THE DNA REVOLUTION:
Can we predict people’s chance of getting cancer? Should we?
Genetic tests for cancer susceptibility are becoming more widely available, but how these are interpreted and how the information is shared can have a huge impact on individuals, their families and the health service.

Today’s speakers Shirley Hodgson, Rebecca Kristeleit, Nazneen Rahman CBE, Mark Taylor and chair Vivienne Parry OBE will discuss DNA tests currently available and their implications for screening, prevention and treatment of cancer; how personal genetic data should be interpreted and shared with patients and others; and the effect this information could have. How accurate might future personal and tumour testing be? Could these techniques eventually lead to cancer being eradicated?

This event has been organised by the Biochemical Society, Cancer Research UK and the Royal Society of Biology, as part of Biology Week 2016.

We hope you enjoy the lively talks and thought provoking debate.

#BiologyWeek  #predictingcancer
WHAT IS CANCER?

Cancer is a disease of cells.

All living organisms are made up of cells – they are the building blocks of life. Our bodies are made up of more than a hundred million cells. And there are over 200 different types of cell, with varied jobs and functions. But they also share some core similarities. Virtually all cells contain a complete set of genetic instructions (called genes) that direct every aspect of the cell's behaviour. These genetic instructions are written in a code stored in long strings of Deoxyribonucleic Acid (DNA). Certain mistakes (called mutations) in a cell's DNA can disrupt these instructions and start a cell on a path to cancer.

Normally genes make sure our cells grow and divide in a controlled way. Cancer starts when mutations make one cell or a group of cells grow and multiply too much. These mutations can occur by chance when a cell is dividing, be caused by external factors such as UV light or cigarette smoke, or can be inherited.

The place in the body where the cancer starts is called the primary tumour. Sometimes cancer can spread to other parts of the body (a process called metastasis) and form a secondary tumour.

Clinicians use staging (how big a cancer is and if it has spread) and grading (how abnormal the individual cells are) to decide how aggressive a cancer is and which treatments may work best for a patient.

The DNA Revolution and Predicting Cancer Risk

We’ve known about DNA for over six decades. But only recently, an explosion in technologies allowing us to ‘read’ DNA has brought us to the brink of something remarkable; the potential for human beings to scan their DNA to check for mistakes, and to prevent cancer.

The DNA revolution

In 1865 Gregor Mendel presented evidence of genetic inheritance in plants. Almost 100 years later Rosalind Franklin revealed the double helix structure of DNA. Watson and Crick later suggested that this molecule had a “copying mechanism”.

Cue a 50-year flurry of advances – cracking the genetic code in 1961, sequencing the first gene in 1972, the invention of PCR in 1982, and the release of the human genome sequence in 2003. This final breakthrough provided a template against which disease-related genes could be studied for faults.

As technology advanced, researchers began to identify faulty genes that drive disease progression, such as BRCA1 in breast cancer.

The current state of DNA technology in cancer research

Today, the world is entering a genomic era of cancer research.

Advanced sequencing is enabling scientists to track how lung cancers evolve and change over time within each individual patient. In clinical trials, genetic testing is informing doctors about which drugs are most likely to work for which person. And a ground-breaking global collaboration is analysing over 25,000 tumours to build a database of genetic changes.

Inherited genetic changes can alter susceptibility to cancer. If we know that a person has a genetic alteration which increases the risk for certain cancers we can offer preventative screening to lower that risk.

Looking to the future, another application that’s showing promise is reading the DNA shed by tumours into the bloodstream. This could become a powerful way to non-invasively diagnose and monitor cancer.
about the speakers

vivienne parry obe is a science writer and broadcaster. she is head of engagement for the 100,000 genomes project and has made many films about cancer, including a 60 minute documentary on the history of cancer. in the past she has presented tomorrow's world, written columns for the guardian and news of the world and been an agony aunt for good housekeeping.

professor shirley hodgson frsrb began her career as a paediatrician and then a general practitioner whilst her children were young. she became a consultant in clinical genetics at addenbrooke's hospital in 1988, and consultant/reader in clinical genetics at guy's from 1990. she specialised in cancer genetics from 1989, doing research with icrf (now cruk), and developing regional cancer genetics services at guys, st marks and st george's hospitals in london. she was appointed professor of cancer genetics at st george's, university of london, in 2003, and is now emeritus, with part time consultant status in leicester. her research investigated inherited aspects of cancer predisposition, she has published widely on the subject, and co-authored several books, notably a practical guide to human cancer genetics now in 4th edition.

“we now have the ability to sequence genomes comparatively easily and cheaply. the benefit of sequencing tumours seems clear, because every cancer is individual and sequencing the tumour dna can identify the particular molecular alterations that are driving that tumour, allowing tailored treatment to be developed which is likely to be more specific and successful than treatments used for every cancer of that type.

sequencing the germline dna of a person however has very different implications. it can identify specific known faults in genes which can cause a strong susceptibility to certain cancers, and allow the individual to be offered screening and preventative options to reduce their cancer risk. it can also help to identify novel cancer susceptibility genes. however many dna variants that would be identified are of uncertain clinical effect, or may alter disease susceptibility only slightly, so that interpretation of genome sequencing results is complex and may be difficult to understand. the use of information about dna variants of small effect is therefore debatable at this time, and could cause misunderstandings. clearly the use of such low penetrance variants in clinical practice should be approached with caution and taken into account in the context of other stronger genetic and environmental factors and their family history.”

Dr rebecca kristeleit is a clinical senior lecturer and consultant medical oncologist at ucl (university college london) /uclh (university college london hospital). she has a specialist interest in cancer drug development as well as treatment of gynaecological malignancies and is leading a number of clinical trials. her research work as part of the core uclh gynaecological oncology team, ucl/uclh clinical research facility and ucl cancer institute, is focused on the development of innovative early phase trials and translational research studies to identify and evaluate treatment strategies for gynaecological malignancies as well as other solid tumours. inherited genetic changes can alter susceptibility to cancer. if we know that a person has a genetic alteration which increases the risk for certain cancers we can offer preventative screening to lower that risk, rebecca has had a pivotal role in the development of rucaparib for BRCA-mutated ovarian cancer and was the ASCO scientific programme committee track leader for gynaecological cancers in 2016.

“There are rapidly developing technologies that are able to analyse cancers for specific genetic abnormalities. For example, in certain types of ovarian cancer we now routinely assess women for BRCA gene mutations. Determining the presence of genetic mutations can guide treatment and optimise the chance of clinical benefit for patients. The tissue most commonly used to assess mutational status is a tumour biopsy, but ‘liquid biopsies’ examining circulating tumour cells (CTC) or circulating tumour DNA (ctDNA) from a blood test may become routine in the future. My view is that the genetic information gleaned from individual patient testing either within a clinical study or as part of routine care should be shared fully with the patient if that is what they want. The genetic information can also sometimes impact on a patient’s family members, so partnership with a genetics service and clinical psychologists is necessary to provide the support and information they need. Unfortunately, I think we are some way off from complete eradication of cancer using this approach but we are able to personalise treatment and optimise clinical outcomes already for patients with certain genetic mutations and I expect this to increase substantially in the next few years.”

Professor nazneen rahman CBE is head of the division of genetics and epidemiology at the institute of cancer research (ICR), London, head of the cancer genetics unit at the royal marsden NHS foundation trust, and director of the TGLclinical gene testing laboratory at the ICR. she qualified in medicine from oxford university in 1991, gained her ccsT in medical genetics in 2001 and completed a PhD in molecular genetics in 1999.

Her research harnesses her scientific and clinical expertise to identify and clinically implement human disease genes. She has a strong focus on cancer predisposition genes, in which she is
an internationally-recognised expert and has discovered many such genes during her career, particularly for breast, ovarian and childhood cancers.

Nazneen has a strong commitment to open science and science communication and has garnered numerous awards, including a CBE in 2016 Queen’s birthday honours. She is also a singer-songwriter.

“The short answer to this question is ‘yes’. We can. But the type and usefulness of the available predictive information varies. Much of the genetic information currently available allows us to say if someone is marginally more or less likely to get cancer, but, on its own, is not sufficient to trigger treatments or prevention strategies.

However, certain types of genetic information in certain people allow us to give much more specific information about their risk of cancer. Sometimes this genetic information makes a person’s cancer risk so high they choose serious interventions to reduce the risk, such as surgical removal of healthy parts of their body. It is paramount in such situations that the cancer risk information given is as accurate as possible, and that people understand the uncertainties inevitable in this type of future-gazing.

The only way we can improve information about cancer risks is if we have more data to go on. In turn, this means we are totally reliant on people being willing to share their data. The benefits for individuals and societies far, far outweigh the risks of data sharing in this context. Indeed every single person would benefit from sharing of cancer genetic data, either directly or through the benefits to a loved one, because cancer is so common.”

Dr Mark Taylor is a Senior Lecturer in the School of Law, University of Sheffield. He specialises in health information law, privacy, and legal and ethical conceptions of the public interest. Author of Genetic Data and the Law (CUP, 2012) he is a British Academy Mid-Career Fellow and a member of a number of national advisory bodies, including the Ethics, Regulation and Public Involvement Committee (ERPIC) of the Medical Research Council. He is currently Chair of the Confidentiality Advisory Group for the Health Research Authority.

“When considering whether predictive information about an individual’s risk of getting cancer should be shared with others, particularly from a perspective of privacy and data protection, then it can be useful to think in terms of a triple test of ‘expect’, ‘accept’ and ‘respect’: (1) Would an individual have reason to expect the sharing? (2) Could they be given a reason to accept the sharing as justified, and, (3) Would the sharing respect any preference that he or she has expressed? If a particular instance of sharing would fail to satisfy this triple test, then there is good reason to think that it should not happen.”
The Biochemical Society works to promote the molecular biosciences; facilitating the sharing of expertise, supporting the advancement of biochemistry and molecular biology and raising awareness of their importance in addressing societal grand challenges.

We achieve our mission by:

• bringing together molecular bioscientists
• supporting the next generation of biochemists
• promoting and sharing knowledge
• and promoting the importance of our discipline.

CRUK funds scientists, doctors and nurses to help beat cancer sooner. We also provide cancer information to the public. Our ambition is to accelerate progress and see three quarters of patients surviving the disease by 2034. To do this, we’re focusing our efforts in four key areas – working to help prevent cancer, diagnose it earlier, develop new treatments and optimise current treatments by personalising them and making them even more effective. We continue to support research into all types of cancer and across all age groups. And we’re keeping our focus on understanding the biology of cancer so we can use this vital knowledge to save more lives.

The Royal Society of Biology is a single unified voice for biology: advising Government and influencing policy; advancing education and professional development; supporting our members, and engaging and encouraging public interest in the life sciences. The Society represents a diverse membership of individuals, learned societies and other organisations.

Biology Week is an annual celebration of the biosciences organised by the Royal Society of Biology. This year it takes place from 8th-16th October 2016. Over 100 events including the first Bioscience Careers Festival, Big Biology Day science festivals, and an awards ceremony for the Society’s photography and books competitions. Biology tackles some of the greatest challenges of the 21st Century, from providing a replacement for fossil fuels to preventing diseases. The events will give people of all ages and backgrounds the chance to learn more about biology. #BiologyWeek

FURTHER LINKS AND INFORMATION

Easy to understand information on cancer:

www.cancerresearchuk.org/about-cancer/