Harnessing the digital transformation of health promotion and disease prevention:
a public health perspective

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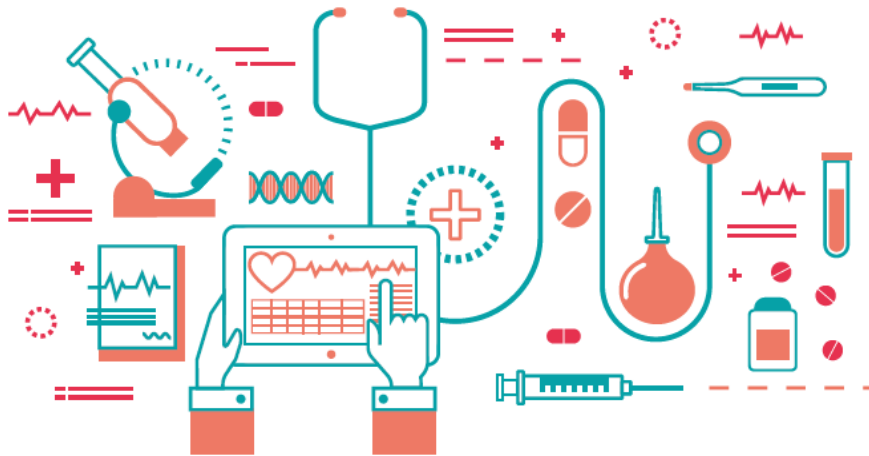*President, Public Health Epidemiology Section, EUPHA*

The state of health in the EU and the digitalisation of health promotion
Brussels, January, 22nd, 2019

The perspective

"Digital transformation brings the potential to impact healthcare in ways that may contribute to health system goals"

to-reach
transferring innovation in health systems

TO-REACH is focused on **setting out clearly** what needs to be done in terms of the **future Health Services and Systems Research agenda**

Public health digitalization in Europe
EUPHA vision, action and role in digital public health

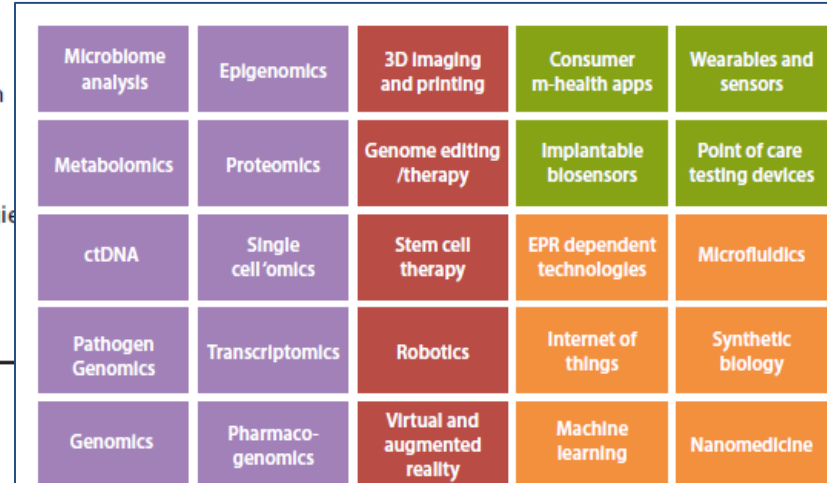Anna Odone[1,2], Stefan Buttigieg[2,3], Walter Ricciardi[2,4], Natasha Azzopardi-Muscat[2,5], Anthony Staines[6]

Table 1 The potential added value of digitalization for public health: a conceptual framework

Public health Pillars	Public health Domains	Digital Health Technologies[a]	Features	Potential Public health Benefits and advantages
Practice Research Training and Education Policy	Health prevention Health communication Health education Health promotion Health services organization, management and delivery Epidemiology and control of communicable diseases Risk management, hospital hygiene and safety Epidemiology and control of non-communicable diseases Food safety Environmental health Surveillance analysis and reporting Impact assessment monitoring and evaluation	Genomics Telehealth Smartphone apps (MHEALTH) Social media Wearables and sensors Virtual and augmented reality Drones Internet of things Big data Artificial intelligence (incl. predictive analytics, speech recognition and natural language processing) Robotics Distributed ledger technologies	Personalization and Precision Automation Prediction Data analytics (incl. Big Data, data transfer and interoperability) Interaction	Shift from cure to prevention Care closer to people People-centered care Safer, faster and more efficient services Less expensive care

Note: [a]Refer to Supplementary appendix S1 for definitions.

Microbiome analysis	Epigenomics	3D imaging and printing	Consumer m-health apps	Wearables and sensors
Metabolomics	Proteomics	Genome editing /therapy	Implantable biosensors	Point of care testing devices
ctDNA	Single cell 'omics	Stem cell therapy	EPR dependent technologies	Microfluidics
Pathogen Genomics	Transcriptomics	Robotics	Internet of things	Synthetic biology
Genomics	Pharmaco-genomics	Virtual and augmented reality	Machine learning	Nanomedicine

- Technologies for greater molecular level characterisation
- Technologies for personalised therapeutic interventions
- Technologies for personalised disease and health monitoring
- Underpinning and enabling technologies

The personalised medicine technology landscape, PHGF, 2018

Evidences on effectiveness of mHealth Interventions-I

Marcolino et al

Review

The Impact of mHealth Interventions: Systematic Review of Systematic Reviews

Milena Soriano Marcolino[1], MD, MSc, PhD; João Antonio Queiroz Oliveira[1], PharmD, MSc; Marcelo D'Agostino[2], MSc; Antonio Luiz Ribeiro[1], MD, PhD; Maria Beatriz Moreira Alkmim[1], MD, MSc; David Novillo-Ortiz[2], MLIS, MSc, PhD

ASSESSING THE IMPACT OF DIGITAL TRANSFORMATION OF HEALTH SERVICES

Report of the
Expert Panel on effective ways of investing in Health (EXPH)

- 23 reviews included, of which the majority were judged as low quality
- Moderate quality evidence of improvement in asthma patients, in attendance rates, and **increased smoking abstinence rates**
- Evidence for efficacy is overall limited especially in the field of health promotion and prevention
- Low-income studies under represented
- No long term studies

Economic evaluations of mHealth Interventions

What is the economic evidence for mHealth? A systematic review of economic evaluations of mHealth solutions

Sarah J. Iribarren[1]*, Kenrick Cato[2,3], Louise Falzon[4], Patricia W. Stone[2,5]

- 39 studies included, of which many did not report all recommended economic outcome items and were lacking in comprehensive analysis

- In 29 studies (74.3%), researchers reported that the mHealth intervention was cost-effective, economically beneficial, or cost saving at base case

- Low-income studies are under represented

- Established economic reporting guidelines are needed to improve this body of research

ASSESSING THE IMPACT OF DIGITAL TRANSFORMATION OF HEALTH SERVICES
Report of the
Expert Panel on effective ways of investing in Health (EXPH)

In the foreseeable future, information from an individual's DNA sequence will become part of their medical record and used to inform their healthcare in many different ways throughout their life course."
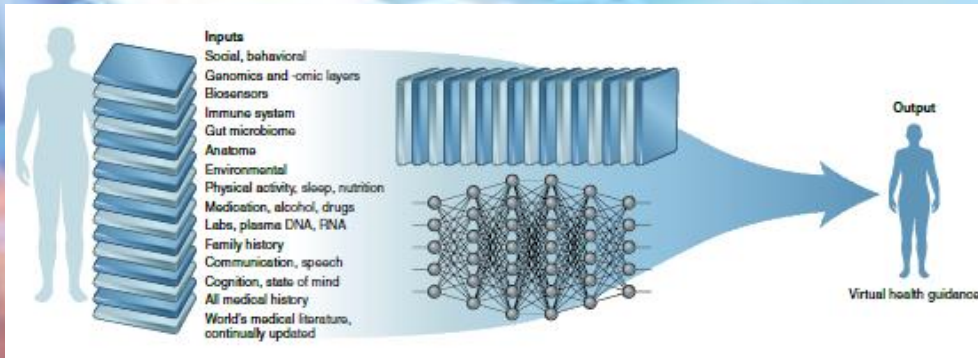**Sir Nilesh Samani**

phg foundation
making science work for health

Personalised healthcare: bringing the future into focus
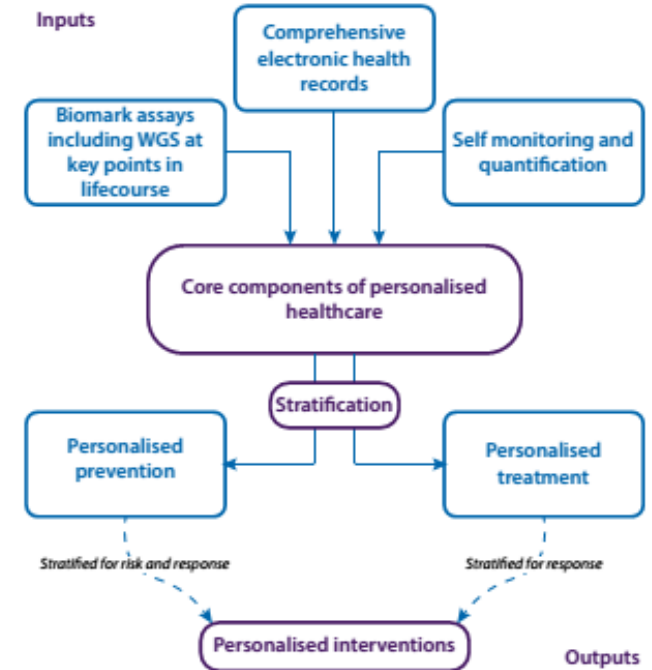
Final report, April 2017

Alison Hall and Leila Luheshi

Signatories: Prof. Bartha Maria Knoppers, Dr Eric Meslin, Prof. Walter Ricciardi, Dr Ron Zimmern

2. Imagining future health

2.1 What could personalised healthcare look like?

At the outset of the meeting the delegates considered what the key features and attributes of a more personalised approach to health might be. These are summarised in the graphic below.

Inputs
- Social, behavioral
- Genomics and -omic layers
- Biosensors
- Immune system
- Gut microbiome
- Anatomo
- Environmental
- Physical activity, sleep, nutrition
- Medication, alcohol, drugs
- Labs, plasma DNA, RNA
- Family history
- Communication, speech
- Cognition, state of mind
- All medical history
- World's medical literature, continually updated

Output
Virtual health guidance

Inputs

Comprehensive electronic health records

Biomark assays including WGS at key points in lifecourse

Self monitoring and quantification

Core components of personalised healthcare

Stratification

Personalised prevention

Personalised treatment

Stratified for risk and response

Stratified for response

Personalised interventions

Outputs

New challenges of public health: bringing the future of personalised healthcare into focus
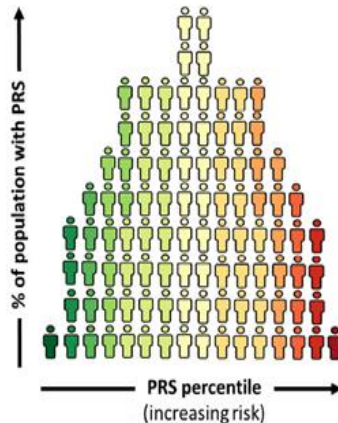
Walter Ricciardi[1,2], Stefania Boccia[1]

Polygenic Risk Scores (PRS) and Public Health

PRS Distribution

PRS percentile	Risk of disease vs. reference group
0-1	Lowest
1-5	
5-10	
10-20	
20-40	
40-60 (reference)	1
60-80	
80-90	
90-95	
95-99	
99-100	Highest

Source: RGA

"The use of polygenic scores for common disease risk assessment is an <u>important area of development for public health</u> and warrants close attention"
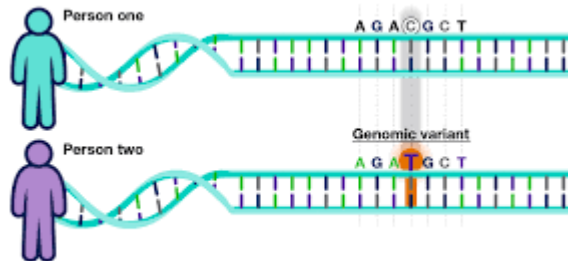
"Looking ahead, predictive prevention may well become an increasingly important part of our wider efforts to prevent disease and preserve health. It seems likely that polygenic scores will have a role to play in these approaches at some point, but <u>there is still a good deal to learn about how to maximise benefits for public health</u>. We need to be very clear about the nature of the evidence so far for using such scores and the implications of doing so"

Professor John Newton, Director of Health Improvement, Public Health England

PRS to support health promotion

ORIGINAL ARTICLE

Genetic Risk, Adherence to a Healthy Lifestyle, and Coronary Disease

Amit V. Khera, M.D., Connor A. Emdin, D.Phil., Isabel Drake, Ph.D., Pradeep Natarajan, M.D., Alexander G. Bick, M.D., Ph.D., Nancy R. Cook, Ph.D., Daniel I. Chasman, Ph.D., Usman Baber, M.D., Roxana Mehran, M.D., Daniel J. Rader, M.D., Valentin Fuster, M.D., Ph.D., Eric Boerwinkle, Ph.D., Olle Melander, M.D., Ph.D., Marju Orho-Melander, Ph.D., Paul M Ridker, M.D., and Sekar Kathiresan, M.D.
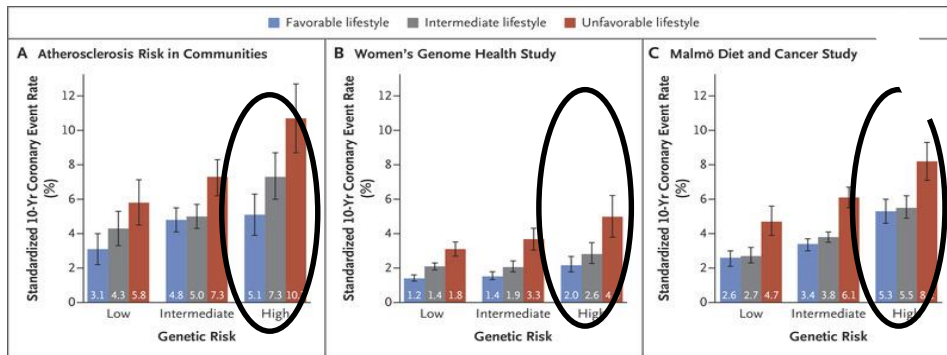
«The expectation is that the disclosure of the genetic risk may motivate behavioural changes»

- Using a PRS authors quantified the genetic risk for coronary heart disease in 3 large cohorts of healthy subjects
- Adherence to healhty lifestyles was measured using a score system of 4 factors: no smoking, no obesity, regular PA, and healthy diet
- Those with a high genetic risk score had an increased risk of coronary events in 10-years (6-11%)
- Those with a favourable lifestyle profile had a lower risk of coronay heart events (1-5%), regardless of the genetic risk category
- In the high genetic risk group there was the highest impact of favourable lifstyles, being able to almost half the absolute 10-years risk in the 3 cohorts

PRS to support therapeutic prevention

Polygenic Risk Score Identifies Subgroup With Higher Burden of Atherosclerosis and Greater Relative Benefit From Statin Therapy in the Primary Prevention Setting
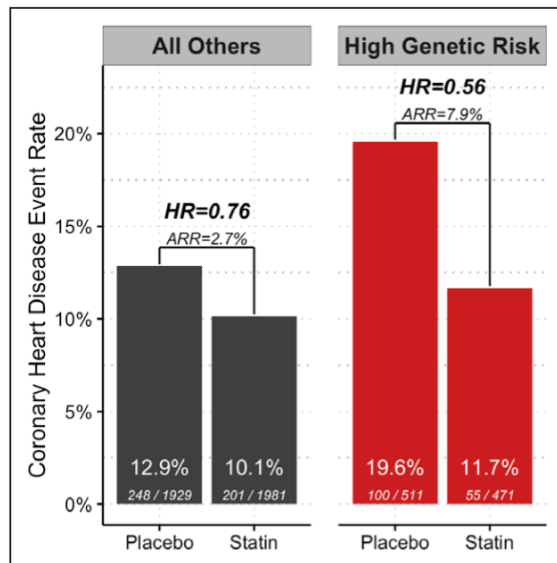

Figure 1. Incident coronary heart disease events by statin therapy and genetic risk group in WOSCOPS (West of Scotland Coronary Prevention Study).

- In analyses of 2 former randomized controlled primary prevention trials (ASCOT and JUPITER, subjects with high cholesterol level and no prior infarction) the statin therapy led to a greater relative risk reduction among a subgroup at high genetic risk of coronary heart disease

- In this additional randomized controlled primary prevention trial authors confirmed that <u>those at high genetic risk derive greater benefit from statin therapy to prevent a first coronary heart disease event</u>

PRS- informed disease screening

Polygenic Risk Scores for Prediction of Breast Cancer and Breast Cancer Subtypes

- Authors developed a PRS from the largest available GWAs of almost 100,000 cases and controls, and validated in two prospective studies

- Women with <u>high PRS for breast cancer can reach the same risk of a 50 years old woman many years before</u>, while at the same time women with low PRS reach the risk of a 50 years old woman at more than 70 years of age.

The Personalized Prevention of Chronic Disease (PRECeDI) Recommendations

Marie SKŁODOWSKA-CURIE
#EUWomen

PRECeDI
Personalized PREvention of Chronic Diseases

How to integrate Personalized Medicine into Prevention?
Recommendations from the
Personalized pREvention of Chronic Diseases (PRECeDI) consortium

PRECeDI Domains	PRECeDI Recommendations
Domain 1: Identification of biomarkers for the prevention of chronic disease.	**R1.** Personalized interventions for the prevention of chronic diseases require robust evidence of efficacy and/or effectiveness of the new technology when implemented in health care.
Domain 2: Economic evaluation of predictive genomic applications.	**R2.** In addition to what reported in R1, a comprehensive evaluation of the value (outcomes/cost) of the new technology should also include evidence on the social aspects, and context-related dimensions to better support the clinical decision-making process. Genetic or genomic applications with evidence of efficacy, effectiveness and cost-effectiveness should be implemented in clinical and public health practice.
Domain 3: Ethico-legal and policy issues surrounding personalized medicine.	**R3.** The era of genomics requires that we clarify and validate the obligations and responsibilities of the research community, research participants, and the general public including patients through collaboration and dissemination of high-quality ethical, policy and legal analysis.
Domain 4: Sociotechnical analysis of the pros-and cons of informing healthy individuals on their genome.	**R4.** A dedicated effort is necessary to stimulate further implementation of evidence-based interventions in health care, such as testing of family members in cases of hereditary cancers or cardiovascular diseases.
Domain 5: Identification of organizational models for the provision of predictive genomic applications.	**R5.** The integration of genomic sciences in other medical specialties should be promoted through new delivery models involving different healthcare professionals and new professional roles, in order to guarantee the use and sustainability of existing and new genomic applications in practice.

Directed to policy-makers, scientists, industry, and citizens aiming to foster the integration of PM approaches in the field of chronic disease prevention

http://www.precedi.eu/site/index.php

Boccia S et al, Public Health Genomics 2019

Conclusion: Key drivers for and requisites to harness digital tools for personalized healthcare

https://www.phgfoundation.org/research/my-healthy-future

1. Establishing the critical digital Infrastructure
2. Training the workforce
3. Citizens awarness
4. Secure safeguarded systems to protect data as a central issue to fostring patients and citizens trust in data sharing

Public health digitalization in Europe
EUPHA vision, action and role in digital public health

Anna Odone[1,2], Stefan Buttigieg[2,3], Walter Ricciardi[2,4], Natasha Azzopardi-Muscat[2,5], Anthony Staines[6]

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