and to the different kinds of approach to the treatment of disease, a physician becomes the recipient and "carrier" of very complex scientific knowledge, much more than in the past [52]. Furthermore, the patient's role during care is now increasingly given primary relevance. These changes have created greater awareness of the need to tailor interventions specific to the individual.

As we have observed, preventive actions against cancer may be enhanced by the acquisition of personal healthy habits (adequate diet, smoking cessation, alcohol reduction, regular physical activity and so on). Particularly, it is important to note that good nutrition has a relevant impact on QoL. Indeed, a proper diet may positively affect both physical health and psychological wellbeing, emphasizing the need for clinicians to understand how to help healthy people and cancer patients adopt a healthy lifestyle.

In this short overview we have identified different interactive tools. However, the principal drawback of these tools is that they are not always applicable in real life, since they are calibrated to specific clinical settings and are not tailored on the subjects. Our cognitive approach suggests that a personalized strategy requires instruments

Figure 2 A conceptual schema of first-person tool design. For discussion, see text.



that can be used more easily by both oncologists and patients as schematized above in Figure 2.

Personalized tools should include and integrate diverse domains: a section that evaluates physiological parameters (weight, height, BMI, age, race, genomic characteristics and so on); a section that assesses energy consumption and energy expenditure on a daily basis; a section that evaluates lifestyle and correlates it to an adequate diet; a section that involves different food categories and nutritional properties and a section that gives tailored nutrition advice through the implementation of an on-line feedback system, which could even develop, for instance, a link to appropriate and healthy recipes. All these interactive tools could be used to achieve personalization not only in clinical trials, but in real life settings everywhere.

References

[1] Ginsburg, G.S. & Willard, H.F. (2009). Genomic and personalized medicine: foundations and applications. *Translational Research* 154 (6) 277-287.

[2] Green, M.J., Peterson, S.K., Baker, M.W., Friedman, L.C., Harper, G.R., Rubinstein, W.S., Peters, J.A. & Mauger, D.T. (2005). Use of an educational computer program before genetic counseling for breast cancer susceptibility: Effects on duration and content of counseling sessions. *Genetics in Medicine* 7 (4) 221-229.

[3] Kussmann, M. & Fay, L.B. (2008). Nutrigenomics and personalized nutrition: science and concept. *Personalized Medicine* 5 (5) 447-455.

[4] Buck, L.B. (2003). I sensi chimici: olfatto e gusto. In: Principi di neuroscienze, trad. It., 3° ed., pp. 618-638. Kandel, E.R., Schwartz, J.H. & Jessell T.M. (a cura di). Milano: Ambrosiana.

[5] Pravettoni, G. & Gorini, A. (2011). A P5 cancer medicine approach: why personalized medicine cannot ignore psychology. *Journal of Evaluation in Clinical Practice* 17 (4) 594-596.

[6] Epstein, R.M., Fiscella, K., Lesser, C.S. & Stange, K.C. (2010). Why The Nation Needs A Policy Push On Patient-Centered Health Care. *Health Affairs* 29 (8) 1489-1495.

[7] Pollack, L.A., Greer, G.E., Rowland, J.H., Miller, A., Doneski, D., Coughlin, S.S., Stovall, E. & Ulman, D. (2005). Cancer survivorship: a new challenge in comprehensive cancer control. *Cancer Causes & Control* 16, 51-59.

[8] Lucchiari, C., Botturi, A. & Pravettoni, G. (2010). The impact of decision models on self-perceived quality of life: a study on brain cancer patients. *Ecancermedicalscience* 4, 187.

[9] Helweg-Larsen, M. & Shepperd, J. A. (2001). Do moderators of the optimistic bias affect personal or target risk estimates? A review of the literature. *Personality and Social Psychology Review* 5 (1) 74-95.

[10] Raats, M. & Sparks, P. (1995). Unrealistic optimism about dietrelated risks: Implications for interventions. *Proceedings of the Nutrition Society* 54, 737-745.

[11] Miles, S. & Scaife, V. (2003). Optimistic bias and food. *Nutrition Research Reviews* 16 (1) 3-19.

[12] Walker, S.N., Pullen, C.H., Boeckner, L., Hageman, P.A., Hertzog, M., Oberdorfer, M.K. & Rutledge, M.J. (2009). Clinical Trial of Tailored Activity and Eating Newsletters With Older Rural Women. *Nursing Research* 58 (2) 74-85.

[13] Brug, J., Steenhuis, I., vanAssema, P. & deVries, H. (1996). The impact of a computer-tailored nutrition intervention. *Preventive Medicine* 25 (3) 236-242.

[14] Block, G., Miller, M., Harnack, L., Kayman, S., Mandel, S. & Cristofar, S. (2000). An interactive CD-ROM for nutrition screening and counseling. *American Journal of Public Health* 90 (5) 781-785.

[15] Demark-Wahnefried, W., Aziz, N.M., Rowland, J.H. & Pinto, B.M. (2005). Riding the crest of the teachable moment: Promoting long-term health after the diagnosis of cancer. *Journal of Clinical Oncology* 23 (24) 5814-5830.

[16] Alfano, M.C., Day, J.M., Katz, M.L., Herndon II, J.E., Bittoni, M.A., Oliveri, J.M., Donohue, K. & Paskett, E.D. (2009). Exercise and dietary change after diagnosis and cancer related symptoms in long-term survivors of breast cancer: CALGB 79804. *Psycho-Oncology* 18, 128-133.
[17] Demark-Wahnefried, W., Clipp, E.C., McBride, C., Lobachi, D.F., Lipkus, I., Peterson, B., Clutter Snyder, D., Sloane, R., Arbanas, J. & Kraus, W.E. (2003). Design of FRESH START: A randomized trial, of exercise and diet among cancer survivors. *Medicine and Science in Sports and Exercise* 35 (3) 415-424.
[18] Demark-Wahnefried, W., Clipp, E.C., Lipkus, I.M., Lobach, D., Snyder, D.C., Sloane, R., Peterson, B., Macri, J.M., Rock, C.L., McBride, C.M. & Kraus, W.E. (2007). Main outcomes of the FRESH START trial: A sequentially tailored, diet and exercise mailed print intervention among breast and prostate cancer survivors. *Journal of Clinical Oncology* 25 (19) 2709-2718.
[19] Lieberman, D.A. (2006). What can we learn from playing interactive games? In: Playing computer games: Motives, responses, and consequences, pp. 379-398. Vorderer, P & Bryant, J., (eds.). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
[20] Peng, W. (2009). Design and Evaluation of a Computer Game to Promote a Healthy Diet for Young Adults. *Health Communication* 24 (2) 115-127.
[21] Lisetti, C. (2012). 10 Advantages of using Avatars in Patient-Centered Computer-based Interventions for Behavior Change. *SIGHIT Record* 2 (1) 28.
[22] Tsai, C.C., Lee, G., Raab, F., Norman, G.J., Sohn, T., Griswold, W.G. & Patrick, K. (2007). Usability and Feasibility of PmEB: A Mobile Phone Application for Monitoring Real Time Caloric Balance. *Mobile Networks and Applications* 12, 173-184.
[23] Steptoe, A., Doherty, S., Rink, E., Kerry, S., Kendrick, T. & Hilton, S. (1999). Behavioural counselling in general practice for the promotion of healthy behaviour among adults at increased risk of coronary heart disease: randomised trial. *British Medical Journal* 319, 943-947.
[24] Steptoe, A., Kerry, S., Rink, E. & Hilton, S. (2001). The impact of behavioral counseling on stage of change in fat intake, physical activity, and cigarette smoking in adults at increased risk of coronary heart disease. *American Journal of Public Health* 91, 265-269.
[25] Van der Veen, J., Bakx, C., Van den Hoogen, H., Verheijden, M., Van den Bosch, W., Van Weel, C. & Van Staveren, W. (2002). Stage-matched nutrition guidance for patients at elevated risk for cardiovascular disease: A randomized intervention study in family practice. *Journal of Family Practice* 51, 751-758.
[26] Kahn, R.L. (1994). Social support: content, causes, and consequences. In: Aging and quality of life, pp. 163-184. Abeles, R.P., Gift, H.C. & Ory, M.G., (eds.). New York: Springer Publishing Company.
[27] Milkereit, J. & Graves, J.S. (1992). Follow-up dietary counselling benefits attainment of intake goals for total fat, saturated fat, and fiber. *Journal of the American Dietetic Association* 92, 603-605.
[28] Barratt, A., Reznik, R., Irwig, L., Cuff, A., Simpson, J.M., Oldenburg, B., Horvath, J. & Sullivan, D. for the steering committee of the staff healthy heart project. (1994). Work-site cholesterol screening and dietary intervention: the staff healthy heart project. *American Journal of Public Health* 84, 779-782.
[29] Neil, H.A.W. & Godlee, R.J.P. (1995). Randomised trial of lipid lowering dietary advice in general practice: the effects on serum lipids, lipoproteins, and antioxidants. *British Medical Journal* 310, 569-573.
[30] Simkin-Silverman, L., Wing, R.R. & Hansen, D.H. (1995). Prevention of cardiovascular risk factors in healthy premenopausal women. *Preventive Medicine* 24, 509-517.
[31] Rhodes, K.S., Bookstein, L.C., Aaronson, L.S., Mercer, N.M. & Orringer, C.E. (1996). Intensive nutrition counseling enhances outcomes of National Cholesterol Education Program dietary therapy. *Journal of the American Dietetic Association* 96, 1003-1010.
[32] Ockene, I.S., Hebert, J.R., Ockene, J.K., Saperia, G.M., Stanek, E., Nicolosi, R., Merriam, P.A. & Hurley, T.G. (1999). Effect of physician-delivered nutrition counseling training and an office-support program on saturated fat intake, weight, and serum lipid measurements in a hyperlipidemic population. Worchester area trial for counseling in hyperlipidemia (WATCH). *Archives of Internal Medicine* 159, 725-731.
[33] Hilton, S., Doherty, S., Kendrick, T., Kerry, S., Rink, E. & Steptoe, A. (1999). Promotion of healthy behaviour among adults at increased risk of coronary heart disease in general practice: methodology and baseline data from the Change of Heart study. *Health Education Journal* 58, 3-16.
[34] Finckenor, M. & Byrd-Bredbenner, C. (2000). Nutrition intervention group program based on pre-action stage-oriented change processes of the Transtheoretical Model promotes long-term reduction in dietary fat intake. *Journal of the American Dietetic Association* 100, 335-342.
[35] Becker, M.H., Maiman, L.A., Kirscht, J.P., Haefner, D.P. & Drachman, R.H. (1977). The health belief model and predicition of dietary compliance: a field experiment. *Journal of Health and Social Behavio*r 18, 348-366.
[36] Houts, S.S., & Warland, R.H. (1989). Rotter's social learning theory of personality and dietary behavior. *Journal of Nutrition Education* 21, 172-179.
[37] Reed, G.R., Velicer, W.F., Prochaska, J.O., Rossi, J.S. & Marcus, B.H. (1997). What makes a good staging algorithm: examples from regular exercise. *American Journal of Health Promotion* 12, 57-66.
[38] Prochaska, J.O. & Velicer, W.F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion* 12, 38-48.
[39] Baranowski, T., Cullen, K.W. & Baranowski, J. (1999). Psychosocial correlates of dietary intake: advancing dietary intervention. *Annual Review of Nutrition* 19, 17-40.
[40] Horwath, C.C. (1999). Applying the transtheoretical model to eating behaviour change: challenges and opportunities. *Nutrition Research Reviews* 12, 281-317.
[41] Elder, J.P., Ayala, G.X. & Harris, S. (1999). Theories and intervention approaches to health-behavior change in primary care. *American Journal of Preventive Medicine* 17, 275-284.

[42] Katz, D.L. (2001). Behavior modification in primary care: the pressure system model. *Preventive Medicine* 32, 66-72.
[43] Anderson, E.S., Winnett, R.A. & Wojcik, J.R. (2000). Social-cognitive determinants of nutrition behavior among supermarket food shoppers: a structural equation analysis. *Health Psychology* 19, 479-486.
[44] Packman, J. & Kirk, S.F.L. (2000). The relationship between nutritional knowledge, attitudes and dietary fat consumption in male students. *Journal of Human Nutrition and Dietetics* 13, 389-395.
[45] Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes* 50, 179-211.
[46] Aarts, H., Verplanken, B. & Van Knippenberg, A. (1998). Predicting behavior from actions in the past: repeated decision making or a matter of habit? *Journal of Applied Social Psychology* 28, 1355-1374.
[47] Ouelette, J.A. & Wood, W. (1998). Habit and intention in everyday life: the multiple processes by which past behavior predicts future behavior. *Psychological Bulletin* 124, 54-74.
[48] Verplanken, B., Aarts, H., Van Knippenberg, A. & Moonen, A. (1998). Habit versus planned behaviour: a field experiment. *British Journal of Social Psychology* 37, 111-128.
[49] Triandis, H.C. (1977). Interpersonal behavior. Monterey, California: Brooks/Cole Publishing Company, A division of Wadsworth Publishing Company, Inc.
[50] Aarts, H., Verplanken, B. & Van Knippenberg, A. (1997). Habit and information use in travel mode choices. *Acta Psychologica Scandinavica* 96, 1-14.
[51] Trafimow, D. (2000). Habit as both a direct cause of intention to use a condom and as a moderator of the attitude-intention and subjective norm-intention relations. *Psychology and Health* 15, 383-393.
[52] Lucchiari, C., Masiero, M. & Pravettoni, G. (2012). Methods for nutrition monitoring in cancer patients: a cognitive perspective. *Ecancermedicalscience* 6 (259) 1-11.