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2021: A bright future for cancer research

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Many advances in cancer research were overshadowed by the pandemic in 2020, but there is reason to be very excited about what is to come in 2021. We caught up with three specialists to find out what milestones they were most excited about and ask how these will help beat cancer.

It was an undeniably tumultuous year, but 2020 will also go down in the history books as a triumph of science. With advances in rapid disease testing and vaccinations dominating the news, it's right to feel pride in the research community battling COVID-19, and yet it has been easy to miss the progress made against other diseases, including cancer. We spoke to experts in the field about what the prominent advances in cancer research were last year and why 2021 is set to be one of the greatest years of progress against cancer yet.

Professor Bissan Al-Lazikani: Advances in artificial intelligence – an AI scientist's perspective

COVID-19 highlighted the growing strain placed on healthcare, particularly with regards to cancer care. But even before the pandemic hit, many healthcare systems around the world were struggling to meet the rising demand on cancer diagnosis services. Fortunately, artificial intelligence (AI)

research is already at work developing new tools to help address this growing shortfall. The year 2020 brought with it some of the most exciting evidence of this progress that I've seen. A team at Google Health delivered on a huge and international effort to develop an AI capable of evaluating breast cancer mammograms. They compared the detection accuracy of the technology with the ability of experienced radiologists and found that the AI surpassed our traditional methods of detection, reducing both the number of false positives and false negatives.

This study marked a step change in the use of AI during standard clinical care for cancer. It made it easier than ever to visualise a future where AI comes as part of the toolkit available to every clinician in the field. Once in use to support the work of physicians and radiologists, AI-supported tools will save a significant amount of time and increase the capacity of diagnosis facilities around the world, potentially even alleviating the pressure in low- and middle-income countries with less to spend on cancer services.

Importantly, the results demonstrate that the role of AI is to support, rather than replace, the human expert – freeing up their time to focus on more complex diagnostic issues rather than the mundane. Faster diagnosis speeds up how quickly patients can receive their treatment for cancer, meaning that we can administer these treatments when they are more likely to be effective, which is often crucial to saving the life of the patient.

This highlight from 2020 left me optimistic about the future of cancer diagnostics and the outcomes of cancer patients. Now we are in 2021, I greatly look forward to seeing how the field progresses in the year to come and how much closer we will be by the end of it to AI-supported diagnostics being in regular use.

Bissan is a professor of cancer and drug discovery data science at the Institute of Cancer Research. She established the Computational Biology and Chemogenomics Team at the Cancer Research UK Cancer Therapeutics Unit, where she led the development of the world's largest cancer knowledgebase, canSAR.

Professor Ed Boyden: The advent of a new tool for research – an engineer's perspective

As bioengineers, many members of my group create tools for studying complex systems like cancers. Tumours are incredibly complex 3D systems, full of different cell types that interact in complicated ways. It is hard to understand these intricacies, such as knowing which genes are on or off in a given cancerous cell type, or how a disease interacts with the host's immune system. But, thanks to a set of exciting developments made over the past decade by many groups working in parallel, there are now tools available to help us do this. These tools allow us to map gene expression throughout a cancer biopsy. Spatial gene expression mapping is beginning to reveal new hypotheses about how cancer cells influence neighbouring cells such as immune cells, or how they might alter nearby cells to obtain nutrients. Importantly, understanding how cells interact in cancer may point to new weaknesses that can be exploited for treatment, provoking the design of new therapeutics.

New tools allow us to map gene expression throughout a cancer biopsy.

Although these technologies are fairly new, they are beginning to greatly influence the field. For example, understanding how immune cells are influenced by cancer cells may provide new immunotherapy targets for cancer treatment. That would be just one of the many developments I expect to see in the coming years made possible by this new toolset. Someday, it may even be used to personalise treatments for patients, ultimately helping us save more lives.

Ed is a professor of biological engineering and brain cognitive sciences at Massachusetts Institute of Technology. He is a co-investigator in the Cancer Grand Challenges IMAXT team.

Dr Matt Kaiser: Controlling the master switch in cancer development – a research funder's perspective

MYC is a master transcription factor with many varied roles in cell proliferation, differentiation and survival. It's critical in cancer development as it's deregulated in most forms of the disease, although it's rarely mutated itself. The many roles MYC dysregulation play in a large variety of human cancers have been studied for a long time, but exactly how it drives tumorigenesis is not fully understood. Unfortunately, directly targeting MYC has always proved a challenge, owing to its apparent 'undruggable' protein structure.

Last year, the Stand Up To Cancer–Cancer Research UK–Lustgarten Foundation Pancreatic Cancer Dream Team published exciting results showing that activated MYC essentially locks cells in a tissue injury phase, driving stromal remodelling and tumorigenesis while simultaneously causing immune cell changes, including the expulsion of T cells from the tumour. By inhibiting MYC, the team were able to kickstart the tissue resolution program machinery blocked in the injury phase, reversing the tumour's progression and restoring the normal architecture of the tissue, including the presence of key immune cells.

This development is particularly important for pancreatic cancer, which is aggressive and extremely therapy resistant. By revealing mechanisms of crosstalk between tumour-intrinsic signalling events, tumour microenvironment remodelling and immune cell dynamics, the researchers have taken a step towards unleashing the potential for using immunotherapy treatment options successfully in people with pancreatic cancer.

The prognosis for pancreatic cancer is dismal and we've unfortunately seen very little progress against it over the years, which is why it's one of Cancer Research UK's cancers of unmet need. But the findings in relation to pancreatic cancer are just the tip of the iceberg when it comes to the significance of this work. The results represent the next stage in a long, careful and systematic interrogation of tumour biology, and it encourages us to think about strategies for how tumours can be deconstructed and how we might re-engage the immune system for therapeutic benefit. It also shows the value of considering the normal physiological function of these pathways, which are too often overlooked when we focus on the aberrant form of genes or proteins without considering the context of how they act in the normal situation.

This work stood out to me because it's emblematic of progress we're seeing in cancer research. The once-separate fields of cell and molecular biology and cancer immunology are integrating in new ways. This allows us to see the dynamic ecology and evolution of tumours in their entirety, helping us uncover innovative and exciting new ways to think about therapeutic combinations for treating the disease.

Matt is the head of careers and discovery research at Cancer Research UK. He supports world-class research and researchers in the advancement of Cancer Research UK's strategic agenda and the development of novel solutions to cancer.

Despite the many challenges faced in 2020, we have seen impressive progress in many areas of cancer research. Breakthroughs, like the three mentioned above, demonstrate the incredible ability of the global research community to achieve great things in the face of adversity. We enter 2021 feeling optimistic about our collective power to improve outcomes for people with cancer through science.

With yet more advances waiting for us as the year progresses, forthcoming research breakthroughs give us something to look forward to in 2021. We can't help but feel excited about what else the cancer research community will have achieved at the end of it.

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