



SMART PERSONALIZED NUTRITION: QUO VADIS

Reflection paper on the discussions of
the Smart Personalized Nutrition workshop

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This report builds on the discussions of the European Commission FOOD 2030¹ workshop entitled "Smart Personalised Nutrition", that was held on the 16th of June 2016 in Brussels.

The complexity of the global food systems is increasing and decision making for citizens and food-sector actors in a plural world of information, products and services is highly demanding. Complex problems demand a purposeful exchange between science, business and civil society to ensure that the processes and outcomes of research and innovation are aligned with the values, needs and expectations of society. Societies are diversifying with growing financial and social inequalities but also with huge differences in diets and in the nutrition & health status. A better understanding of the interplay between biological, behavioural and environmental factors, influencing people's ability to live healthy lives, is needed. Enabling European citizens to make choices that result in healthy diets that are also sustainable and affordable using goods that are produced in a socially and environmentally responsible manner, is therefore of highest priority. In the fusion of advanced food production and supply methods with e-commerce, smart connected objects, Internet of Things, Big Data, Future and Emerging Technologies (FET), digital tools and solutions, ICT and applications in eHealth and m-health, SMART PERSONALIZED NUTRITION (SPN) creates a window of opportunities. Opportunities with a huge innovation potential and with benefits for citizens' health and wellbeing as well as for future-proofing our food systems so that they become more sustainable, resilient, responsible, diverse, competitive, and inclusive.

¹ See also the FOOD 2030 Staff Working Document [SWD(2016)319] entitled "Research and Innovation for Food and Nutrition Security. Available under: http://www.consilium.europa.eu/register/en/content/out/?&typ=ENTRY&i=ADV&DOC_ID=ST-12761-2016-INIT

getting a customized product at a unit cost similar to those of mass-production. In contrast to mass-customization, personalization requires a much higher level of involvement from the consumer and a greater degree of knowledge about the consumer to be shared. At its extreme, each customer is targeted as an individual, although these types of personalized products are typically targeted at a higher market segment. Alternatively, if via 'niche' or 'micro' marketing a relatively homogeneous sub-segment of consumers can be identified, opportunities to offer these segmented consumers more personalized versions of a product derived from a stable product base can be explored. Regardless of whether a business chooses to offer mass-customized products, personalized products or both, mechanisms for interacting with the customer and obtaining specific information in order to realize the customer's choices into the final product are fundamental. This typically involves the development of sophisticated IT software or toolkits often called "configurators" which are essential for guiding the user through the process and capturing the resultant choice combinations. Within the development of these systems it is important to recognize that when attempting to increase consumer choice, customers can easily become overwhelmed if presented with a vast array of choices, and that engaging with the choice process may involve significant time investment by the consumer. One way to overcome this is by the careful design of the customer interface within which consumers could be asked to express need(s) or preference(s) which can then be translated into a more focused choice set or even end-product selection, rather than being forced to trawl through all the choice options themselves. For example, if when purchasing the pizza the consumer defines themselves as a vegetarian at the outset, then all of the non-vegetarian choice options could be automatically eliminated from subsequent choice scenarios. Personalized nutrition services and products rely on accurate and appropriate data about things such as food choices and preferences (usually recorded by food frequency and other questionnaires which in future may be extended to image-based analysis of foods/menus or other measures such as sensors for chewing/swallowing).

Any SPN offering needs to account for food allergies and intolerances, likes and dislikes but also for ethical, cultural, religious and social constraints. If the SPN offering targets the health-dimension, input variables need to cover in addition phenotypic data (e.g. gender, age, body height and mass) and physical activity levels

and may include other biomarkers that report on the health status such as blood glucose, cholesterol levels or blood pressure. Possible nutrient deficiencies or at least intakes below the recommendations require also the analysis of corresponding status markers. This applies in particular to the growing number of elderly that are malnourished as well as to people that despite a proper caloric intake show selective nutrient deficiencies (hidden hunger). SPN approaches with dedicated services can help to tackle these problems – also via caretakers that may not have the expertise to identify and treat these deficiencies. In this respect SPN has the potential to prevent the development of nutrient deficiencies but it also may turn into a therapeutic approach when targeting diseases (diabetes, CVD, Alzheimer ect.) in which dietary support may have the character of an adjuvant – conceptually often called “medical food”.

Although not *a priori* required for SPN but easily available (and in future likely free of charge) is genetic information of the individual and its microbiota. There is evidence that individuals carrying certain genetic risk variants may profit from genotype-based targeted diets, but long-term studies demonstrating the success of such an approach in preventing disease progression are missing. Moreover, several studies have shown that recommendations for lifestyle changes based on genetic risks do not significantly increase compliance. When considering the ethical problems associated with provision of genetic information to a third party, it may be wise for the time being not to put too much emphasis on nutrigenetics approaches in the framework of SPN.

However, other data provided by the consumer on which individualized solutions are based are also sensible and that raises questions about data protection, privacy and ownership. SPN thus should have a proper legal and ethical framework. Credibility, transparency and trust into the SPN system (and providers) is essential and will be most critical for successful implementation and long term development of SPN in the commercial environment. SPN offerings, whether services or products or combinations thereof have to be safe, affordable, comprehensible, implementable and practical, but also enjoyable and deliver on the nutritional requirements of an individual/or metabotype.

Since modifiable life style factors - in particular dietary habits and physical activity levels - provide the closest link to diet-related chronic diseases like diabetes, coronary heart diseases, or cancers, assessment of all biomedical and nutritional parameters embeds SPN intimately into the health care system. When SPN approaches enable consumers to adopt a healthy lifestyle, SPN can have a significant positive impact on public health and may help to reduce the health care system costs. With the data generated on lifestyle parameters and on food consumption, citizens are also empowered - like never before - to have their share in the food systems and to take over responsibilities for food and health based on knowledge and experience. For people/citizens not able to do this on their own it may be the caretakers which then need proper education and skills. It will also be important to consider who has access to which information about individuals for which purpose. Health behaviour data is of interest to those making health resource decisions and thus data providers are open to the dangers of discrimination.

Furthermore, SPN could as well help to reduce the negative impact of food production and distribution on the environment for example by reducing food waste and by providing food products (or the information on such products) with little environmental impact. In this respect SPN offers a variety of options and solutions for the markets of tomorrow and for the empowerment of citizens making their role and responsibilities in the food systems transparent.

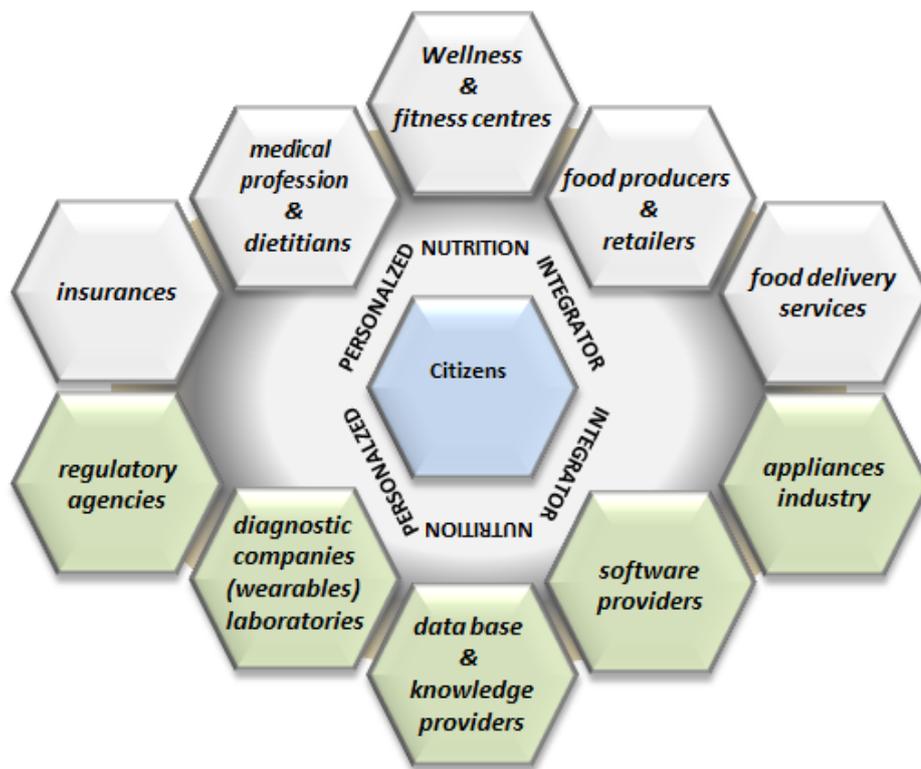
From concept to businesses

SPN departs from the classical routes of food production and distribution and therefore requires investment in new areas of science and in the creation of the appropriate business environment for smart personalized nutrition offerings. For businesses to invest in personalized nutrition, a market needs to exist or needs to be created. It is of course convenience in the first place that will create new business opportunities for established players such as food producers or retailers, but it may equally well attract new players as for example from the ICT or health sector. Public health is a societal imperative and there is an opportunity to now create the right environment to enable the sciences (existing and new) and the businesses to be integrated in such a way that it supports healthier lifestyles and diets that are not just

nutritious and convenient but also sustainable. This requires a deep understanding of consumer needs and behaviors and more science is needed on this.

Developing SPN is a great challenge because of different science cultures and philosophies that need to work in partnership while it is also a unique opportunity for innovation by working across numerous science and business areas. How disruptive SPN approaches will be for the classical businesses in the food area is currently hard to judge. However, SPN attracts individuals and companies not experienced in the food production and distribution systems and this defines the need for robust knowledge transfer (and education) in food safety, health and environmental issues.

One of the key challenges in bringing personalized nutrition to the market relates to creating a fit-for-purpose regulatory environment that accommodates the required mix of diagnostic, nutritional and service solutions. The current regulatory environment is fragmented across sectors and services, with personal data, food consumption data and data generated by different devices, but opportunities exist to frame this space with the key actors. Overall, it is essential that food businesses wishing to implement a personalized product offering not only develop a good understanding of the parameters most likely to affect a consumers' perceived value of their products, but also a good understanding of the potential barriers which may be inherent in their own production processes. The processing, packaging, distribution, quality, safety and regulatory requirements will also vary significantly between the various food sectors and as such are likely to present different challenges for implementation.



A compilation of putative business actors for smart personalized nutrition offerings (redrawn and modified from EU FP7 Food4me project white paper)

Societal needs

The rapidly growing world population requires more food while at the same time food production needs to reduce its impact on the environment with the negative effects on climate and in turn on food production whilst ensuring that the food produced provides the appropriate nutrition. This can only be achieved through societal shifts that enable consumers to make more sustainable and healthy food choices that result in less food waste. SPN offers the opportunity to make this happen by providing appropriate information for decision making. The extent to which people will act on nutrition advice based on health parameters analyzed by machine-learning algorithms remains to be determined. It may be the case that for some people it will be a sufficient motivator for them to change. It will still be necessary to ensure that people have the psychological and physical capability and the physical and social opportunity, to adopt healthy diets.

Data and evidence collected in relation to food systems (from farm to consumer) play an important role to better understand, assess and monitor resources and also to measure resilience of the system. In the framework of SPN consumers have the

option to assess their impact on the system and define their own needs not only for the products but also for how they should be produced. When health is included into SPN offerings, monitoring of biomarkers allows timely recognition of impairments and timely intervention. Promoting a healthy lifestyle including a more healthy diet by means of nudging approaches build into SPN is a great opportunity. An important consideration is who will bear the cost of SPN, non-access to these technologies as a result of income, levels of technological-engagement, level of education or non-willingness to share private information with others could lead to parts of society being discriminated in terms of access to services. A point of concern is that SPN may not serve the groups that could benefit most from a healthy diet, i.e. those with a low interest in health, thus resulting in more inequality. That asks for special efforts to bring SPN solutions to consumer groups of low income and low educational status but also to minorities and the elderly that may not have access to or may not be familiar with the technologies.

The way forward for R&I and the policy framework – Outcome of the workshop 'Smart Personalised Nutrition'

SPN requires interdisciplinary and transdisciplinary approaches in which different sciences, businesses but also policy makers and civil society work together to offer coherent and trusted global and context-specific solutions for the individual or groups of similar needs. SPN will mainly be demand-driven but should be based on scientific evidence to deliver services and products that can promote a healthy and environment-friendly lifestyle, framed by a science-policy dialogue. SPN needs to be underpinned by robust biological and social scientific evidence to deliver services and products that promote healthy and sustainable diets and that help to protect the environment, shaped by a science-policy dialogue with regard to the roles and responsibilities of all actors. To move the process forward it is recommended to:

- ***Bring together a “community” to develop an EU roadmap for SPN which should include an evaluation of the existing foresight activities and identify new issues to be considered. The “community” should also map the existing capacity and capability within the system as well as undertake an horizon scanning exercise that considers the challenges that need to be addressed across policy, industry, civil society and science (and other sector such as insurances, NGO) domains.***
- ***Foster and enable more interdisciplinary, multidisciplinary and transdisciplinary research on SPN, through which appropriate***

partnerships with national and regional funders in the EU and internationally can be facilitated

- ***Foster and enable the development of appropriate research infrastructures to collect, connect, compare and share SPN relevant data***
- ***Support and facilitate purposeful exchange between science, business and civil society to ensure that the processes and outcomes of SPN-related research and innovation are aligned with the values, needs and expectations of society***
- ***Create a higher awareness and engagement with and for society on the importance of food for a healthy life and for the environment to better meet the demands of sustainable food systems in times of climate change and increased production needs***
- ***Enable and support research in the social sciences and humanities to better understand how changes in behaviour can be achieved effectively in the framework of SPN. The use of 'personas' to help people understand the value for them might help in this regard.***
- ***Foster ways of integrating the focus on individual biological and lifestyle causes of disease with the need to address environmental and systemic determinants of illness***
- ***Enhance current education processes and programmes to attract, recruit and embed new talents from different sectors in science, policy and practice (e.g. health and commerce) and civil society, encouraging interdisciplinary training, and promoting discipline-hopping for the food systems of tomorrow***
- ***Establish a legal and ethical framework for SPN and promote its international harmonization. This should encompass data sharing frameworks, privacy laws, information law and food legislation.***

Issues discussed during the workshop and included in this report may be taken further as advice for next steps of the FOOD 2030 process.