



Data analytics in breast cancer prevention pathways

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A wide range of emerging technologies are showing considerable potential for improving healthcare through enabling personalised approaches at different stages of care and disease prevention pathways.

Currently, health promotion and screening are the predominant vehicles for breast cancer prevention and, in the main, are targeted at large sub-sets of the population. This means they do not take into account detailed biological characterisation of individuals or provide tailored prevention pathways.

We know that the development of breast cancer is influenced by many different factors, which are likely to vary between individuals, and that breast cancer is not one disease but has many sub-types with different outcomes. Can we create prevention pathways that take these factors into consideration?

In this series of briefings we provide some perspectives on particular technology areas to stimulate discussion on the vision for the future. These perspectives have been developed together with experts in these fields with the aim of stimulating discussion about the 20 year horizon.

There is some way to go in gathering the scientific knowledge and technical capabilities sufficient to optimising the impact of these technologies. Nevertheless, it is important to reflect on their potential in order to visualise how prevention pathways could differ in the future and how health systems will need to adapt to move towards more personalised prevention pathways.

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What is data analytics?

In broad terms data analytics can be thought of as the processes used to examine and derive conclusions from data. Analysis may be confined to single small datasets or to large volumes of diverse data (big data). Processes for data analysis are dependent on the type, volume and source of material.

What is data analytics useful for?

Data analysis is essential to understanding health and disease and has always played an important role in healthcare delivery at the individual and population level. For example, analysis of information from single or multiple biomarkers can contribute to clinical decision making by providing a diagnosis or identifying individuals at increased risk of disease through predictive analytics. Population disease surveillance relies on data analysis to identify and respond to healthcare emergencies.

Data analytics is already used in prevention of breast cancer. One application is in the development of models that predict risk of disease in individuals by bringing together diverse sets of information (e.g. age, family history etc.). It is also an important part of genomic analysis, which enables identification of individuals at high risk of disease.

The future for data analytics

Many factors are impacting on the prospective use of data analytics in healthcare. The volume, variety and velocity at which we are accumulating health related data is increasing. This is being enabled by the digitisation of healthcare as systems move towards the use of electronic healthcare records, increasing knowledge of biomarkers and development of tools to monitor these through biosensors, wearables and apps.

There is a concomitant rise in interaction of individual citizens with data and information through their access to and use of consumer health devices. This, together with improvements in interoperability and use of electronic health records and the internet-of-things is likely to lead to more interactive or connected repositories of data.

The increased use of data requires infrastructure and automated processes for collection, storage, sharing and analysis. Mechanisms to process data can take the form of simple or sophisticated algorithms or

machine learning techniques that are less reliant on explicit human programming. The latter is a means of building artificial intelligence (AI) systems based on analysis of large data sets that can perform tasks which would normally require human intelligence (e.g. visual recognition).

Algorithms or machine learning techniques can increase the efficiency with which particular tasks are carried out. This can improve prevention pathways by enabling the inclusion of a wider range of biomarkers. For example, breast density is a key risk factor for breast cancer but current analytical techniques can be onerous - a trained machine learning algorithm could dramatically improve turnaround times. An example of more sophisticated use would be the incorporation of machine learning techniques to develop more accurate predictive AI models for estimating risk.

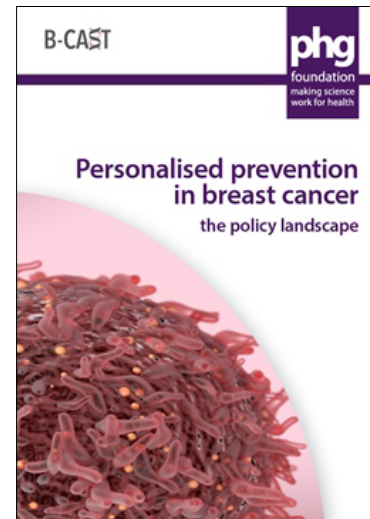
Sophisticated integrative analysis, together with developments in apps, may enable tailored messages to be delivered to individuals, after taking into account a diverse array of information. In addition, researchers are envisaging the development of individualised coaching programmes created by AI systems based on analysis of behavioural and predictive models.

Points for reflection

Two overarching trends are changing the way data is analysed. One is the increasing use of artificial intelligence, where the ability to model risk is achieved by methods that are more powerful but also not immediately amenable to interpretation (black box models). The other trend is the availability of these models in mobile devices, enabling an unprecedented level of personalised risk assessment.

- Consumer-facing tests, including genomics, continue to become more affordable. Will this change the way participant data is acquired for risk assessment?
- The ability to deliver advanced machine learning models onto mobile devices is disintermediating the health care system. Who will be the new stakeholders for precision prevention?
- We do envisage patients taking a much more active role in devising their own prevention pathways. How will clinicians configure access to information from a variety of sources in order to promote effective responses to real-time analytical results?

A vision for the future starts with an understanding of the present. We have undertaken an analysis of current approaches to breast cancer prevention, and the discourse around personalised breast cancer prevention, with focus on primary and secondary prevention programmes.



About our work for B-CAST

As part of a European Commission (EC) funded research project, Breast Cancer Stratification (B-CAST), PHG Foundation is leading work on examining the potential for developing personalised prevention for breast cancer within national health systems. Building a better understanding of the influence of different risk factors on specific subtypes of cancer can, ultimately, help clinicians target treatments and prevention strategies to deliver improved health outcomes for patients.

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