Atelier 3: Computational and Mobil based solutions in personalized nutrition – effectiveness and limitations

Dr. David De Lorenzo, Universitat Pompeu Fabra

David de Lorenzo is a B.Sc. (Honours) graduated from the University of Navarre, and PhD (cum laude, Molecular Population Genetics) from the University of Barcelona. He has focused his scientific career on the understanding of the genetic basis of complex diseases, and the study of the interactions between genetic and nutritional factors in relationship to human health. His past professional experience consists of different positions at the University of Texas Health Science Center (USA), the Ludwig-Maximilians University of Munich (Germany), and the University of Lleida (Spain). Currently David de Lorenzo is associated professor at the university Pompeu Fabra in Barcelona (Spain), and director of the area of Personal Genomics at NIMGenetics SL (Scientific Park of Madrid, Spain). He is member of the Spanish Society of Genetic Counselling (SEAGEN), the Spanish Association of Human Genetics (AEGH), and the Spanish Society of Genetics (SEG).

Modération: Dr. Robert Sempach, Migros Kulturprozent

Computational and mobile based solutions in personalised nutrition

Effectiveness and limitations

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Universitat Pompeu Fabra Barcelona

IT solutions in personalised nutrition

1. Current state of the art
2. Why IT solutions for PN?
3. Limitations and Current Challenges
4. Ethics and Perspectives

State of the art - IT solutions for Personalised Nutrition

1. **Nutrition assessment**
   - Dietary Recalls
   - Food Frequency Questionnaires (FFQ)
   - Multiple-day Food Records
   - Specific Food Questionnaires

State of the art - IT solutions for Personalised Nutrition

1. **Nutrition assessment**
   - Dietary Recalls

In-depth "unannounced" interview that collects detailed information on all foods and beverages consumed by a participant during the previous 24 hours.

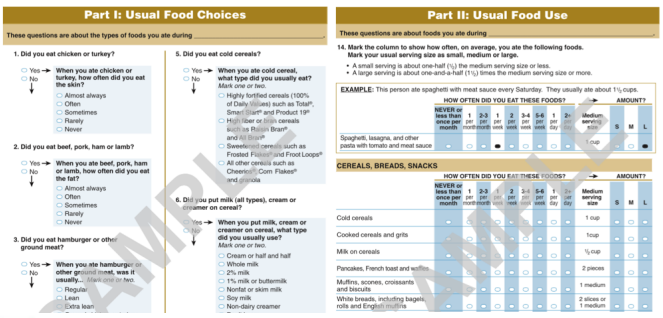
State of the art - IT solutions for Personalised Nutrition

1. **Nutrition assessment**
   - Dietary Recalls
   - Food Frequency Questionnaires (FFQ)

Report of the frequency of consumption and portion size of X items over a defined period of time.

State of the art - IT solutions for Personalised Nutrition

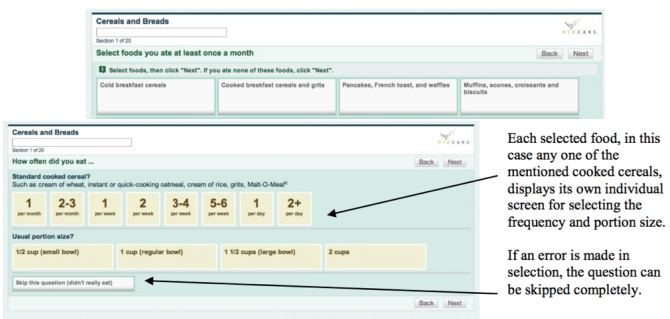
1. **Nutrition assessment**
   - Food Frequency Questionnaires (FFQ)



State of the art - IT solutions for Personalised Nutrition

1. **Nutrition assessment**
   - Food Frequency Questionnaires (eFFQ)

VioScreen/VioFFQ User's Guide



State of the art - IT solutions for Personalised Nutrition

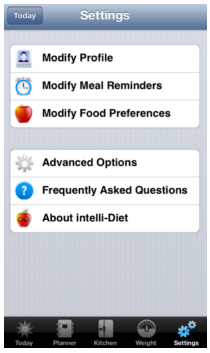
1. **Nutrition assessment**
   - Dietary Recalls
   - Food Frequency Questionnaires
   - Multiple-day Food Records

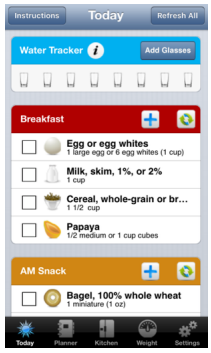
A food record or food diary is a detailed description of all foods and beverages consumed over a period of three to seven days.

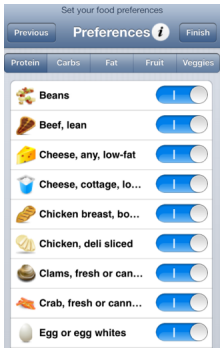
State of the art - IT solutions for Personalised Nutrition

1. **Nutrition assessment**
   - Dietary Recalls
   - Food Frequency Questionnaires
   - Multiple-day Food Records: IT Tools
     - Web Food Diaries

State of the art - IT solutions for Personalised Nutrition

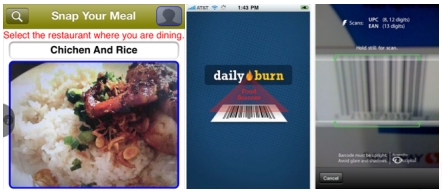






State of the art - IT solutions for Personalised Nutrition

1. **Nutrition assessment**
   - Dietary Recalls
   - Food Frequency Questionnaires
   - Multiple-day Food Records: IT Tools
     - Food Diaries
     - Food Scan Apps - Input: Photos, BarCodes, etc.



Why IT solutions for Personalised Nutrition?

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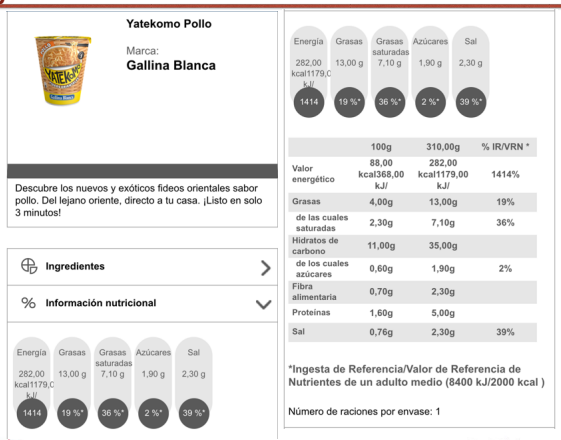
Why IT solutions for Personalised Nutrition?



Why IT solutions for Personalised Nutrition?

Food Scanner Horizon Prize

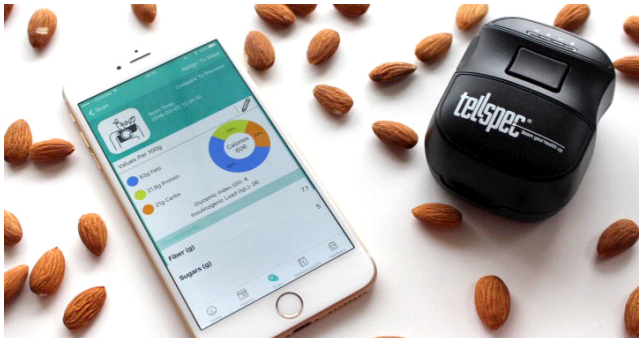
https://www.youtube.com/watch?v=v0uggsj4Ars

If labels are not enough…

Why IT solutions for Personalised Nutrition?

Tellspec

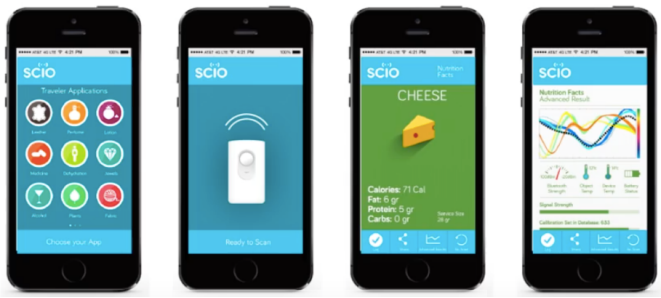
http://tellspec.com/howitworks/



Why IT solutions for Personalised Nutrition?

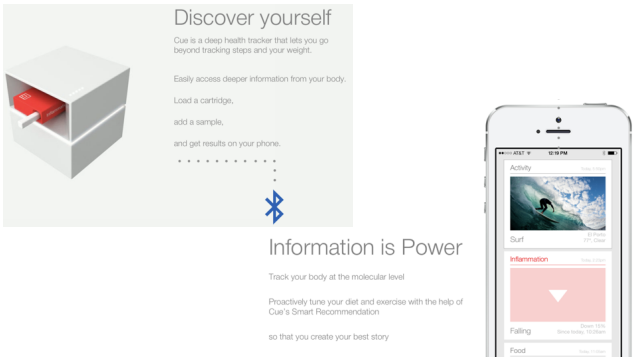
Scio

https://www.consumerphysics.com/myscio/order/



Why IT solutions for Personalised Nutrition?

Foodscan + Metabolic biomarkers:



Why IT solutions for Personalised Nutrition?

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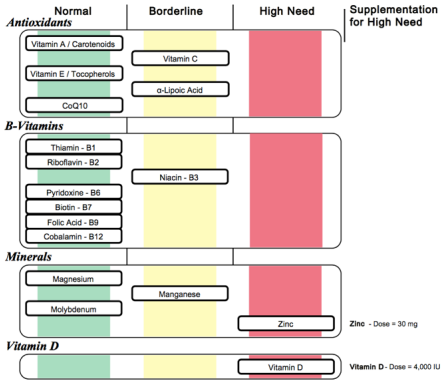
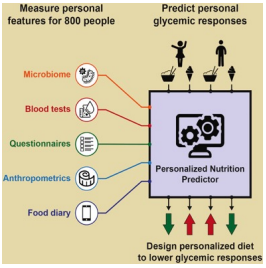


Why IT solutions for Personalised Nutrition?

1. **Nutrition assessment**
2. **Personalised recommendations**

Based on Nutrition assessment + metabolic & metagenomic markers



Source: Personalized Nutrition by Prediction of Glycemic Responses. Zeevi et al. Cell 163, 1079–1094, November 19, 2015

Why IT solutions for Personalised Nutrition?

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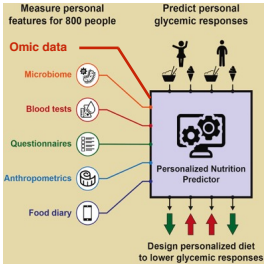
2. **Personalised recommendations**

Based on Nutrition assessment + genetic (GxE), metabolic and metagenomic markers



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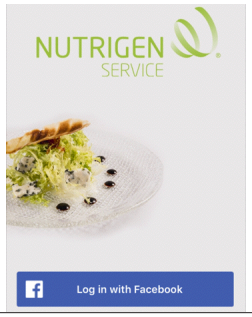
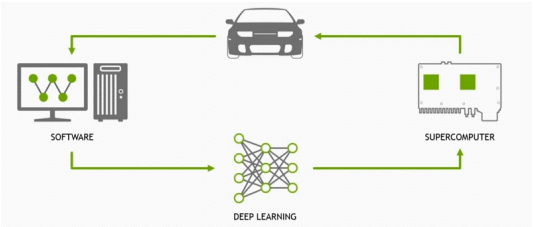


Why IT solutions for Personalised Nutrition?

1. **Nutrition assessment**
2. **Personalised recommendations**
3. **(Machine) Learning from Genetic background + Environment-Nutrition and Health Outputs**



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IT for Personalised Nutrition is not one-directional knowledge, but bi-directional

Computational and mobile based solutions in personalised nutrition

Effectiveness and limitations

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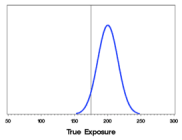
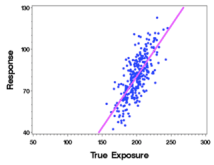
Limitations and Current Challenges

Two main current applications:

1. Describe intake distributions (define needs, both at population and individual level)



2. Estimate Diet-Health relationships



Limitations and Current Challenges

Limitations of FFQ

1. Cognitively challenging
2. Affected by recent diet
3. Finite food list
4. Lack of detail: assumptions required in converting to nutrient and food group intake

Limitations and Current Challenges

Limitations of FFQ

1. Cognitively challenging
2. Affected by recent diet
3. Finite food list
4. Lack of detail: assumptions required in converting to nutrient and food group intake
5. BUT Inexpensive, and very easy to implement through web applications.

Limitations and Current Challenges

Limitations of Dietary Recalls (24 h recalls)

1. Less cognitively challenging (relies on short- term recall)
2. Rich detail & fewer assumptions required in converting to nutrient and food group intake
3. Aims to capture recent diet -> Need more than one to assess usual intake
4. Expensive to collect and code

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3. Aims to capture recent diet -> Need more than one to assess usual intake
4. Expensive to collect and code
5. BUT Computational approaches (web-based recalls) makes possible this approach at much lower cost.

Limitations and Current Challenges

Limitations of Food Records

1. Less cognitively challenging (does not rely on memory)
2. Aims to capture current diet (often over several consecutive days)
3. Rich detail -> fewer assumptions required in converting to nutrient and food group intake
4. Recording may affect intake (reactivity)
5. Expensive to code

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Limitations of Food Records

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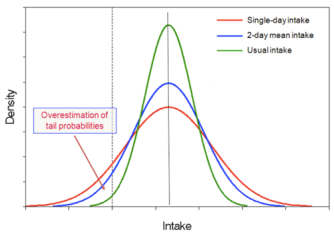
3. Rich detail -> fewer assumptions required in converting to nutrient and food group intake
4. Recording may affect intake (reactivity)
5. Expensive to code
6. BUT Computational approaches, such as food record apps on mobile phones that may reduce much of the manual coding required.

Limitations and Current Challenges

Challenges to estimate usual intake

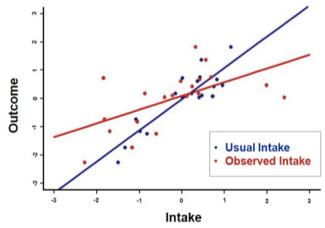
1. **Self-report** instruments used to assess usual dietary intake are affected by several types of measurement error – If we ignore this error, our results may be biased
2. Using **observed rather than true intake** can lead to erroneous conclusions



Limitations and Current Challenges

Challenges to estimate usual intake

3. Regression using **observed rather than true intake** produces attenuated slope estimate and loss of power to detect relationship between a dietary exposure and an outcome



Limitations and Current Challenges

The structure of measurement error

$$R_{ij} = \beta_0 + \beta_1 T_i + u_i + e_{ij}$$

- Constant additive error
- Intake-related bias
- Random error
- Person-specific bias

R = reported intake

T = truth

i=person, j=day

Limitations and Current Challenges

The structure of measurement error

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Systematic errors that can be reduced by the use of Computational (web+app) solutions

Less error means more statistical power

Perspectives & Ethics

Without -omic markers, use of IT-solutions provide:

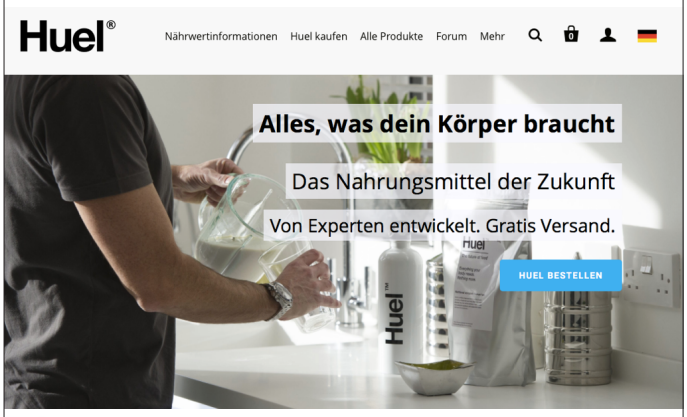
- Better estimates of population intake requirements
- Better regression of nutritional factors and health effects at population level

With -omic markers, use of IT-solutions provide:

- Better estimates of individual intake requirements
- Better regression of nutritional factors vs health effects

Analysis of the interaction Nutrient intake, omic markers & other environmental values (by machine learning) allows the elaboration of precise personalised nutritional recommendations

Perspectives & Ethics



Perspectives & Ethics

Ethical considerations

1. Complex systems biology: Genes implicated in different diseases with unwanted information - ApoE.
2. The results may have implications not only for the person who is being analysed, but also for genetically related family, raising questions about the sharing of the information with the patient's families.
3. In addition, a genetic test is always a potential paternity test.
4. There is growing concern about the best way to ensure that the results of a genetic test be kept confidential, and how to avoid discrimination based on genetic information.

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