

Who has misled Trond Mohn?

The medical research community has for decades sustained the myth that the solution to cancer is just around the corner. The fact is that today's cancer epidemic is not a problem that modern medicine is about to solve – it is a problem we are about to create. It is therefore necessary to communicate a more realistic understanding of cancer and cancer research.

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On 23 December, Norwegian philanthropist Trond Mohn announced that his family is donating NOK 1 billion (USD 135 million) to cancer research (1). This exceptional commitment to society will help many people and merits our deepest respect. What is worrying, however, are the expressed expectations that underlie this Christmas gift.

Appearing on national news the same evening, Mohn emphasised that it is difficult for a layman to understand what cancer research is all about, and that he therefore relies on the experts in the field: «There are those who say that maybe in about 15 years, cancer will be defeated. This forms part of the work to eliminate a disease that affects every family in the country, directly or indirectly» (2).

Like many others, Mohn has thus been led to believe that the solution to society's cancer problems may be imminent. Given that for many years he has donated large sums to cancer research and should have the best advisors in the field, this is remarkable. All cancer statistics, everything we know about epidemiology and our entire understanding of cancer biology tell us that in 15, 30 and 60 years there will be more – and not fewer – cancer cases in the population. Globally, it is estimated that the number of new cancer cases will increase from 12.7 million in 2008 to 22.2 million in 2030 (3). This trend is of course well known to cancer researchers, but the difficult message is usually overshadowed by the scientific community's and the pharmaceutical industry's eagerness to promote positive research results and better treatment methods. Trond Mohn, and everybody who wonders why there is increasingly more cancer, therefore deserves an explanation.

An unresolvable paradox

Public discourse on cancer is largely about new and better methods of treatment. These are often costly, and there is an ongoing debate on how the public health system

should prioritise (4). Should we strive to provide the same sophisticated treatment that billionaires can buy at exclusive hospitals abroad (5), or should we lower expectations in the name of equity and socioeconomic realities? There are no easy answers, but progress continues: availability of advanced treatment is improving and more patients survive their cancer. Cancer research has contributed to a revolution in biomedical knowledge and technology, and the development of modern cancer treatment is a story of continuous scientific success.

Importantly however, this development also comprises a formidable paradox: According to the statistics, approximately one in three of us will get cancer during our lifetime (6), and because of modern medicine, most will survive. The problem is that having survived once increases the risk of getting cancer again. The reason familiar to most is that cells from the original tumour may have metastasised, to return elsewhere in the body. A lesser-known reason is that radio- and chemotherapy are themselves carcinogenic (7). What was lifesaving treatment in the first instance may thus be the cause of cancer and other diseases later in life. This information can be difficult to present to patients who have survived cancer and want to put those troubles behind them. Nevertheless, it is important that people know about this relationship. Late effects of cancer treatment can often be reduced by preventive measures, and cancer survivors need special follow-up (8).

Although important, neither metastases nor cancer-inducing cancer treatment is the main reason why cancer is on the rise in the population. By far the most important cause of the increase in cancer cases is simply that we are living longer (6, 9). Cancer may affect anyone, and there are several underlying causes. Some forms are clearly hereditary, while others are primarily due to environmental factors. Yet there is no risk factor more important than advanced age. The risk increases especially after the age of 50 and after the age of 80 most people have cancer cells in their body. It is only a matter of how carefully you look (10).

The chances are that you will die *with* rather than *from* the cancer, but the trend is clear: as we grow older, our cells become increasingly unruly.

The better we become at treating cancer and other diseases, the longer we live and the more cancer cases there will be in the population. The great cancer epidemic is therefore not a problem modern medicine is about to solve – it is a problem we are about to create. The idea that the solution to cancer awaits around the next corner, as some kind of ingenious medical discovery, is therefore misleading and should be discarded once and for all (11). We can cure individual diseases and extend the average life expectancy, but we cannot treat ourselves out of the cancer epidemic.

Where are we heading?

The relationship between cancer and ageing is deeply rooted in biology (12–14). The human body has evolved over millions of years to fulfil one overriding purpose: to reproduce, raise children and then pass the world on to the next generation. The genes that control our cells have therefore evolved through natural selection to do just that. They are not optimised to enable us to live as long as possible. On the contrary, our cells are programmed to die when they become old and unstable. They should commit suicide when they can no longer fulfil their function in the organism, and cancer occurs, paradoxically, when mutated cells lose this capacity for programmed death (15–17).

The genes that control our cells accumulate errors as we grow older (18), and the big question is whether we can prevent or reverse this process. That is certainly not impossible. Current cancer research, related to concepts such as gene therapy, immunotherapy and stem cell therapy, is all about reprogramming and replacing old and unstable cells (19). Concurrently, transplantation of cells and tissues is already standard treatment for some forms of cancer (20–21). Combined, such modern cancer treatment is in principle a way of renewing the ageing human body bit by bit. After



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removing the breasts or the prostate, and replacing the liver and the blood cells, one can theoretically move on to the rest of the organs of the body. In the end, only the nervous system remains, and one may wonder if it is possible to replace the brain and still be yourself.

Faced with our own mortality, it is not the aged body that we are most worried about losing. It is our identity, consciousness, and the ability to communicate that we are so eager to preserve. The solution to the riddle of cancer may therefore be very different from what most people imagine. It is not some undiscovered medicine, but more probably a new way to propagate ourselves, a synthesis of biology and technology that preserves the «self» independent of the limitations of the human body. Ultimately, we are talking about the end of humanity as we know it, and leading scientists are voicing real concerns about the future of our civilisation (22).

The struggle for understanding

Such futuristic scenarios may not appear relevant when we as scientists, health pro-

viders and current or future cancer patients are battling a deadly disease. The forces driving the developments are indeed the most powerful and noble of all: the will to live and to save others. Moreover, cancer research is driven by a combination of scientific curiosity and an international pharmaceutical industry fuelled by public and private funding (23).

«The war on cancer» occupies a unique position in the political and public consciousness. It generates strong support and large sums of money for medical research, and it is in many ways the engine of the biotechnological revolution (24). For Norway to be in the forefront of this development is particularly important for the country's competitiveness, especially now that the petroleum age is approaching its end. It is primarily in this economic perspective that Mohn's NOK 1 billion investment in cancer research makes sense. Here the economist, billionaire and philanthropist is right at home. An investment in cancer research is an investment in education, innovation and industry, and it should not be necessary to mislead Mohn or others into believing that

Norwegian scientists are about to liberate humanity from cancer.

Cancer is in many ways a difficult matter, scientifically as well as emotionally. There is therefore good reason to moderate the flow of information, especially when facing sick and vulnerable individuals. In a societal perspective, however, when the goal is to underpin democratic and knowledge-based development, it is important that everybody is well informed. No one likes to hear that our risk of getting cancer increases every day of our lives or that cancer development is inextricably linked to being human (25). Nevertheless, as scientists we have a responsibility to communicate with honesty and integrity, not only in scientific journals, but also when reaching out to the public and our elected representatives. This responsibility is especially great when we are entrusted with a large portion of society's resources. Someone must therefore have the courage to tell Trond Mohn that NOK 1 billion to cancer research will lead to more and not less cancer in the population.

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