

# Pervasive Health Workshop on Pervasive Health and Personalised Medicine Crossroads: Challenges and Opportunities

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<http://pervasivehealth.org/pervasive-permed/>

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## Background and Motivation:

Today the promise of precision and Personalised Medicine (PM) needs to take into consideration the potentiality offered by new technologies aiming at collecting and managing environmental, healthcare and lifestyle data, such as Pervasive Health does. The challenges imposed by the integration of Pervasive Health and Personalised Medicine (PH-PM) go far beyond only technological aspects that still need to be solved. In fact, these also include, among others, regulatory concerns about data management and data ownership, validation of cost-benefits of utilizing PM approaches and ethical and legal aspects concerning personal user information.

The overall topic of the workshop was the crossroads between Precision and Personalised Medicine (PM) and Pervasive Health Research. The topic is of particular interest at this point of time, given the maturity level that Pervasive Health technologies are reaching and the opportunities to implement these solutions as part of PM scenarios in actual clinical practices. In fact, nowadays, it is common to see Pervasive Health startups providing disease-specific, personalised applications to the market (e.g. using mHealth, wearable sensors, etc.). However, the integration of data generated from these new applications are still facing many challenges to get integrated into more sophisticated PM scenarios including their migration and innovative use in combination with existing electronic health records (EHRs).

## Workshop Outline:

The workshop was jointly organised by Riccardo Miotto from Mount Sinai Hospital (New York, USA) and Oscar Mayora from Fondazione Bruno Kessler (FBK, Italy) with the scope of discussing the state of the art topics and open challenges towards the implementation of synergic Personalised Medicine – Pervasive Health applications in future healthcare provisioning scenarios.

The Workshop included presentations involving current trends in Pervasive Health and in Personalised Medicine in order to use them as grassroots for

identifying the commonalities and complementarities of both fields. The specific presentations included:

- Automatic processing of Electronic Medical Records using Deep Learning.  
By Venet Osmani, Li Li, Matteo Danieletto, Benjamin Glicksberg, Joel Dudley and Oscar Mayora.
- Contextual Analysis to Understand Compliance with Smartphone based Ecological Momentary Assessment  
By Mehdi Boukhechba, Lihua Cai, Philip I. Chow, Karl Fua, Matthew S. Gerber, Bethany A. Teachman, Laura E. Barnes.
- Transfer Learning and Data Fusion Approach to Recognize Activities of Daily Life  
By Netzahualcoyotl Hernandez, Muhammad Asif Razzaq, Chris Nugent, Ian McChesney, and Shuai Zhang.
- A case study of an interaction design approach to pervasive healthcare  
By Ben Salem, and Philip Hampton.
- An Architecture for Cloud-Assisted Clinical Support System for Patient Monitoring and Disease Detection In Mobile Environments  
By Cornelius Agbo, Qusay Mahmoud, and Mikael Eklund

The discussion highlighted the opportunities for each of the previous researches in which a joint Pervasive Health – Personalised Medicine cooperative approach may evolve the current clinical practice by favoring innovative methods for data collection, analysis and intervention to improve healthcare provisioning in a personalised manner.

A number of specific pre-conditions leading to relevant research questions for the implementation of the joint Pervasive Health – Personalised Medicine goals were identified as follows:

- Technology needs to be improved, and here improvement can be in granularity, reliability, validity and frequency of renewal, before clinicians and other healthcare practitioners can use it.
- A focus on patients involvement for adoption of new healthcare delivery approaches needs to be empowered (personalisation vs. personalized medicine).
- How to make sense of technology and how to make pervasive health accepted.
- Evidence must be well proved before it can be used in the clinical setting; Methodologies will only be accepted if they go through clinical trials.

- Improvements need to be domain-specific (2% in a domain is more relevant than 2% in another domain).
- Prediction is the most promising field in machine learning for healthcare because regular medicine is not doing it.
- Working on prevention seems to be currently the biggest opportunity to change the field through a combined PH-PM approach.
- PH-PM will enable a holistic approach that takes into account all the aspects of health, care, and lifestyle.
- It is very expensive to get Ph-PM data in naturalistic conditions since daily living environments are dynamic, unpredictable, and exposed to new activities. New strategies for this should be part of the open research items.
- Dataset availability is hard (closed data) – there is a growing need of for open data sets.
- Interpreting data, and decision making process is are hard and expensive. Intelligent processing of the data, including expert medical knowledge, care knowledge and lifestyle knowledge seems to be the way forward, although challenges are numerous and significant.

A number of areas or opportunity for the proposed future researches including the use of Pervasive Health – Personalised Medicine were identified such as:

- Identifying medication adverse reactions.
- Predicting future disease risk.
- Predicting co-morbidities.
- Characterising disease / patient subgroups.
- Use of deep learning in combined EHRs and lifestyle data repositories.
- Addressing the concerns of security and privacy of pervasive health data
- Transfer learning across domains / technology to reduce the cost of data-driven labeling tasks in naturalistic environments.