VINTURA

Innovation for Sustainable Cancer Care

So we can continue to put patients and outcomes first

VINTURA

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All.Can Changing cancer care together

DIGESTIVE CANCERS EUROPE

eahp european association of hospital pharmacists

European Cancer Patient Coalition

efpia European Federation of Pharmaceutical Industries and Associations

eit Health Co-funded by the European Union

Erasmus MC University Medical Center Rotterdam

EUROPA UOMO The Voice of Men with Prostate Cancer in Europe

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MPE Myeloma Patients Europe

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Key messages

Outcomes for people with cancer in Europe have improved significantly over the past decade. Cancer diagnoses are, however, on the rise as the population grows and ages, placing pressure on already overextended healthcare budgets and resources.

Smart investments in cancer care are urgently needed. They can improve outcomes, alleviate demands on healthcare systems and improve sustainable access to cancer care, while at the same time reducing waste and contributing to a better planet.

Cancer care decision-makers have a choice to make: either to continue with cancer care as we know it, caring for more and more people with the same or fewer resources with little regard for sustainability of any kind, or to innovate, which will free up resources for more sustainable care.

The good news is that there are five trends which offer real possibilities for redesigning cancer care, to make it more effective, efficient and sustainable:

- Artificial Intelligence & Machine Learning
- Digital Health & Digital Medicine
- Precision Medicine & Biomarker Testing
- Curative & Capacity extending therapies
- Out-of-hospital care

These five trends hold enormous potential for redesigning cancer care and meeting the ambition of Europe's Beating Cancer Plan. This is demonstrated by a wealth of examples of innovations, implemented at national or hospital level and across all steps of the cancer care pathway. In this report, 30 examples are highlighted, to show how innovative cancer care is not only needed, but also realistic and achievable within budget constraints.

Our plea to healthcare decision-makers is to make five commitments which allow for redesigning cancer care. Together, these five commitments can create an environment to find, implement and deliver the urgently needed innovations to transform cancer care for the benefit of people, prosperity, and the planet:

1. **Cancer care policies** reflect a long-term ambition to continue to put patients and outcomes first, through a focus on innovation and sustainability rather than simply continuation and cost containment
2. **Long-term funding programs**, instruments and initiatives at European and national level ensure the delivery of investments required to make the necessary fundamental changes in cancer care.
3. **Robust data and analytics** on patient needs, outcomes, experiences, costs and efficiency are made available to healthcare decision-makers and innovators to facilitate evidence-based decision-making on implementing innovations
4. **Cancer care reimbursement** is redirected from a short-term focus on volume, to a long-term focus on value, efficiency and sustainability
5. **Innovation networks** allow for best practice sharing and ensure a clear progression pathway towards wider implementation.

Let's make this happen!

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Cancer care sustainability

A critical need to rethink how we deliver cancer care

There is an urgent need to redesign the way in which we deliver cancer care, in order to make cancer care more sustainable. It is essential to make smart investments in innovations which free up resources to optimally balance outcomes for People, Prosperity, and Planet.

Outcomes for people with cancer have improved

Over the last 30 years, there have been significant improvements for people with cancer (see Figure 1). These improvements have been driven by positive changes to several factors, including research and development, prevention, screening, better and earlier diagnosis, and improved treatment.[1]

As well as the obvious benefits for patients and their loved ones, these investments have a proven benefit for the workforce and the economy, as healthier people live more active and fulfilling lives (see Figure 2).

Figure 1
The number of people who are still alive, five years after their diagnosis, has improved significantly over the last 30 years. Example from the Netherlands[2,3]

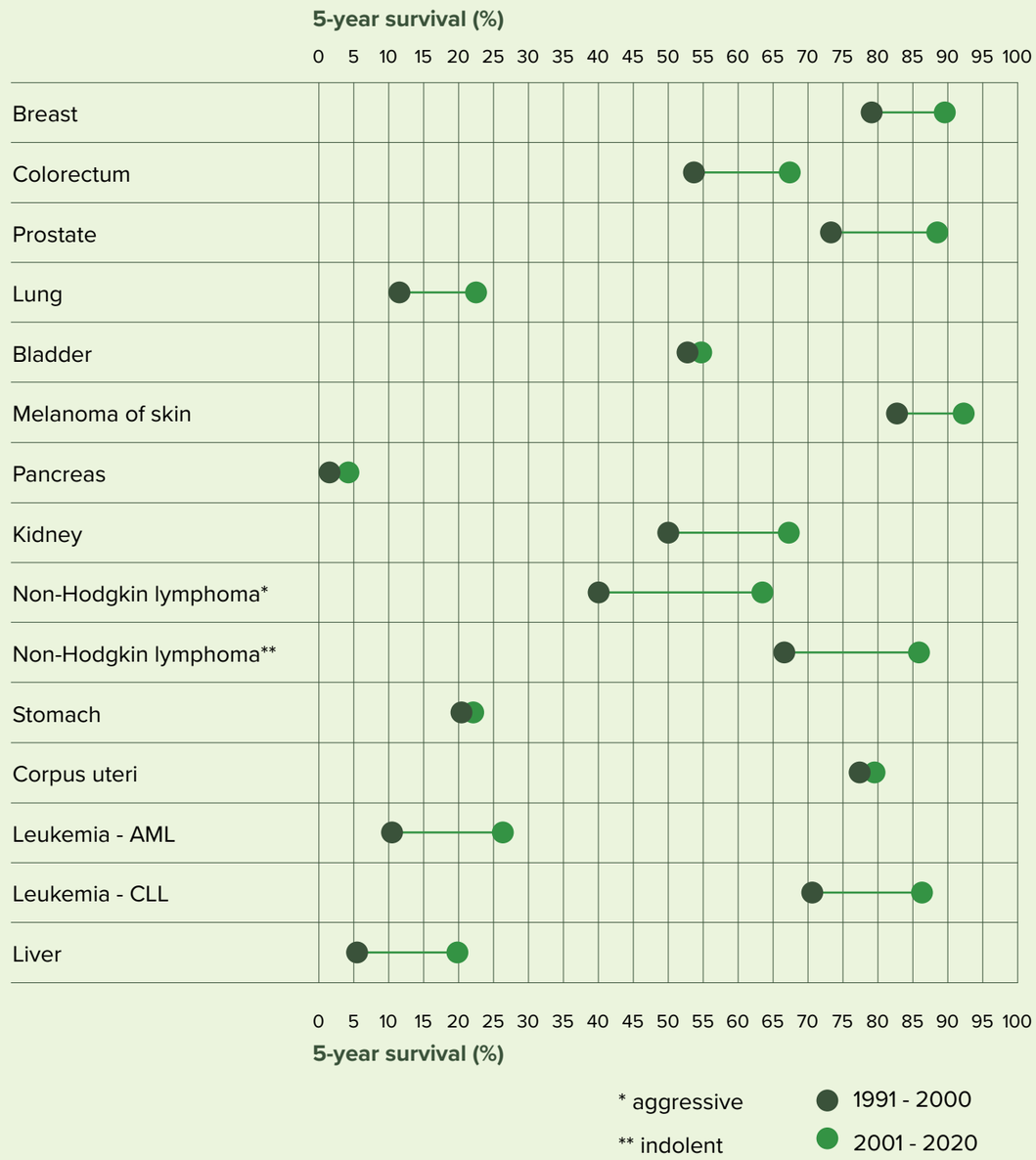
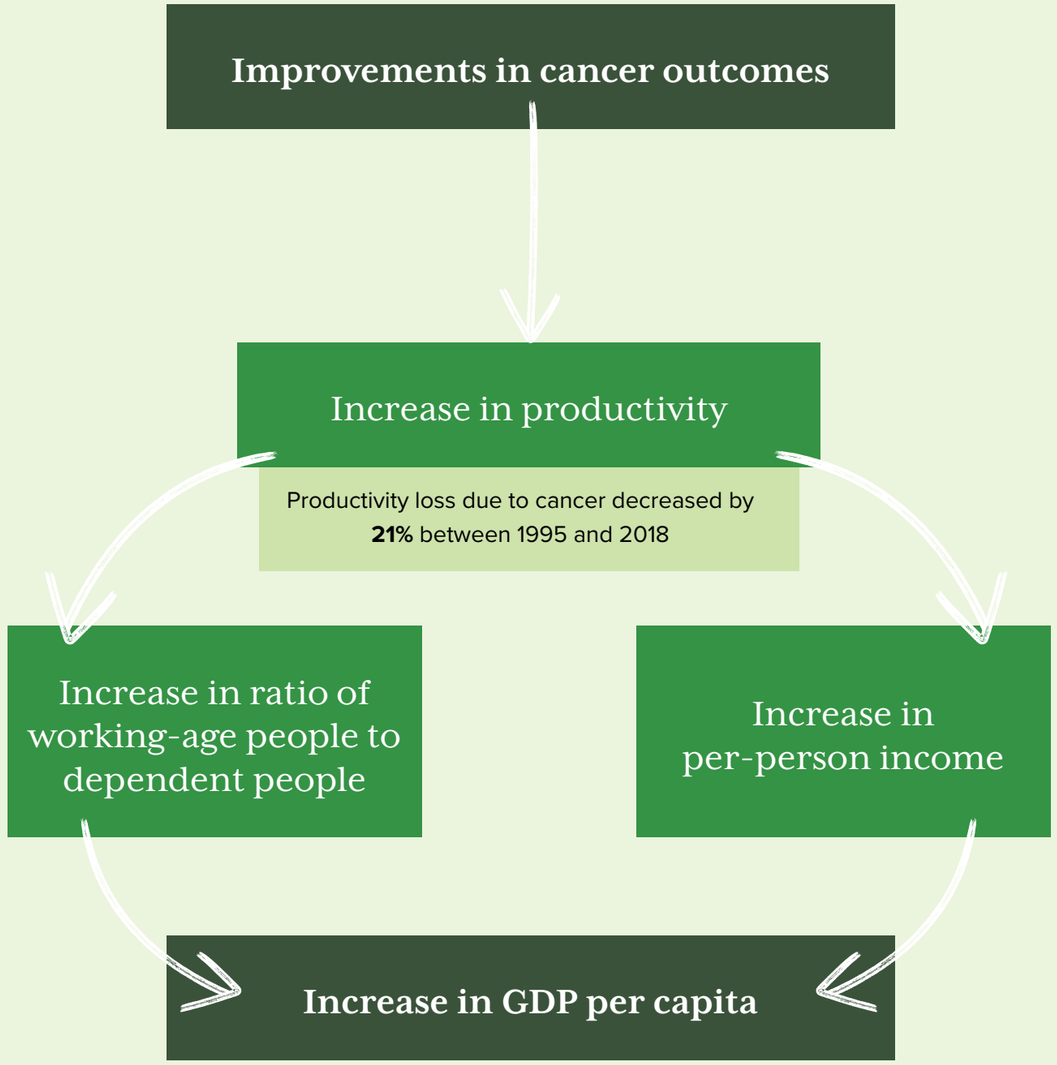


Figure 2
The workforce and the economy benefit from healthier people[4,5]



Cancer diagnoses are on the rise

Cancer diagnoses are becoming more common, largely because of a growing, ageing population. As people age, their risk of developing cancer increases. Combined with the improved chance of living longer with cancer, this increases the number of cancer diagnoses, the total number of cancer patients and the overall demand for cancer care.

More than five new cancer diagnoses are currently made every minute across Europe, with cancer set to replace cardiovascular disease as the leading cause of death in the EU by 2035.[6]

As cancer diagnoses rise, so does the precision with which people are diagnosed, allowing for more complex, targeted treatment.

Growing care needs put pressure on healthcare budgets. Currently, the annual economic impact of cancer in Europe equals 100 billion euros[7] – and this sobering figure will only increase if we continue on the same path.

The healthcare workforce is also under enormous pressure, which in turn has a negative effect on patients. By 2030, there will be a shortage of some 4.1 million health workers in Europe and the UK.[8]

Yet, the impact of the rising necessity for cancer care reaches further than this, with the planet also being affected. In fact, currently 1,200kg of waste is generated per hospital bed each year.[9]

A sustainability challenge

Increasing demand means more cancer care must be delivered to reduce (or even to maintain) waiting lists and maintain access to high quality care. In addition, further advances are needed in cancers with poor prognosis, such as pancreatic cancer, liver cancer, rare cancers, hereditary cancers and paediatric cancers.[10] Unacceptable inequalities still mean millions of cancer patients across Europe do not have optimal access to cancer knowledge and services, from prevention to diagnosis, treatment and care.[11,12]

When economies grow, increasing tax revenues and GDP mean available funds can keep pace with expanding demand for cancer care due to rising cancer incidence.[13] In recessionary times[14], however, the twin pressures of increasing demand for care and the dwindling availability of already scarce resources require tough choices by decision-makers regarding optimal budget allocation. Put simply, they need to find ways to get even more bang from even fewer bucks.

A fork in the road

Cancer care decision-makers have a choice to make.

They can continue with cancer care as we know it, caring for more and more people with the same or fewer resources with little regard for sustainability of any kind, or they can choose innovation which will free up resources for more sustainable care. Let’s look at these choices in more detail.

Choice 1:

Continuity and decline

The easy choice for healthcare systems, especially in relatively rich countries, is **continuation**: carrying on as before, but **with unchanged or even reduced budgets**.

As patient numbers increase, this will lead to an **increasing shortage** of specialist and general healthcare professionals. As a necessary consequence of this choice, patients will receive less attention and/or will face longer **waiting lists**.

There will be **less capacity to optimise** prevention, screening, diagnosis, treatment, and care. As healthcare systems struggle to extract more value from every resource there will be less thought given to the protection of the natural environment.

This approach will lead to:

- A **deterioration** in patient outcomes
- A **decline** in affordability and equal access to quality care
- An **increase** in negative impacts on the environment

Choice 2:

Innovation to advance

OECD estimates suggest that approximately 20% of healthcare spending is currently wasted on ineffective or inefficient interventions. Examples of inefficiency can be detected at system level, the provider level and the patient level.[15]

By choosing to redesign cancer care through **smart investments in innovation**, healthcare decision-makers can create a different path which ensures efficiency in cancer care, and sustainable resource use to promote better outcomes for patients, professionals, and the planet.

Increased focus on, for example, **prevention** and **remote care** will mean **fewer patients in hospital**. This will enable professionals to be more **efficient and effective** as they can focus on the patients who need their care most. At the same time, fewer disruptive hospital visits will allow many patients and their carers to take less time away from their daily activities, work and loved ones.

Using scarce resources in an efficient, more innovative way will **free up capacity to further optimise** prevention, screening, diagnosis, and treatment to improve patient outcomes.

This approach will enable:

- **Ongoing advances** in patient outcomes
- **Improvements** in affordability and equal access to quality care
- A **reduction** in negative impacts on the environment

The solution

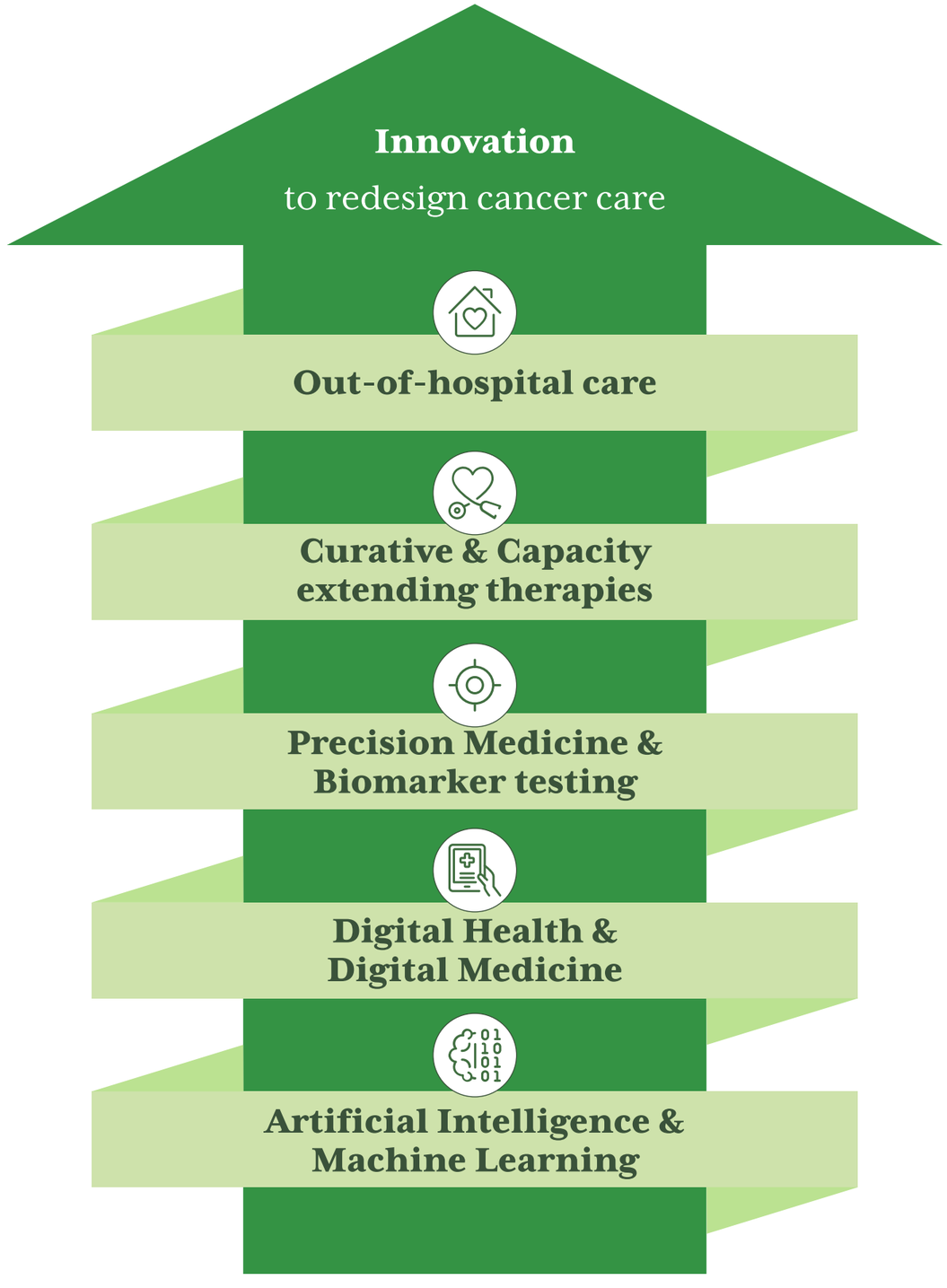
Innovation as the key to redesigned cancer care

Five important trends offer real possibilities for innovation. Together they will help in delivering the ambition of a more effective, more sustainable redesign of cancer care pathways. The potential of these trends in redesigning cancer care is demonstrated by examples showing how sustainable and innovative cancer care is not only realistic, but also achievable within budget constraints.

Five key trends enabling more sustainable cancer care

Out of hospital care

Patients can increasingly receive cancer care in community settings (for example their family doctor, local health centre or pharmacist) or even at home, provided that appropriate networks, communication, and training are in place. Every patient who doesn't need to visit a hospital for care reduces waiting lists and frees up resources (such as physicians and nurses, hospital beds, diagnostic devices, and activity-based payments), which can be deployed or reinvested elsewhere in the system. This will create more efficient cancer care without compromising, and often improving, on quality and patient outcomes.[16]



Curative and capacity-extending therapies

Whilst the availability of existing and essential cancer medicines needs to be maintained, new therapies can provide the right care at the right time, thereby helping to cut the number of hospital or other visits each patient makes to receive care. This in turn reduces waiting lists, keeps patients out of hospital in the long term and lowers the number of patients requiring outpatient follow-ups – further freeing up resources for redeployment or reinvestment elsewhere in the system.[17]

Precision medicine & Biomarker testing

Precision medicine (sometimes known as precision oncology, personalised medicine, or predictive medicine) uses molecular information, phenotypic information, and other patient health data to generate insights which can prevent, treat, or predict disease.

Biomarker testing is a key enabler of precision medicine. It refers to the measurement of any molecule in the human body after it has been derived from blood, body fluids or tissue, including, for example, DNA.[18,19] Optimal integration of biomarker testing in cancer care pathways allows for significant efficiency gains. Genetic testing to identify genetic mutation carriers can inform cancer prevention measures. Precision medicine enables the use of the right treatment for the right patient at the right time, thereby maximising the therapeutic benefit, preventing wasteful use and freeing up healthcare resources.

Digital health & Digital medicine

Digital health uses the Internet of Things, social media, and big data to allow patients, healthcare professionals and other stakeholders to interact, rather than restricting interaction to a clinical setting. Examples include electronic patient records, patient portals, apps, and wearables, which can also be used to monitor patients and/or generate real-world data about patients, their disease and their (adherence to) treatment. Digital medicine takes this a step further, using digital health to inform diagnosis and treatment.[20]

Artificial intelligence & Machine learning

Artificial Intelligence (AI) refers to programs which mimic human behaviours according to algorithms. In the case of machine learning, these programs can mimic human behaviours without being explicitly programmed.[21] AI can play an important role in precision medicine. Data-intensive assays can reveal appropriate intervention targets and strategies for personalising medicines during clinical development, testing and implemention of new therapies.[22]

> “Europe urgently needs a renewed commitment to cancer prevention, treatment and care which recognises the growing challenges, and opportunities to overcome them, including the developments in cancer care.”
>
> Europe’s Beating Cancer Plan

Thirty innovations to make cancer care more sustainable

A wealth of examples are available which demonstrate how innovation makes cancer care more sustainable. This report showcases 30 impactful initiatives at all stages along the care pathway, from prevention and early detection through diagnosis, pre-habilitation and treatment to palliation, rehabilitation, and survivorship.

These innovations – which can be products, processes, or both – each harness one or more of the key trends listed above. Each of these innovations has a clear impact for patients, in combination with impacts on prosperity or the planet (see Figure 3).

Real potential for positive change

All these innovative programs show there is currently enormous potential to advance cancer care in an innovative way. They are all happening now and show that positive change – even systemic change – is realistic and achievable within current budget constraints.

Let's look at the innovations along each stage of the cancer care pathway (See Figure 4).

Figure 3
Sustainable cancer care optimally balances outcomes for People, Prosperity, and Planet since a negative impact on one of these pillars negatively impacts other pillars.

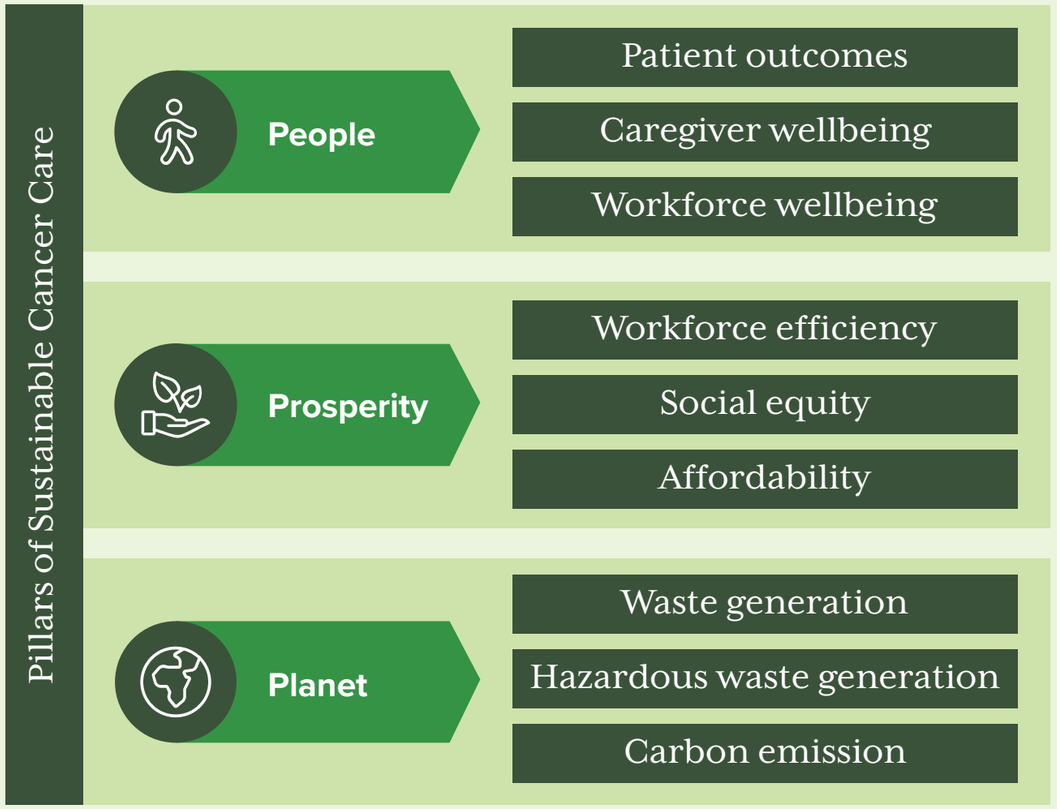
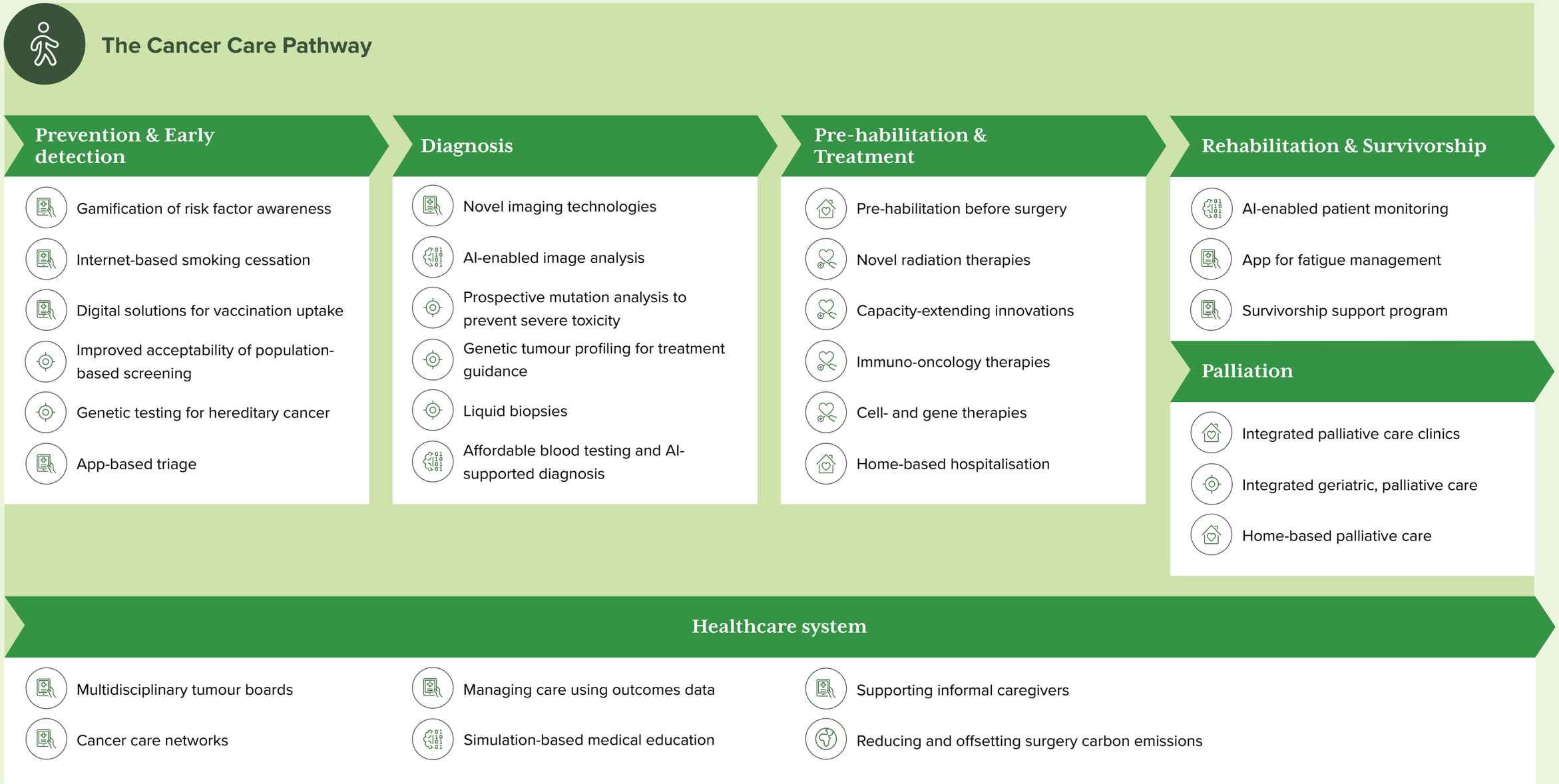


Figure 4
Cases in this report demonstrate an enormous potential to advance cancer care through innovation.



Prevention & Early detection

Gamification of risk factor awareness

People: **Patient outcomes**

Prosperity: **Affordability**

Creating and distributing an app aimed at promoting better lifestyle choices – including nutrition, alcohol use, physical activity and so on – among girls aged between 12 and 19 raised awareness on how to reduce breast cancer risk factors, with 931 registered users across 27 countries.[23-25]

Internet-based smoking cessation

People: **Patient outcomes**

Prosperity: **Social equity, Affordability**

Stopping smoking – even at or after diagnosis – may be associated with a 35% reduction in mortality risk. Using interventions such as push text messages, smartphone apps, quitting websites, video games and social media platforms led to a 36% improvement in quitting rates.[26-30]

Digital solutions for vaccination uptake

People: **Patient outcomes**

Prosperity: **Social equity, Affordability**

Prophylactic immunisation of children against oncogenic human papillomavirus (HPV) infections can prevent cancer cases. The effectiveness of this intervention depends on uptake. At 20% uptake, 318 cases per 200,000 can be prevented, rising to 1904 at 60% uptake. At 80% uptake, sex-neutral vaccination has a favourable cost-effectiveness profile in most EU countries. Vaccination rates were significantly higher (+18.8%) among daughters of parents using decision-support tools for HPV vaccination via a smartphone web app.[31-37]

Improved acceptability of population-based screening

People: **Patient outcomes**

Prosperity: **Affordability**

Stage of colorectal cancer diagnosis has a significant impact on outcome. 5-year survival rates for patients diagnosed at stage 1 vs stage 4 are 90% and 10% respectively. Through population wide screening of age or hereditary factors, it is possible to increase the proportion of colorectal cancer cases identified at stage 1 from 15% to around 50%, significantly improving outcomes for those patients. In Scotland, the participation increased with 5-6% after introduction of a more user-friendly test.[38,39]

Genetic testing for hereditary cancer

People: **Patient outcomes**

Prosperity: **Affordability**

Clinical genetic testing for mutations in the BRCA gene reduces breast- and ovarian cancer cases based on prophylactic surgery (which reduces breast cancer risk by over 90%), or high-risk surveillance. To identify more women with BRCA gene mutations, approaches such as testing all women with epithelial ovarian cancer, population-based testing and proactively reaching out to biobank participants have been suggested.[40-49]

App-based triage

People: **Patient outcomes**

Prosperity: **Social equity, Affordability**

Smartphone apps can analyse images of suspicious skin lesions to determine whether they are potentially cancerous. Based on meticulous development and rigorous scientific validation, these apps are a powerful tool to ensure earlier detection, minimise morbidity and reduce costs related to skin cancer management.[50-53]

At an uptake level of 60%, vaccination of children against HPV can prevent >1,900 per 200,000 cancer cases. Vaccination rates are significantly higher (+19%) among children of parents using app-based decision support.

Diagnosis

Novel imaging technologies

People: **Patient outcomes**

Prosperity: **Workforce efficiency, Social equity, Affordability**

Initially praised as a universal achievement to improve women's health and reduce the burden of breast cancer, the pros and cons of mammography screening have been the subject of heated debate over the last few years. Disadvantages include the low sensitivity in increased breast density (associated with younger age), false-positive outcomes, anxiety and pain, and the (extremely low) risk of radiation-induced injury. A new device which uses microwaves instead of ionizing radiation (X-ray) provides a radiation-free, pain-free, faster, more accessible and more cost-effective method for breast cancer screening.[54-59]

AI-enabled image analysis

People: **Patient outcomes**

Prosperity: **Workforce efficiency**

Planning radiotherapy treatment is a skilled, time-consuming job. It starts with a 3D Computed Tomography (CT) imaging scan of the part of the body to be targeted. Dozens of stacks of 2D images must be examined, segmented and marked up (contoured) by a radiation oncologist or specialist technician. By switching to AI-enabled, rigorously validated, and well-understood software to support this process, it is possible to reduce reading time of lung cancer CTs by approximately 40%. This process enables 13 times faster image segmentation, enabling human resources to be deployed elsewhere for further gains in productivity. In addition, CT image contouring time for head-and-neck cancers was cut by around 90%.[60-67]

Prospective mutation analysis to prevent severe toxicity

People: **Patient outcomes**

Prosperity: **Affordability**

Prospective DPYD gene mutation analysis before commencing fluoropyrimidine-based chemotherapy predicts severe toxicity, protecting patients from severe and potentially fatal toxicity. This also reduces costs, as hospital admission costs are significantly higher than the cost of performing DPYD tests.[68-70]

Genetic tumour profiling for treatment guidance

People: **Patient outcomes**

Prosperity: **Affordability**

DNA / genomic tests such as the 21-gene test in breast cancer, or whole genome sequencing to show detailed tumour characteristics both improve and personalise treatment decision making. 56% of patients at the lowest risk of disease recurrence are spared chemotherapy, saving around €2,500 per patient. Based on their tumour profile, 31% of patients were also found to be eligible for experimental medication.[71-79]

Liquid Biopsies

People: **Patient outcomes**

Prosperity: **Workforce efficiency, Affordability**

Blood biopsies allowing real-time monitoring of circulating tumour cells or cell-free tumour DNA from non-small cell lung cancer. This form of diagnosis offers similar prognostic power as tissue biopsies. Progression was observed 8 months prior to objective progression, allowing guided, more timely treatment. Other liquid biopsy assays may have predictive utility for selection of targeted therapies.[80-84]

Affordable blood testing and AI-supported diagnosis

People: **Patient outcomes**

Prosperity: **Workforce efficiency, Affordability**

Over 90% of cancer referrals made by general practitioners (GPs) in England do not have cancer but undergo expensive, time consuming and stressful diagnostic tests. A new type of blood test, based on artificial intelligence to look at features in the blood, supports general practitioners to determine the chance that a patient has cancer. The test identifies both high-risk and very low-risk patients within 72 hours. An initial study indicated a sensitivity (ability to identify patients with cancer) of 90% for cancer cases with a high probability of cancer and specificity (ability to identify patients without cancer) of 20%, based on which it can be used to de-prioritise patients identified to have the very lowest levels of risk, in conjunction with appropriate safety netting. The test successfully identified 94-99% of non-cancer patients who are at very low risk of cancer, so that other possible causes of their symptoms can be considered rather than continuing with referral for further testing.[85-88]

AI-enabled image analysis allows radiation oncologists to reduce reading time of lung cancer CTs by approximately 40%, and to perform image segmentation 13 times faster.

Pre-habilitation & Treatment

Pre-habilitation before surgery

People: **Patient outcomes**

Prosperity: **Affordability**

Offering physical exercise sessions, personal trainers, and psychological support at local cancer centres for around 15 weeks before surgery resulted in improved quality of life, significantly greater tumour regression and a reduction in the length of postoperative hospital stays.[89-92]

Novel radiation therapies

People: **Patient outcomes**

Prosperity: **Workforce efficiency, Affordability**

Hypo-fractionated radiotherapy delivers higher doses over fewer treatments. Nanoparticles for immune-brachytherapy of breast cancer also enable a one-hit treatment. Recent studies suggest this therapy can play a significant role in addressing radio-resistance and tumour recurrence, and lead to less frequent and less invasive treatments at lower cost.[93-96]

Capacity extending innovations

People: **Patient outcomes**

Prosperity: **Workforce efficiency, Affordability**

Capacity extending therapies deliver equal or better outcomes while reducing the burden of clinical management, hospital visits and healthcare costs. Examples include home-based therapies, fixed-duration or 'treat to remission' therapies (after which the patient is off-treatment), and other therapies with less adverse events, higher transfusion independence or lower monitoring needs. Similarly, patient-initiated follow-up empowers patient self-management and reduces the number of clinically unnecessary follow ups.[97-101]

Immuno-oncology therapies

People: **Patient outcomes**

Prosperity: **Affordability**

Instead of using targeted cancer therapies to affect the tumour cell directly, immune oncology activates the patient's immune system to fight cancer. In Belgium, the estimated benefit of all immuno-oncology therapies combined, compared to the standard of care, was 27% in life years gained, a 34% increase in QALYs and an 80% increase in PFS. Related healthcare costs will decrease over time as more patients achieve long-standing remission.[102,103]

Cell- and gene therapies

People: **Patient outcomes**

Prosperity: **Affordability**

Transferring nucleic acids into tumour or normal cells for direct cell-killing, immunomodulation, or correcting genetic errors, can eliminate or reduce tumour cells. Trial results in diffuse large B-cell lymphoma showed 10 vs. 2 months of event-free survival. Gene therapy led to longer survival times in non-small cell lung cancer, an increase in PSA doubling time in prostate cancer and promising results in melanoma. Many of these therapies have shown to be cost-effective, offering savings to the healthcare system and society.[104-109]

Home-based hospitalisation

People: **Patient outcomes**

Prosperity: **Workforce efficiency, Affordability**

Many cancer care interventions are traditionally performed in hospitals., These interventions are resource-intensive and may require patients (and caregivers) who are fit for work to take time out of their jobs. Home-based care offers an alternative, provided quality and safety standards are met. In France, the cost of delivering subcutaneous injections at home was 20% lower than a hospital-based intervention. In Italy, procedures were carried out at home, there was a reduction in both direct medical costs related to receiving subcutaneous blood cancer treatment at home and a 70% cut in indirect costs including working days lost and travel costs for patients and carers alike. Patients and carers reported greater satisfaction (98% of patients said they preferred to be treated at home), and there was an increased adherence rate.[110-113]

Injecting cancer therapies at home is the preferred method for most patients. It has the potential to reduce hospital-related costs by 20% and patient- and caregiver related costs by 70%.

Palliation, Rehabilitation & Survivorship

AI-enabled patient monitoring

People: **Patient outcomes, Caregiver wellbeing**

Prosperity: **Workforce efficiency, Affordability**

Many lung cancer patients are subject to relapses and complications, which means that traditionally they are required to attend frequent follow up appointments. An app-based scheme in France used weekly questionnaires so patients could self-report their symptoms and general health rather than having to sacrifice the time, effort, and expense of attending the hospital. The programme saw the median overall survival rate of patients increase from 12 months to 19 months, while the average annual cost of following up with lung cancer patients fell by EUR 362 per patient. 31% of patients reported increased quality of life, there was a 4% drop in hospitalisations, and emergency room visits fell by 7%.[114-119]

App for fatigue management

People: **Patient outcomes, Caregiver wellbeing**

Prosperity: **Social equity**

Cognitive behavioural therapy (CBT), mindfulness-based cognitive therapy (MBCT) and Physical and Psychological Rehabilitation can be used to help reduce fatigue for cancer patients and survivors. This approach has resulted in significant improvements in fatigue severity, and a significant increase in quality of life. Allowing access to a service which otherwise could be costly also increased social equity.[120,121]

Survivorship support program

People: **Patient outcomes, Caregiver wellbeing**

Prosperity: **Workforce efficiency, Social equity**

More people are living beyond cancer. Between 33-50% of patients with breast cancer experience distress, which can be reduced by psychosocial interventions. eHealth solutions can help overcome traditional barriers to psychosocial treatment, such as costs, waiting lists, and time or mobility restrictions. After using eHealth solutions, results on metrics such as distress levels and quality of life are similar to results seen after following conventional psychosocial approaches.[122-126]

Integrated palliative care clinics

People: **Patient outcomes, Caregiver wellbeing**

Prosperity: **Affordability**

Many cancer patients experience delayed access to palliative care due to a lack of both facilities and experienced personnel, especially in outpatient clinics and small community hospitals. In Norway, a multidisciplinary team of cancer and palliative care specialists meets weekly to discuss and plan patient care, and ensure timely palliative care for patients who need it. Starting palliative care earlier allows patients who want to die at home the opportunity to do so with less travelling and improved quality of life for them and their caregivers.[127,128]

Integrated geriatric palliative care
Sustainability pillars addressed:

People: **Patient outcomes**

Prosperity: **Affordability**

Older people typically have greater adverse effects from cancer and cancer treatment. A Comprehensive Geriatric Assessment (CGA) can be used to identify those individuals who are more likely to have tangible benefits from oncogeriatric care. Recipients of this integrated care reported better quality of life over 24 weeks and underwent significantly fewer unplanned hospital admissions (-41%) over the same period.[129-131]

Home-based palliative care

People: **Patient outcomes, Caregiver wellbeing**

Prosperity: **Affordability**

Caring@home is an Australian national palliative care project offering free education resources to individual carers and community services. These resources support them in using subcutaneous medicines and managing symptoms of palliative care patients safely.[132-134]

An AI-based program to monitor lung cancer patients at home reduced the need for regular follow-up appointments in the hospital. At the same time, the survival rate of patients increased from 12 months to 19 months, while the average annual cost of following up with lung cancer patients fell by EUR 362 per patient. 31% of patients reported increased quality of life.

Healthcare system

Multidisciplinary tumour boards

People: **Patient outcomes, Workforce wellbeing**

Prosperity: **Workforce efficiency, Social equity, Affordability**

Multiple studies have shown an improvement in diagnostic and staging accuracy as a result of employing multidisciplinary tumour boards. Ten studies described improved survival for colorectal, head and neck, breast, oesophageal, and lung cancer. Patients and professionals alike reported improved satisfaction with this process, and it led to a reduced number of patient visits. Digital solutions can enhance Tumour Board accessibility and efficiency.[135-144]

Cancer care networks

People: **Patient outcomes**

Prosperity: **Workforce efficiency**

Collaboration between cancer hospitals and their external stakeholders (patients, other hospitals, clinicians, companies, regulators, and payers) help to shape the ecosystems necessary for redesigning cancer care. This collaboration contributes to the ambition of Europe's Beating Cancer Plan to have, by 2025, an EU Network linking recognised National Comprehensive Cancer Centres in every Member State. The Cancer Plan aims to ensure that 90% of eligible patients have access to such centres by 2030.[145-148]

Managing care using outcomes data

People: **Patient outcomes**

Prosperity: **Affordability**

The Martini Clinic (part of University Medical Centre Hamburg-Eppendorf) has found that specialisation combined with high volumes plus a rigorous commitment to follow-up therapy and evaluation of outcomes, together with strong patient orientation has led to significantly better outcomes: 94% full continence (vs. 57%), 35% erectile dysfunction after one year (vs. 76%), 15 times lower rates of ureteral injury and 62 times lower rates of sepsis.[149-151]

Simulation-based medical education

People: **Patient outcomes, Workforce wellbeing**

Prosperity: **Affordability**

Virtual reality planning software for lung surgery allows for 3D visualisation to provide better insights into a patient's bronchial anatomy. 60% of studies reported improvements in contouring ability, while 80% of surgeons found that VR prepared them better for surgery. Preoperative decisions were adjusted in 33% of cases due to 3D VR-based evaluation of the anatomy.[152-155]

Supporting informal caregivers

People: **Patient outcomes, Caregiver wellbeing**

Prosperity: **Social equity**

Caregivers provide unpaid care to someone close to them and provide 80% of care in Europe. They are the very backbone of our healthcare system, yet often we do not acknowledge or systemically support them in their own times of need. They silently slip into the role of caregiver to a loved one with cancer, with no specific end date, and it can quickly and drastically drain their employment, finances, mental and physical health, and social lives. The increasing burden of diseases such as cancer mean that urgent policy action is needed to ensure the sustainability of caregiving. Embracing caregivers is a program which generates a better understanding of and support for the emotional, financial and health implications of being an informal (unpaid) caregiver.[156,157]

Reducing and offsetting surgery carbon emissions

People: **Workforce wellbeing**

Planet: **CO_2 emission**

Surgery is an energy-intensive activity, and just as in every area of human activity it is an imperative to try to reduce the carbon footprint it generates. The oncology team at Solihull Hospital (University of Birmingham) in the UK conducted a five-hour bowel cancer surgery which was completely carbon neutral. Emissions from the keyhole procedure were cut by 80%, through a range of initiatives including wearing reusable scrubs, reducing energy use, and administering anaesthesia intravenously rather than with gas. The remaining carbon emissions were offset by planting three trees and the surgeons chose cycling or running to work rather than taking their cars. This is only a proof of concept, but it is a powerful reminder of both the environmental impact of surgery and the healthcare industry as a whole, as well as the steps we can take to reduce it.[158]

In 2022, the world's first 'net-zero' cancer operation was performed. This is important as hospitals have a surprisingly large carbon footprint. They are estimated to account for around 6% of total CO_2 emissions. Per day, a hospital bed generates 0.5 kg of hazardous waste, and a hospital generates 133,000 tonnes of plastic a year, of which 95% goes to waste.

Commitments

Achieving sustainable cancer care through innovation

Our plea to healthcare decisionmakers is to redesign cancer care based on five commitments that together create an environment to find, implement and deliver the urgently needed innovations to transform cancer care for the benefit of people, prosperity, and the planet.

Five commitments to harness the power of innovation

All the initiatives described above show the potential for redesigning cancer to ensure delivery of outcomes which matter most to patients while being more efficient, less wasteful, and more sustainable for the future. At the same time, they show it is possible to maintain patient access to high-quality care, ensure further advances in areas of poor prognosis, and to tackle existing inequalities in access to cancer knowledge, prevention, diagnosis, treatment, and care. But to turn the isolated examples described above into real, systemic change will require five enablers to be in place.

Our plea to healthcare decision-makers is to redesign cancer care based on five commitments which, we believe, will create the environment necessary to allow healthcare systems to find, implement and deliver innovations in cancer care. These innovations will make cancer care more sustainable for people, prosperity, and the planet – and will allow people with cancer to get the care they need and the improved outcomes they deserve, even in today's straitened economic times.

Policies | Keep the end in mind

Cancer care policies should reflect a long-term ambition to continue to put patients and outcomes first, through a focus on innovation and sustainability rather than simply continuation and cost containment. Public health policies should facilitate nation-wide adoption of innovations contributing to cancer care sustainability.

The French "Stratégie Décennale De Lutte Contre Les Cancers" aims to significantly reduce the burden of cancer in the daily lives of French people. The strategy revolves around four priorities: (1) to improve prevention; (2) to limit the after-effects and enhance the quality of life; (3) to fight against cancers with poor prognosis; and (4) to ensure that progress benefits everyone. Research and innovation are a key component of the strategy, which highlights the need for methodologies for the pursuit of innovation, its deployment and monitoring.

Investments | Bring from laboratory to patients

Fundamentally changing the way in which cancer care is delivered and reducing long-term costs will require upfront investments in research and development (R&D). The scattered landscape of investors, grants and public financing schemes makes fi nding these investments difficult, especially for innovations for which no sustainable economic model is in place (see Reimbursement). Long-term funding programs, instruments and initiatives at European and national level should be in place to facilitate research, development and large-scale implementation in clinical practice.

EU funding programmes such as EU4Health, Horizon Europe, the European Innovation Council Transition Challenges, the Innovative Medicines Initiative (IMI), and the Innovative Health Initiative (IHI) are an important source of investment in promising cancer care innovations.

Evidence | Measure to achieve

To maximise the impact and scale of cancer care innovations, healthcare decisionmakers at all levels need robust data and analytics on patient needs, outcomes, experiences, costs and efficiency. This information must signpost the potential for impact across the system on people, prosperity, and the planet, to allow decisionmakers to identify and implement innovations to continuously improve sustainability of cancer care.

Easy, inexpensive access to real-world data is also needed by researchers and innovators to generate evidence on the value of their innovation. Traditional clinical trials provide the highest level of evidence on the benefits and risk of cancer care innovations. However, they are complex to run and not always suitable to match with the way science is evolving. They need to be complemented with novel, adaptive methodologies and high-quality, accessible and interoperable real-world data.

To realize this ambition, a key challenge to overcome is the fragmented nature of IT systems across the healthcare sector – and the fact many of them are outdated, underpowered and incompatible.

The EU INSIGHT programme will develop an analytic framework for using synthetic control data for evaluating effects of small-scale one-armed clinical trials, to facilitate evidence generation for optimal decision-making.

Reimbursement | Reward sustainability

Current healthcare models are not focused on sustainability. In fact, activity-based financing encourages volume over outcomes, and often it encourages continuity over efficiency when care delivery activities are reimbursed but transition and optimisation activities are not. In this setting, healthcare organisations wishing to implement more sustainable healthcare products and processes, while delivering the best outcomes for patients, are discouraged from doing so. In a world which needs to address both scarcity and climate change across every sector of human activity, there must be clear incentives to reward sustainability and penalise inefficiency.

Similarly, annual budgeting incentivises short-term cost reduction, favouring continuity and incremental change over innovation and capital investments, to reduce future costs.

Together with pressures on healthcare staffing, this means there is limited room for employees to own, implement, and monitor initiatives to redesign more sustainable cancer care. In conflict with this, every innovation program requires people to own it, drive its implementation and function as its advocate in discussions about its wider adoption.

In France, implementation of the Hospitalisation à domicile (home-hospitalisation) programme is facilitated by a national roll-out: every region is obliged to provide this service to its patients. Costs are reimbursement by healthcare insurers based on a specific tariff.

Networks | Foster innovation

While pilot schemes may show interesting results and exciting potential, they often remain small scale. There must always be a clear progression pathway towards wider implementation. Governments, decisionmakers, and other stakeholders should, as a matter of course, share best practices and provide guidance at a regional, national, and international level to encourage the uptake of successful innovations which improve patient-relevant outcomes and sustainability. By leveraging networks dedicated to knowledge exchange, dissemination, connecting ideas, assistance, implementation, and scaling, decisionmakers can support an ecosystem which fuels continuous cancer care innovation.

EIT Health, is a Knowledge and Innovation Community (KIC) of the European Institute of Innovation and Technology (EIT), an EU body. EIT Health is also an EU Institutionalised Partnership under Horizon Europe. Created to tackle the EU 'health, demographic change and well-being' societal challenge, its mission is to help overcome the well-known EU paradox whereby state-of-the-art education, excellent research and a dynamic industry seldom turn breakthrough ideas into new transformative products and services. EIT Health thus creates a fertile environment in which innovation can flourish: where the brightest minds can explore new ideas and find practical resources to create products and services rooted in innovation. EIT Health activates a network of trailblazers to break down barriers, challenge convention and put healthcare solutions in people's hands. By building health enterprises and bringing innovative products and services to market, EIT Health creates new jobs to grow and strengthen a sustainable European economy. .

Let's make this happen

Together, we believe these commitments will create a healthier, more dynamic environment where patients, citizens and society continue to have access to high quality cancer care, and which at the same time protects equal access and promotes ongoing processes in scientific advancement.

They will make it simpler and more cost-effective for healthcare providers to adopt new innovations and initiatives like those described. This will, in turn, improve outcomes and access for cancer patients as well as quality of life for carers and those around the patient.

They will make it easier for governments to balance financial constraints with their responsibility to provide advanced, effective healthcare, and they will help make that care more responsible from an environmental perspective.

We believe the time has come to take a fresh look at cancer care. We believe in the power of innovation and collaboration to transform cancer care for the benefit of people, prosperity, and the planet.

List of abbreviations

2WW	2-week-wait
ADL	Activities of Daily Living
AE	Adverse Events
AI	Artificial Intelligence
AML	Acute Myeloid Leukemia
ASCO	American Society of Clinical Oncology
BRCA	BReast CAncer Gene
CAR-T	Chimeric Antigen Receptor – T-Cell
CBT	Cognitive Behavioural Therapy
cfDNA	Circulating Cell-Free DNA
CGA	Comprehensive Geriatric Assessment
CLL	Chronic Lymphocytic Leukemia
CO_2	Carbon Dioxide
COrOS	Centri Orientamenti Oncologici (Orientation Cancer Centres)
CRF	CRF - Cancer-related Fatigue
CT	Computerised Tomography
CTC	Circulating tumour cells
ctDNA	Circulating Tumour DNA
DLBCL	Diffuse Large B-cell Lymphoma
DNA	Deoxyriboucleic Acid
DPYD	Dihydropyrimidine Dehydrogenase
EC	European Commission
EFPIA	European Federation of Pharmaceutical Industry Associations
EIT	European Institute of Innovation and Technology
EOP	EFPIA Oncology Platform
ER	Emergency Room
EU	European Union
FIT	Fecal Immunochemical Test
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
gFOBT	Guaiac Fecal Occult Blood Test
GI	Gastro-intestinal
GP	General Practitioner
HAD	Hospitalisation à domicile (home hospitalisation)
HFRT	Hypo-Fractionated Radiotherapy
HPV	Human Papillomavirus
IACO	International Alliance of Carer Organizations
IHI	Innovative Health Initiative (EU)
IMI	Innovative Medicines Initiative (IMI)
IOT	Immuno-oncology therapy
IT	Information Technology
IV	Intravenous
MBCT	Mindfulness-based Cognitive Therapy
MDT	Multidisciplinary Tumour Boards
NHL	Non-Hodgkin Lymphoma
NHS	National Health Service, United Kingdom
OS	Overall Survival
PD-1	Programmed Cell Death Protein 1
PD-L1	Programmed Cell Death Ligand 1
PFS	Progression-Free Survival
PIFU	Patient-Initiated Follow-up
PSA	Prostate-specific Antigen
QALY	Quality Adjusted Life Year
QoL	Quality of Life
RCT	Randomized Control Trial
SBME	Simulation-Based Medical Education
SC	Subcutaneous
TME	Tumour Microenvironment
UK	United Kingdom
US	United States
VR	Virtual Reality
WGS	Whole Genome Sequencing

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Disclaimer: this publication is the result of a multi-stakeholder collaboration but does not necessarily reflect the views of individual organisations or people involved.

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The joint development of this report was initiated by the EFPIA Oncology Platform (EOP). The EOP is a collaboration of 19 companies from the research-based pharmaceutical industry in Europe, launched in 2016 with the vision that every patient in Europe has access to the cancer care they need:

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Annex

30 case examples of innovations that improve the sustainability of cancer care

Gamification of risk-factor awareness

Care pathway element
Prevention & Early detection

Key trend
Digital Health & Digital Medicine

Cancer
Breast cancer

Innovation type
Product

Key beneficiaries
Healthy adolescents

Developed / implemented by
European Association of Cancer Leagues

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
European Commission Health Programme Pilot Projects scheme Grant Agreement PP-2-5-2016 (# 769767)

Sources and more information:
see List of references #23-25

About the innovation

Background & Challenge

Breast cancer is the leading cause of cancer deaths in women worldwide. For women, it accounts for 25% of the annual number of cancer diagnosis. One in 11 women in the EU will develop breast cancer before the age of 74, of which ~21% of occurs before the age of 50. Breast cancer therefore affects many women during their years dedicated to working and raising a family. A growing body of evidence shows the link between physical activity, healthy body weight, nutrition, alcohol use, breast feeding and hormone replacement therapy and breast cancer risk.

Solution

The WASABY app delivers information on healthy lifestyles and cancer prevention to healthy adolescents in the EU aged 12-19 years old. The app follows a gamified method of teaching (10 modules of interactive content and quizzes, reward badges, ranking of EU top scorers).

Background & Challenge

Primary prevention of breast cancer through increased awareness of how a healthy lifestyle based on e.g., physical activity, healthy body weight, nutrition, alcohol use, and breast feeding affect breast cancer risk.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

A few months after launch, in May 2021, the app raised awareness on how to reduce breast cancer risk factors with 931 registered users across 27 countries.

Key considerations for stakeholders aiming to implement

- Partnership with the European Cancer League (ECL) to ensure that project results are made available to the population target groups (dissemination and promotion program of the digital tool.)
- Dissemination campaign consisted of tutorial and message videos of the digital tool prepared by a youth ambassadors for the European Code against Cancer, and social media cards linked to the World Cancer Day's format.

2018
Start of 3-year pilot programme funded through the EU Health Programme

Feb 2021
External launch of digital tool and online courses on World Cancer Day

2023
Experience can be useful for the proposed 'EU Mobile App for Cancer Prevention', described in Europe's Beating Cancer Plan

2018 — 2021 — 2023

Internet-based smoking cessation

Care pathway element
Prevention & Early detection

Key trend
Digital Health & Digital Medicine

Cancer
Smoking-related cancers, including lung, oral cavity, larynx, oesophagus and bladder cancer

Innovation type
Product

Key beneficiaries
Smokers

Developed / implemented by
Various settings and various types of providers

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Most interventions are implemented or studied with public funding

Sources and more information:
see List of references #26-30

About the innovation

Background & Challenge

In Europe, 28% of cancers in males and 10% of cancers in females are attributable to tobacco use. Smoking cessation is proven to reduce cancer mortality, with the strongest effects observed the sooner cessation occurs. Cancer patients who stopped smoking already before their diagnosis have 75% lower mortality rates. Quitting at or shortly after cancer diagnosis reduces mortality with 35%. About 70% smokers would like to stop. Internet is an attractive platform to help because of low costs per user, and its potential to reach smokers who may not seek help from a (healthcare) professional, such as young or stigmatized people, or because of limited availability / accessibility.

Solution

Internet-based smoking cessation interventions such as automatic text messaging, smart phone apps, quitting websites, video games and social media platforms can offer low-cost methods of increasing smoking cessation rates.

Objective

Primary cancer prevention which is less expensive and time-consuming for both health providers and recipients (due to lengthy waiting times and the need to take time off work) and reaches a wider target group than health provider-led interventions.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: workforce efficiency | **social equity** | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- A Cochrane review found that internet interventions have a similar effectiveness compared to face-to-face counselling.
- Internet-based application results were strongest when interactive interventions were tailored to individuals and/or when combined with behavioural support.
- Internet-based interventions have the potential to reach a large audience, particularly those in harder-to-reach locations.
- Review of 13 text-based quitting programs showed a 36% improvement in quit rates compared with control groups.

Key considerations for stakeholders aiming to implement

- Consider the stakeholder group and the position in the care pathway at which the intervention is aimed.
- Consider the costs of developing an internet-based application compared with conventional smoking cessation programs.
- Improving upon an existing intervention may be more cost-effective and efficient than developing a new one from the ground up.

2003
Launch US of SmokeFree.Gov

2003-2012
Tailored SmokeFree programmes for women, teens, Spanish-speakers, veterans

2020
SmokeFree consists of 6 mobile-optimized websites, 9 text messaging programs, and 2 mobile apps - complemented by social media platforms

2003 — 2003-2012 — 2020 — 2023

Digital solutions for vaccination uptake

Care pathway element
Prevention & Early detection

Key trend
Digital Health & Digital Medicine

Cancer
HPV-related cancers, predominantly, cervical, anal, and oropharyngeal cancer

Innovation type
Product & Process

Key beneficiaries
Adolescents

Developed / implemented by
National Governments and healthcare authorities

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
National Governments

Sources and more information:
see List of references #31-37

About the innovation

Background & Challenge

In Europe, sexually transmitted infections with oncogenic HPV account for around 73 000 anogenital and 14 000 oropharyngeal cancer cases per year. HPV vaccines have proven to be highly efficacious when given before a person becomes sexually active. Depending on uptake, 318 (<20% uptake) to 1904 (>60% uptake) per 200 000 cancer cases can be prevented by HPV vaccination of boys and girls. At 80% uptake, sex-neutral vaccination has a favorable cost-effectiveness profile, but most European countries are not yet able to reach this level of HPV vaccination coverage. Insufficient information and safety concerns are the main barriers to vaccination acceptance.

Solution

Digital solutions using social media / online peer networks, web-based and mobile applications can make decision-support tools for HPV vaccination widely available to reduce vaccine hesitancy and confusion.

Objective

Making information more accessible for hard-to-reach groups facing language- or geographical barriers for example. With the final aim of enhancing informed decision-making, uptake and (cost-)effectiveness of HPV vaccination.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: workforce efficiency | **social equity** | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- A study in the US found that first dose vaccination rates were significantly higher (+18.8%) among daughters of parents using decision-support tools for HPV vaccination via a smartphone web app.

Key considerations for stakeholders aiming to implement

- Vaccination acceptance is critical to ensuring the success of national immunization programs and coordinated efforts should be made to provide the relevant population with information for informed decision-making about HPV vaccination.
- The percentage of female adolescents knowing about HPV is consistently higher than that of boys. Adolescent's age at first sexual intercourse, age of respondent parents, and religion were also identified as being related with HPV knowledge.
- Main drivers to vaccination are perception of efficacy of HPV vaccine and social responsibility.

2006
Introduction of the first HPV vaccines

2008
First ECDC guidance on HPV vaccination in EU countries

2012
Update of ECDC guidance following evidence on efficacy of HPV vaccination in males

2016
On average, European countries on reach 39.2% of the targeted population

2006 — 2008 — 2012 — 2016

Improved acceptability of population-based screening

Care pathway element
Prevention & Early detection

Key trend
Precision Medicine & Biomarker Testing

Cancer
Colorectal cancer

Innovation type
Process

Key beneficiaries
Citizens aged 50 to 74 years old

Developed / implemented by
National Governments and healthcare authorities

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
National Governments

Sources and more information:
see List of references #38-39

About the innovation

Background & Challenge

Colorectal cancer represents 12.4% of all cancer deaths in the EU, despite the disease being preventable in many cases. The stage of diagnosis has a significant impact on outcome, with 90% of individuals diagnosed at the earliest stage (stage 1) surviving for at least five years compared with 10% survival for those diagnosed at the latest stage (stage 4). Costs of treatment are ten-fold lower than for cancers diagnosed at stage 4. The European Council of Health Ministers recommends population-wide screening for all citizens aged 50 to 74 years old. As of 2020, only a few countries in the EU have achieved the desired 65% participation rate.

Solution

The fecal immunochemical test (FIT) is more acceptable to participants than the older guaiac fecal occult blood test (gFOBT), because it only requires one stool sample rather than three for gFOBT. Participants take stool samples at home, which are then sent in for analysis.

Objective

Without screening, only ~13% of cases are diagnosed at the earliest stage. Improving the effectiveness and cost-effectiveness of colorectal cancer screening, through improved participation, represents a significant opportunity to save lives and costs across Europe.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- In Scotland, the uptake of the FIT as the first-line test (58.5%) was 5-6% greater than that achieved using gFOBT only, supporting the view that more user-friendly fecal collection encourages screening participation.
- In countries with a high participation rate, the results of FIT-based population screening are significant: in the Netherlands, 48% of patients are now diagnosed at Stage I.

Key considerations for stakeholders aiming to implement

- Thus far however, only 14% of EU citizens (50 - 74 years) can participate in the population-based screening programme.
- Experiences from countries with high participation rates can be leveraged for best practice sharing.
- There is evidence that adopting more tailored strategies for FIT testing might influence the effectiveness and cost-effectiveness of colorectal cancer screening.

2003
2006
Council of Health Ministers recommendation to implement population-wide colorectal cancer screening (ages 50-74)

2020
2020
Slovenia, Netherlands, Denmark & Lithuania achieved 65% participation rates

2022
2022
Start of the roll-out for a national FIT-based screening program in Finland

Genetic testing for hereditary cancer

Care pathway element
Prevention & Early detection

Key trend
Precision Medicine & Biomarker Testing

Cancer
Breast cancer and ovarian cancer

Innovation type
Product & Process

Key beneficiaries
Individuals with BRCA mutations

Developed / implemented by
National health systems and guideline committees

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
National health systems
Co-funded by the European Union (project no. #220720)

Sources and more information:
see List of references #40-49

About the innovation

Background & Challenge

In women with a BRCA gene mutation, the risk of developing breast and ovarian cancer is 72% and 40%, respectively, compared with 13% and 1% in women without this mutation. These mutations are more common in women diagnosed before the age of 50 and may be missed by national breast cancer screening programs, which typically target women over 50. Therefore, clinical genetic testing for the determination of breast cancer susceptibility is widely available in most developed countries. However, most guidelines restrict such testing based on family history-based testing criteria, a suboptimal approach known to identify less than 50% of mutation carriers.

Solution

Biobanks in Australia, Northern Europe, and the US have applied a genotype-first approach, in which mutation carriers are recontacted. In the UK, researchers modelled the cost-effectiveness of BRCA mutation testing in all women with epithelial ovarian cancer.

Objective

Fewer cases of breast cancer and ovarian cancer based on prophylactic surgery, which reduces breast cancer risk by over 90%, or high-risk surveillance and the reduction in future cases of breast and ovarian cancer in relatives.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- In the UK, BRCA testing of all women with epithelial ovarian cancer was modelled to be cost-effective at a threshold of £20,000/QALY.
- Researchers from the UK, Netherlands, Brasil, China, India and Australia modeled population-based BRCA testing to be cost-saving in high income countries (incremental cost-effectiveness ratio of minus $3000 to minus $11,000 per QALY) and appears to be cost-effective in upper-middle income countries.
- In Estonia, biobank data was used to recontact 180 female participants aged 22–79-years carrying any of the 11 genes listed in relevant clinical guidelines as increasing the risk of breast cancer. During the study, breast cancer was diagnosed in six participants that would have otherwise been missed or discovered late.

Key considerations for stakeholders aiming to implement

- Adequate training for multidisciplinary team members is crucial for the success of screening and patient care following testing results.

1994
BRCA1 discovered

1995
First genetic test for BRCA mutations become available

1995
BRCA2 discovered

2000
NHS offers genetic testing for BRCA for high-risk people

2005
PARP inhibitors are found to be effective at killing cancer cells with BRCA mutations

2013
BRCA is tested at routine cancer clinic appointments

2023
Plans to develop international databases to study BRCA mutations

1994 — 1995 — 1995 — 2000 — 2005 — 2013 — 2023

App-based triage

Care pathway element
Prevention & Early detection

Key trend
Digital Health & Digital Medicine

Cancer
Skin cancer

Innovation type
Product

Key beneficiaries
Patients with skin cancer lesions

Developed / implemented by
Used by doctors, pharmaceutical companies and health insurers

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
European Academy of Dermatology and Venereology

Sources and more information:
see List of references #50-53

About the innovation

Background & Challenge

Early and accurate detection is important, since prognosis and cost of treatment are both highly dependent on cancer stage at detection. Population screening programs can help, but widespread implementation of such initiatives is unlikely due to their high cost and lack of evidence of benefits. Additionally, access to specialized health care professionals is not always straightforward, and even when access is possible, the accuracy of general practitioners in differentiating benign and malignant skin tumors is relatively low (<60%). Smartphone apps can help increase access to skin cancer triage.

Solution

Smartphone apps equipped with algorithms for image analysis of suspicious lesions to detect skin cancer provide access to skin cancer triage in cases where access to dermatologists is slow or unavailable.

Objective

Early detection can lead to a higher survival rate (99% at early detection vs. 68% when the lymph nodes are reached) and less invasive treatment choices, thus reducing costs and burden on patients.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: workforce efficiency | **social equity** | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- Skin cancer triage apps currently offer 95% sensitivity (proportion of lesions correctly classified as high risk) and 78% specificity (the proportion of lesions correctly rated as benign).
- Usage of apps could, for many people, replace conventional triage methods such as biopsy, which are painful, slow, and time consuming.
- A visit to the GP or specialist is only recommended when the skin cancer triage app rates an image as high-risk. Consequently, the number of unnecessary visits to the GP or dermatologist can be reduced.

Key considerations for stakeholders aiming to implement

- Some population groups (e.g. digital illiterates and older people) may be more difficult to reach via apps.
- The trustworthiness of these app may be questioned requiring extra attention to information and communication.

2011
Developed by researchers & dermatologists

2013
Clinically proven

2014
First skin cancer app with CE mark

2018
App proven to have 95% sensitivity and 78% specificity

2020
1.2 million users worldwide

Ongoing
Ongoing use of AI to enhance effectiveness of app

2011 — 2013 — 2014 — 2018 — 2020

Novel imaging technologies

Care pathway element
Diagnosis

Key trend
Digital Health & Digital Medicine

Cancer
Breast cancer

Innovation type
Product

Key beneficiaries
Women at risk of breast cancer, in particular young women and women living in remote areas

Developed / implemented by
Toscana Life Sciences, Umbria Bioengineering Technologies, London South Bank University, Elaros, Servicio de Salud de Castilla – La Mancha, IMT School for Advanced Studies Lucca, EVITA Hereditary Cancer

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
European Commission Horizon Mission 2021 Cancer

Sources and more information:
see List of references #54-59

About the innovation

Background & Challenge

Over the past 25 to 30 years, the use of ionizing radiation in medicine has greatly increased and mammography screening for breast cancer is widely available in many countries. Initially praised as a universal achievement to improve women's health and to reduce the burden of breast cancer, the benefits and harms of mammography screening have been debated heatedly in the past years.

Solution

Mammowave is a device which uses very low power (<1 mW) microwaves instead of ionizing radiation (X-ray) for generating images to detect breast lesions. The images are processed through an integrated imaging algorithm which describes image parameters.

Objective

Provide a radiation-free, pain-fee, faster and more cost-effective method for breast cancer screening that addresses the disadvantages and harms of X-ray screening: low sensitivity in increased breast density (associated with younger age), false-positive outcomes, anxiety and pain, and the (extremely low) risk of radiation-induced injury.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: **workforce efficiency** | **social equity** | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

The exam:

- is radiation-free, eliminating the risk of radiation-induced breast cancer and making it safe to be used at any age, in any condition (e.g., pregnancy) and for unlimited number of times
- is pain-free, as no breast compression is applied
- is more comfortable as it is performed with the patient lying in a comfortable facing down position
- leads to less false-positive outcomes and related follow-up tests and patient impact
- is fast, as it takes only a few minutes per breast
- has lower set-up and running costs than x-ray equipment
- can be applied in a wider population, including women with higher breast density (sensitivity of 82%), women with less geographical access to a health facility with X-ray equipment, women with cultural or religious barriers to undressing, thereby enhancing the cost-effectiveness of breast cancer screening programs.

2020
Start of a clinical trial to test the algorithm and compare outcomes with the effective diagnosis obtained by standard clinical methods

2022
Selected for funding from HORIZON-MISS-2021-CANCER, with the total score of 15/15

Forthcoming
Clinical validation on thousands of participants to inform expanded breast cancer screening

2020 — 2022

AI-enabled medical image analysis

Care pathway element
Diagnosis

Key trend
Artificial Intelligence & Machine Learning

Cancer
Prostate, head-and-neck, lung cancer

Innovation type
Product & Process

Key beneficiaries
Radiation oncologists, specialist technicians

Developed / implemented by
Karolinska Institute & partners, Microsoft (InnerEye, Research Cambridge, Azure), Addenbrooke's Hospital, Aidence

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Vinnova (Sweden innovation agency), EIT Health program to advance early cancer screening and diagnosis, hospitals

Sources and more information:
see List of references #60-67

About the innovation

Background & Challenge

Analysis of CT scan data can take several hours for each patient, starting with a 3D CT image scan which is stacked as dozens of 2D images, each examined and manually marked up (contoured) by a radiation oncologist or specialist technician. This leads to high variability and a shortage of personnel for performing such tests.

Radiology assessments of chest CT scans to find abnormalities is time-consuming as medical professionals search for millimetric lesions with the naked eye and (semi-)manually count, segment, and measure.

Solution

Machine Learning (ML) is applied to build and train deep neural networks to analyse digitized biopsy results for the detection of prostate cancer and head-and-neck cancer. Artificial Intelligence (AI) enabled software can identify, quantify, assess growth and classify lung nodules from 3mm to 30mm in size in CT scans.

Objective

Accelerate clinicians' ability to perform radiotherapy planning up to 13 times faster compared with traditional methods.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: **workforce efficiency** | social equity | affordability

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- When using ML assistance to segment and contour CT images in preparation for radiotherapy (a process taking several hours), clinicians work up to 13 times faster than during the manual process, with accuracy within the bounds of human expert variability.
- The time needed by a radiation oncologist is shown to be reduced by >90% for head and neck CT image segmentation and contouring.
- AI can detect lung nodules at a sensitivity of 91% and lead to an average of ~40%reduction in reading time when reporting on pulmonary nodules.
- In a Dutch hospital, a radiologist was inclined not to follow up on a small change in nodule diameter, however, the tool identified significant volume growth, helping clinicians with an apt diagnosis.

Key considerations for stakeholders aiming to implement

- Training healthcare workforce to use the system to its full capacity.
- Allowing time for transition period, due to significant engineering and infrastructure required for integrating ML into clinical settings.

2012
Start of project

2014
End of data collection on needle core biopsies (for Lancet publication)

2020
Release InnerEye open-source deep learning toolkit, Lancet publication

2020
Further validation in 9-country multicenter study

2023
Continued hospital implementation

2012 — 2014 — 2020 — 2020 — 2023

Prospective mutation analysis to prevent severe toxicity

Care pathway element
Diagnosis

Key trend
Precision Medicine & Biomarker Testing

Cancer
Various cancers

Innovation type
Process

Key beneficiaries
Patients at risk for severe toxicity due to DPYD gene polymorphisms

Developed / implemented by
Bon Secours Hospital, Cork Ireland (private hospital)

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Bon Secours Hospital, Cork Ireland (private hospital) & University College Cork

Sources and more information:
see List of references #68-70

About the innovation

Background & Challenge

Fluoropyrimidine-based chemotherapy can lead to severe toxicity in a substantial minority of patients receiving this treatment. In ~20% of the cases, the severe toxicity is attributable to DPYD gene polymorphisms.

Solution

Patients receive prospective DPYD mutation analysis before commencing fluoropyrimidine-based chemotherapy, rather than reactive testing in patients who have already experienced severe toxicity.

Objective

Better patient outcomes and reduced costs.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- Prospective analysis in patients commencing fluoropyrimidine chemo is more cost-effective than reactive testing in severe toxicity, as hospital admission costs are significantly higher than DPYD testing costs.

n=134 patients		**Systematic Screening (€)**	**Usual Care (€)**
Cost of DPYD screening		23,718	5,310
Cost of severe toxicity-related admission to hospital	92,824 (based on 60% success rate in preventing admissions)		232,061
Total cost of care		**116,542**	**232,371**
Incremental cost of systemic screening vs usual care		**- 120,829**	

- Prospective identification coupled with initiation on a reduced dose protects patients from severe and fatal toxicity, as well as improving QoL.

Key considerations for stakeholders aiming to implement

- As the findings come from a small single centre study, results may be biased. Additional studies have been completed or are ongoing, often in specified cancer types (i.e., colorectal cancer) which will further inform stakeholders considering implementation.

1st Jan 2010
Study initiation

June 2011
Testing was performed by sequencing exons 13, 14, and 22 (including 4 DPYD variants targeted by the later method)

June 2011
Quantitative PCR targeting 4 specific DPYD variants associated with fluoropyrimidine toxicity was adopted as the testing method

31st dec 2013
Study completion

2010 — 2011 — 2011

Genetic tumour profiling for treatment guidance

Care pathway element
Diagnosis

Key trend
Precision Medicine & Biomarker Testing

Cancer
Various cancers

Innovation type
Product & Process

Key beneficiaries
Patients diagnosed with cancer

Developed / implemented by
Exact sciences, local healthcare systems, physician associations such as ASCO (guideline inclusion and development); Hartwig Medical Foundation

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
National health systems, insurance companies, philanthropy

Sources and more information:
see List of references #71-79

About the innovation

Background & Challenge

Cancer is an individual disease - no two patients have the same tumour. Currently, many patients are given treatment based on their cancer type as well as treatment guidelines, but may not be benefiting from the care given due to genetic uniqueness.

Solution

Perform diagnostic DNA / genomic tests that show the detailed tumour characteristics. Findings from the analysis can be used to improve the treatment decision making, enable more personalized treatment, and determine an individual's risk for recurrence.

Objective

Leverage genomic tests, such as the 21-gene test in breast cancer, or Whole Genome Sequencing (WGS) to develop a complete view of the genomic characteristics of a tumour.

Precisely identify those patients who will and will not benefit from treatment, and determine an individual's risk of disease recurrence.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: **workforce efficiency** | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- By selecting chemotherapy for those who will most likely benefit, patients at lowest risk of disease recurrence have been spared chemotherapy (56%),and there has been a reduction in ineffective chemotherapy and related hospital services.
- As a result of a reduction in chemotherapy, in Germany, the use of the 21-gene test led to estimated average savings per patient of 2,500€.
- Treatment advice from Whole Genome Sequencing used for a group of 5100 metastatic cancer patients to improve their outcomes – 31% of patients were indicated for responding better through using experimental medication through clinical trials.

Key considerations for stakeholders aiming to implement

- The long-term healthcare savings still require an upfront investment.
- The Hartwig Medical Foundation developed a free database to make WGS data available for academic research; patient consent was collected for GDPR purposes.

2004
Launch of first 21-gene test

2007
21-gene test included in the ASCO guidelines

2014
21-gene test helps more than 500,000 patients worldwide

2016
NICE recommends 21-gene test

2019
Landmark TAILORx results published in NEJM

2019
WGS study on 2399 patients is published in Nature

Future
Standardization and guidelines for application

2004 — 2007 — 2014 — 2016 — 2019 — 2019

Liquid biopsies

Care pathway element
Diagnosis

Key trend
Precision Medicine & Biomarker Testing

Cancer
Various cancer types, including pancreatic cancer

Innovation type
Product

Key beneficiaries
Patients with suspected lung cancer

Developed / implemented by
Hospitals, cancer research centers, national health systems

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Innovative Medicines Initiative (IMI) for the CANCER-ID project and potentially a grant via the EU Innovative Health Initiative (IHI).

Sources and more information:
see List of references #80-84

About the innovation

Background & Challenge

Lung cancer is the most common cancer worldwide – more than half of people die within one year of being diagnosed. It is therefore imperative to identify methods for early detection enabling a timely treatment plan.

Pancreatic cancer is one of the deadliest cancers. It is rarely diagnosed before it starts to spread and has a survival rate of less than 5% over five years.

Solution

Liquid biopsies are a non-invasive way to easily obtain tissue specimens from patients. This biopsy method allows for real-time monitoring of the tumour, and includes circulating tumour cells (CTC), circulating tumour DNA (ctDNA), circulating cell-free DNA (cfDNA) and exosomes, and samples can be derived from blood, urine, saliva and the like.

Objective

Use of less invasive techniques for screening, early diagnosis, patient stratification, treatment decisions, disease monitoring and detecting acquired treatment resistance, to improve patient outcomes and health system efficiency.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

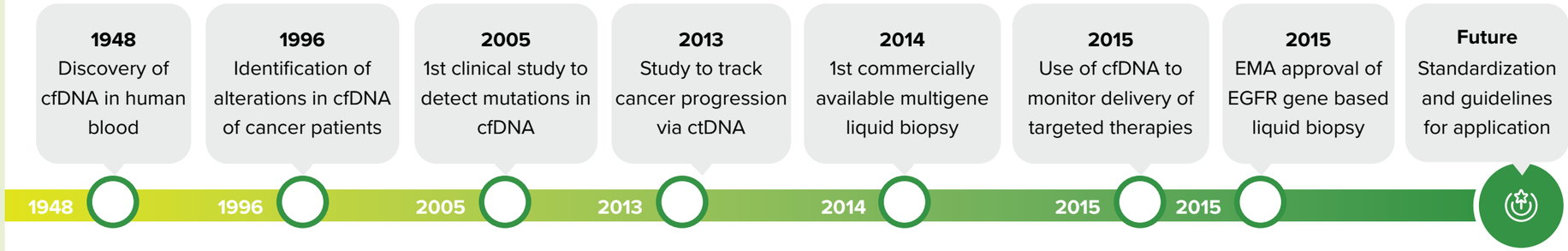
Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- PFS and OS achieved based on liquid biopsies are (at minimum) at the same level compared to when therapy decisions are made based on tissue biopsy, but achieved through a less invasive technique.
- Using liquid biopsies, progression was observed 8 months prior to objective progression – additionally, early progression as indicated by T790M mutation in plasma can be detected earlier than that detected in computed tomography (CT) scans leading to a timely treatment action.
- A liquid biopsy test based on biomarkers in extracellular vesicles –particles that regulate communication between cells – were used to detect pancreatic, ovarian and bladder cancer at stages I and II. The test was able to identify 95% of early pancreatic cancers.

Key considerations for stakeholders aiming to implement

- While several biomarkers have shown exciting results, diagnostic performance and clinical applicability is currently still being investigated.



Affordable blood testing and AI-supported diagnosis

Care pathway element
Diagnosis

Key trend
Artificial Intelligence & Machine Learning

Cancer
Breast, gynaecological, hematological, head & neck, lower GI, lung, skin, upper GI & urological cancer

Innovation type
Product & Process

Key beneficiaries
Patients with cancer symptoms, GPs, national health system

Developed / implemented by
NHS England, PinPoint

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
NHS Cancer Program
Cancer Innovation Open Call competition

Sources and more information:
see List of references #85-88

About the innovation

Background & Challenge

A major National Health Service (NHS) cancer policy to diagnose cancer earlier led to the introduction of Urgent Suspected Cancer Referrals in the United Kingdom. Patients suspected of cancer are assessed within 2 weeks ('2-week wait' (2WW) referral). The 2WW pathways have contributed to improving outcomes, as higher general practice use of referrals for suspected cancer is associated with lower mortality for the main cancer types. However, over 90% of cancer referrals made by GPs in England do not have cancer but undergo expensive, time consuming and stressful diagnostic tests.

Solution

A new type of blood test, based on AI to look at features in the blood, supports GPs to determine the chance that a patient has cancer. The test identifies both high-risk and very low-risk patients within 72 hours.

Objective

Reduce the number of people needing extensive diagnostic testing, reduce waiting times, improve the patient experience and allow GPs to more accurately triage and prioritise those at highest risk, improving the early detection of cancer.

Impact

Sustainability pillars addressed

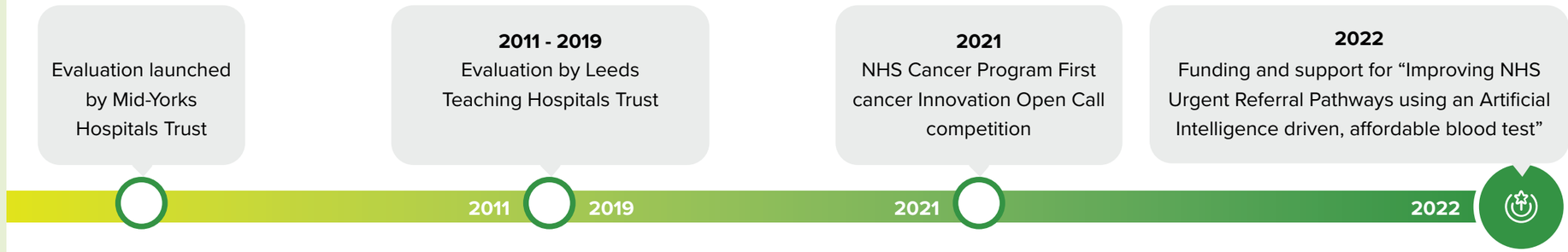
People: **patient outcomes** | caregiver wellbeing | workforce wellbeing
Prosperity: workforce efficiency | social equity | **affordability**
Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

An initial study indicated a sensitivity (ability to identify patients with cancer) of 90% for cancer cases with a high probability of cancer. The specificity (ability to identify patients without cancer) was 20%. Consequently, it can be used to de-prioritise patients identified to have the very lowest levels of risk, in conjunction with appropriate safety netting. In this setting, the test successfully identified 94-99% of non-cancer patients who are at very low risk of cancer, for the nine urgent referral pathways, so that other possible causes of their symptoms can be considered rather than continuing with a 2WW referral.

Key considerations for stakeholders aiming to implement

The 2WW pathways are an effective and well-used route for earlier cancer diagnosis in the NHS. However, the pressures resulting from this increased use mean that business-as-usual is no longer an option, and the NHS must adapt. New diagnostic technologies can be a part of this solution.



Pre-habilitation before surgery

Care pathway element
Pre-habilitation & Treatment

Key trend
Out-of-hospital care

Cancer
Breast, gynaecological, hematological, head & neck, lower GI, lung, skin, upper GI & urological cancer

Innovation type
Product & Process

Key beneficiaries
Patients undergoing cancer surgery

Developed / implemented by
NHS Wessex (Clinical Networks), NSH University Hospital Southampton, University of Southampton

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
NHS England Sustainability and Transformation Funding, administered by Wessex Cancer Alliance

Sources and more information:
see List of references #89-92

About the innovation

Background & Challenge

In the UK, 45% of people with cancer have surgery to remove a tumour and are at higher risk of post-surgery complications, such as breathing difficulties, reduced mobility, and general lowered fitness. The physical toll of other cancer treatments, and anxiety or depression in the period around a procedure can impact a person's recovery from surgery.

Solution

Combining physical exercise with psychological support where personal trainers lead the exercise sessions and are tailored to the participants' needs. Programs last ~15 weeks and people can also access counselling at local cancer centers, which help them prepare for surgery and improve overall wellbeing. The program has been implemented across 21 sites in England.

Objective

- Reduce the impact of surgery on people with cancer.
- Reduce the length of hospital stays following cancer surgery.
- Provide exercise programs and additional psychological support to prepare patients for surgery (improving mental fitness).

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- Between 2017 and 2020, 250 people took part in the program, with 97% attending three sessions per week.
- The program has improved the physical fitness of people due to have surgery for rectal cancer following chemotherapy and radiotherapy (significantly greater tumour regression grading value in WesFit group).
- The program has reduced the length of post-surgery hospital stays.
- Patients interviewed after participating the WesFit program said they were able to build camaraderie and peer support, and experience a sense of control.

Key considerations for stakeholders aiming to implement

- Patients indicated they would like continued support to get back to exercise after surgery.

2017
Program launched

2020
Expansion to 21 sites in England

2020
Research team behind program wins Cancer Care Initiative of the Year

2020
Spin-off for post-surgical care during COVID-19 launched

2017 — 2020 — 2020 — 2020

Novel radiation therapies

Care pathway element
Pre-habilitation & Treatment

Key trend
Curative & Capacity extending therapies

Cancer
Various cancers, including lung, breast, prostate, and cervical cancer

Innovation type
Product & Process

Key beneficiaries
Patients undergoing radiotherapy

Developed / implemented by
Numerous hospitals

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Public fund raising (Swim to Fight Cancer); health insurance companies

Sources and more information:
see List of references #93-96

About the innovation

Background & Challenge

- Recent technological advances in external beam radiotherapy have allowed larger doses per fraction delivered to tumour, while minimizing doses to the adjacent normal tissue.
- Conventional surgical- or radiotherapy breast cancer treatments are invasive with undesired side-effects (breast deformation/removal). Post-surgical radiotherapy requires weekly visits to the hospital, which is demanding for patients, especially in remote locations.

Solution

- Hypo-fractionated radiotherapy is radiation treatment delivered at higher doses in fewer treatments than conventional standard radiotherapy. Conventional fractionated radiotherapy delivers in small fractions over several weeks, whereas hypo-fractionated radiotherapy delivers high dose in fewer fractions.
- Thermo-brachytherapy is based on intratumoral injection of magnetic, radioactive nanoparticles with a radioactive core programmed to generate heat and deliver brachytherapy. The breast is exposed to an alternating magnetic field that causes thermal ablation; the brachytherapy kills the remaining cancer cells.

Objective

- Less frequent and less invasive radiotherapy treatments.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing
Prosperity: **workforce efficiency** | social equity | **affordability**
Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- Many studies have shown that hypo-fractionated radiotherapy can induce immune-activated TME and improve treatment efficacy. Recently, studies have suggested that hypo-fractionated radiotherapy can also play a significant role in addressing radiotherapy resistance and tumor recurrence. Combined with PD-1/PD-L1 inhibitors it can induce protective immunologic memory in long-term survivors.
- The proof-of-principle of the thermo-brachytherapy with nanoparticles is currently being demonstrated in mice models. After clinical evaluation of the developed materials, the impact on the patient's quality of life and economic outcomes will be demonstrated in clinical trials.

Key considerations for stakeholders aiming to implement

- For hypo-fractionated radiotherapy, different sites and types of tumours may respond differently to the same dose and fractionated irradiation. Exact doses and schedules to activate anti-tumour immune response and induce immune suppression are still unknown.

2020
Nanoparticle thermo-brachytherapy materials developed

2021
HFRT published in Frontiers in Immunology

2022
Nanoparticle thermo-brachytherapy in vitro tests

2023 + 2026
Pre-clinical tests + Clinical trials

2020 — 2021 — 2022 — Future

Capacity-extending innovations

Care pathway element
Pre-habilitation & Treatment

Key trend
Curative & Capacity extending therapies

Cancer
Various cancers, including lung, breast, prostate, and cervical cancer

Innovation type
Product & Process

Key beneficiaries
Patients undergoing radiotherapy

Developed / implemented by
Numerous hospitals

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Public fund raising (Swim to Fight Cancer); health insurance companies

Sources and more information:
see List of references #97-101

About the innovation

Background & Challenge

Even before the COVID-19 pandemic, cancer services faced capacity challenges due to a rising demand and workforce shortages. This poses a barrier for cancer services in meeting national targets across the patient pathway. Since COVID-19, new backlogs have emerged on top of existing waiting lists in many health systems.

Solution

Capacity extending therapies deliver equal or better outcomes while reducing the burden of clinical management, hospital visits and healthcare costs. Examples include home-based therapies, fixed-duration or 'treat to remission' therapies after which the patient is off-treatment, and other therapies with less adverse events, higher transfusion independence or lower monitoring needs. Similarly, patient-initiated follow-up (PIFU) empowers patient self-management and reduces the number of clinically unnecessary follow ups.

Objective

Capacity extending innovations can alleviate capacity concerns by reducing the need for patients to visit the hospital in the long-term, freeing-up resources that can be reinvested elsewhere in the system. This can reduce the number of patients requiring outpatient follow up, and deliver long-term financial savings to the health system.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing
Prosperity: **workforce efficiency** | social equity | **affordability**
Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

Numerous clinical trials evaluating new treatment options for CLL are underway, including potential **fixed-duration treatment** options.

- Significantly longer periods of progression-free survival (PFS) in CLL have been obtained with 2 years of fixed-duration therapy.

Treatments that increase **transfusion independence** have both humanistic and economic benefits to patients with AML:

- patients were more likely to rate achieving transfusion independence as very important (62.3%) vs physicians (46.9%).
- Eighty percent of patients noted that their monthly out-of-pocket infusion costs were more than $500.

Key considerations for stakeholders aiming to implement

- The UK National Health Service has developed a guide for implementing **patient-initiated follow-up**. An emphasis on patient engagement, psychosocial issues, symptom reporting and reliable, quick routes back to the clinic will be important. Certain patient groups may be less suited to PIFU.

2021
Oral therapies have almost entirely supplanted chemo-immunotherapy in the treatment of CLL

2021

Immuno-oncology therapies

Care pathway element
Pre-habilitation & Treatment

Key trend
Curative & Capacity extending therapies

Cancer
Various cancers

Innovation type
Product

Key beneficiaries
Patients

Developed / implemented by
Pharmaceutical companies and hospitals

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
National health systems

Sources and more information:
see List of references #102-103

About the innovation

Background & Challenge

Until recently, cancer therapy comprised four main types of treatment: surgery, radiotherapy, chemotherapy and targeted therapy. Over the past decade, immuno-oncology (IO) has emerged as a novel and important approach to cancer treatment through the stimulation of the body's own immune system to kill cancer cells.

Solution

Multiple cancer types have shown sustained clinical responses to immunotherapy, though not all patients respond, and the underlying mechanisms are not well understood. Immune infiltrates in the tumour microenvironment (TME) play a key role in tumour development and will affect clinical outcomes. Single-cell technologies are powerful tools for the dissection of the TME.

Objective

To develop novel therapies to treat various cancers and patient groups, which will enhance efficacy and safety in comparison to conventional therapies and work towards a cure for cancer, if possible.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- Patients with lung cancer now have twice the chance of being alive after 5 years (chemotherapy OS at 60 months was 16.3% vs 31.9% with pembrolizumab).
- Chances for melanoma patients of being alive after 3 years are now 4x higher than in 2001.
- In Belgium, the estimated benefit of immuno-oncology therapies were +27% in life years gained, +34% increase in QALYs, +80% PFS.
- In 2022, the anti-PD-(L)1 class was projected to result in an additional average 4,000 life years gained.
- As patient outcomes improve with novel IOTs in oncology, related healthcare costs will decrease over time as fewer patients are in hospital and more patients achieve long-standing remission.

Key considerations for stakeholders aiming to implement

- As of 2018, there were 93 agents in clinical development., This number has likely increased, with approved medications expanding to new cancer indications.

1863
Earliest case of cancer immunotherapy by William Coley

1946
Introduction of chemotherapy, 'chemicals to kill fast-growing cells'

1977
Targeted therapy initiation, medicines targeting cancer cells

2011
Immunotherapy, medicines boosting immune system

2022
Ongoing research and innovation in IOT such as cancer vaccines, (prophylactic or to prevent relapse) or CAR T cell therapy

1863 — 1946 — 1977 — 2011 — 2022

Cell- and gene therapies

Care pathway element
Pre-habilitation & Treatment

Key trend
Curative & Capacity extending therapies

Cancer
Various cancers

Innovation type
Product

Key beneficiaries
Patients

Developed / implemented by
Pharmaceutical companies and hospitals

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
National health systems

Sources and more information:
see List of references #104-109

About the innovation

Background & Challenge

Cell, gene and tissue-engineered therapies have been developed to treat various cancers. They offer t reatment of disease and injury, restoration of function, and even cures. More than 75 therapies had been launched by the end of 2019, and many more are in development. These therapies offer the hope of revolutionizing cancer care.

Solution

In cancer, cell, gene and tissue-engineered therapy is the transfer of nucleic acids into tumour or normal cells. They eliminate or reduce tumour burden through direct cell-killing, immunomodulation, or correcting genetic errors to reverse the malignant state. Genes may also be incorporated into normal tissues to lower resistance to conventional cancer treatments.

Objective

Correct defective genes to cure a disease or help the body better fight disease. Genetically engineer cells to provide curative therapies for cancers where existing treatments provide limited benefit.

Impact

Sustainability pillars addressed

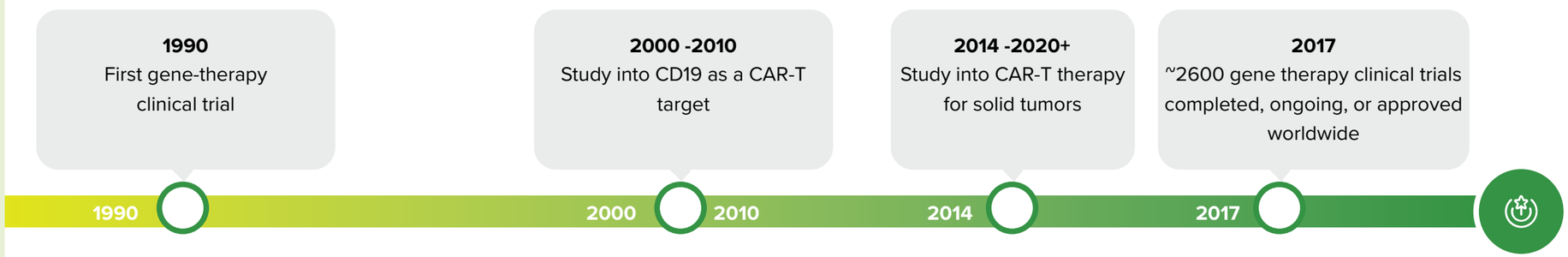
People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- In diffuse large B-cell lymphoma (DLBCL), trial results showed a significant benefit of using CAR-T therapy over the standard of care, including 10 vs. 2 months of event free survival, 86% vs. 48% overall response rate, and a complete response rate of 66% vs. 39%.
- Gene therapy has also led to longer survival times in non-small cell lung cancer and an increase in PSA doubling time in prostate cancer.
- There is also potential to unmask the tumour from immune invasion using immunostimulatory genes inserted directly into the tumour tissue. Trials in malignant melanoma showed a systemic immune activation, as well as local apoptosis in 22 patients.
- Although most cell, gene, and tissue-engineered therapies fall into the high-cost category, many have shown to be cost-effective providing savings to the healthcare system and society.



Home-based hospitalisation

Care pathway element
Pre-habilitation & Treatment

Key trend
Out-of-hospital care

Cancer
Various cancers

Innovation type
Process

Key beneficiaries
Patients, hospitals

Developed / implemented by
Various hospitals and pharmaceutical companies

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
National health systems, hospitals, pharmaceutical companies

Sources and more information:
see List of references #110-113

About the innovation

Background & Challenge

With strained financial and human resources, hospital budgets are consistently tight. Homecare, including the SC and IV administration of medications to patients in their homes, is becoming increasingly popular to alleviate workforce and financial burdens in hospitals and increase convenience and QoL for patients. In addition, it alleviates an important burden for patients: in 2020, only slightly more than 1 in 10 regions within the EU had their total population estimated to be living within 15 minutes driving time of a hospital.

Solution

Homecare can include self-administration or HCP-administration of medications in a patient's home. These solutions focus on more complex regimens, including SC and IV administration of medicines to patients in their home.

Objective

To alleviate the burden on the hospital and health system, as well as improve patient satisfaction and QoL, homecare has been introduced for selected treatments in some countries including France, Italy, and Greece.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: **workforce efficiency** | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- In a prospective trial of 50 myeloma patients in France, one injection administered at home cost 20% (€285.52) less. Quality of life improved in 84% of patients, increased well-being in 78%, and 98% of participants preferred home administration over hospital administration.
- A study in Italy assessed the direct costs (hospitalization), and indirect costs incurred by patients and informal carers (time, productivity and travel) of providing blood cancer treatment at home. All patients (n=7) reported high adherence and satisfaction, lower hospitalisation, and a 70% reduction of indirect costs for carers, with the same safety.

Key considerations for stakeholders aiming to implement

- Homecare policies – including the medication approval process and reimbursement – are complex and differ by country. Healthcare financing changes may need to be made (e.g. hospital reimbursement systems, or the allocation of costs and savings across budget silos), to ensure the actual cost reduction is also reflected in stakeholder budgets.

2011 - 2014
French case study of SC home administration in myeloma patients

2016
French case study publication (Annals of Oncology)

2018
Italian case study with SC home administration for patients with Non-Hodgkin Lymphoma (NHL)

2019
Italian case study publication (Am. Society of Heme, Blood)

Ongoing
Ongoing use and policy shaping to allow for home administration

2011 — 2014 — 2016 — 2018 — 2018

AI-enabled patient monitoring

Care pathway element
Rehabilitation & survivorship

Key trend
Digital Health & Digital Medicine

Cancer
Lung cancer

Innovation type
Product & Process

Key beneficiaries
Patients on treatment or who have received treatment

Developed / implemented by
Developed by Sivan Innovation (Moovcare); Implemented by numerous (10+) hospitals

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Social Security in France

Sources and more information:
see List of references #114-119

About the innovation

Background & Challenge

Increased availability of oral therapies for home administration results in less healthcare supervision during treatment. Therefore, careful monitoring of adverse events (AEs) during self-administration of treatments at home is becoming essential to facilitate prompt intervention, improve clinical outcomes and reduce costs.

Solution

An AI-enabled patient monitoring app that uses a weekly questionnaire to detect relapse or complication during follow-up of lung cancer patients. Implementation allows for analysis of patient-reported symptoms with the ability for anomalies to be identified on a near real-time basis, thus alerting medical teams for early intervention.

Objective

To provide a proactive and dynamic solution to increase the frequency of follow-ups via weekly web updates. This will offer the earliest possible detection to improve OS, involve patients directly in their monitoring, enhance constant communication to provide greater reassurance.

Impact

Sustainability pillars addressed

People: **patient outcomes** | **caregiver wellbeing** | workforce wellbeing

Prosperity: **workforce efficiency** | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- In a randomized trial evaluating overall survival (OS), patients in the experimental arm (using the patient monitoring app) had a median OS of 19 months vs 12 months.
- Relapses were detected 5 weeks earlier.
- In another study, the average annual cost of surveillance follow-up was €362 lower per patient (€941/year/pt. vs €1,304/year/pt.)
  - This presented an incremental cost-effectiveness ratio of €12,127 per life-year gained and €20,912 per QALY gained.
  - The probabilities that the experimental strategy is very cost-effective and cost-effective were 97% and 100%, respectively.
- Another RCT with 766 metastatic cancer patients demonstrated that digital symptom monitoring with the app during chemotherapy improves QOL (31%), reduces hospitalizations (4%) and ER visits (7%).

Key considerations for stakeholders aiming to implement

- Outcomes of AI-enabled monitoring may differ per cancer type and/or type of therapy used, requiring additional evidence generation.

2012
Symptom dynamic evaluation before lung cancer relapse (two prospective trials)

2013
Relapse detection algorithm validation (Ph 2 trial)

2014
Ph 3 multicentric prospective randomized trial initiation

2017
Certification as medical device, Class I, CE marked

2018
Ph 3 trial results (JAMA, ASCO)

2019
HAS approval, ASA III

2012 — 2013 — 2014 — 2017 — 2018

App for cancer fatigue management

Care pathway element
Rehabilitation & survivorship

Key trend
Digital Health & Digital Medicine

Cancer
Various cancers

Innovation type
Product

Key beneficiaries
Patients, informal caregivers

Developed / implemented by
Tired of Cancer B.V. (Untire App)

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
EU Horizon 2020 research and innovation program grant agreement #756641

Sources and more information:
see List of references #120-121

About the innovation

Background & Challenge

Cancer-related fatigue is one of the most common side effects of cancer and its treatments. It affects 80-100% of people with cancer, irrespective of type of cancer or cancer treatment. Chronic cancer fatigue may last months or years and harms quality of life.

Solution

A mobile app that provides a step-by-step program to improve self-management and help reduce fatigue for cancer patients and survivors. It is based on a combination of proven psychological methods including cognitive behavioral therapy (CBT), mindfulness-based cognitive therapy (MBCT) and Physical and Psychological Rehabilitation.

Objective

To reduce cancer-related fatigue for patients and survivors by improving access to psychological and physical rehabilitation therapy methods, as well as increase quality of life by mentally and physically engaging users, thus breaking the vicious circle of fatigue.

Impact

Sustainability pillars addressed

People: **patient outcomes** | **caregiver wellbeing** | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- In a study assessing the app's effectiveness, cancer patients and survivors in the intervention group experienced a significantly larger reduction in fatigue severity and interference from baseline to 12 weeks and a significant increase in QOL on average vs participants in the control group.
- The app promotes social equity as it provides accessibility of good support to all patients, either face-to-face or virtually, to a service which otherwise could be costly.

Key considerations for stakeholders aiming to implement

- Simple solution to stimulate patients and survivors, needing no additional efforts from healthcare workforce, apart from introducing the App.
- Effect size of the app is larger than other self-management eHealth interventions, but smaller than the effects of therapist-guided online interventions and face-to-face therapy targeted at CRF.

2018
Launched in English, later in Dutch, German and Spanish

2018
Multiple awards won including 2018 March best mobile app winner

2019
Receives NHS approval

2020
Admission to EC Horizon 2020 Phase 2 program

2022
Ongoing use (>27,000 users)

2018 — 2018 — 2019 — 2020 — 2022

Survivorship support program

Care pathway element
Rehabilitation & survivorship

Key trend
Digital Health &
Digital Medicine

Cancer
Various cancers

Innovation type
Product

Key beneficiaries
Children, Adolescents and Adults who survived cancer

Developed / implemented by
Institut Català d'Oncologia (ICO) & Pan-European Network for Care of Survivors after Childhood and Adolescent Cancer

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
European Union, EIT Health, Generalitat de Catalunya

Sources and more information:
see List of references #122-126

About the innovation

Background & Challenge

More people are living beyond cancer (e.g. 5-yr survival rate for breast cancer >80% across EU). Between 33-50% of patients with breast cancer experience distress, which can be reduced by psychosocial interventions. However, uptake is low, due to barriers such as shortage of personnel, funding and knowledge, wait lists, time or mobility restrictions, and poor early detection.

Solution

eHealth solutions can help overcome traditional barriers to psychosocial treatment. Two examples include 1) ICOnnecta't eHealth cancer care tool, which includes online educational materials, interactive forums and group therapy, and 2) the PanCare FollowUp Care intervention and app. This app is based on state-of-the-art knowledge about the regular screening individual survivors need, and how it can be best delivered using person-centred care.

Objective

Fostering social support appears as a key to facilitate a resilient response, prevent emotional distress, and improve overall quality of life after breast cancer diagnosis (and survival). eHealth solutions offer a digital relationship with psychosocial services and access to early support pathways.

Impact

Sustainability pillars addressed

People: **patient outcomes** | **caregiver wellbeing** | workforce wellbeing

Prosperity: **workforce efficiency** | **social equity** | affordability

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- eHealth solutions seem to tackle the main limitations of accessing psychosocial support (see background & challenge for the limitations).
- Results such as distress levels and QOL are similar to results seen after following conventional psychosocial approaches.

Key considerations for stakeholders aiming to implement

- Materials to support replication of the PanCareFollowUp Care and Lifestyle interventions in new countries across Europe will be available in the future.
- Acceptance rates, uptake and attrition must be considered. For example; some population groups (e.g. digital illiterates and older people) may be more difficult to reach via apps and translation of the app to local languages may be required.

2017
Founding of Oncommun

2019
Start of PanCareFollowUp

2021
PanCareFollowUp first

Materials to support replication of eHealth solutions in new countries

2017 — 2019 — 2021

Integrated palliative care units

Care pathway element
Palliation

Key trend
Out-of-hospital care

Cancer
Various cancers

Innovation type
Process

Key beneficiaries
Patients in the palliative phase

Developed / implemented by
Orkdal Hospital, Norway

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Orkdal Cancer Clinic

Sources and more information:
see List of references #127-128

About the innovation

Background & Challenge

Palliative care aims to improve quality of life throughout the care pathway. It can alleviate physical, psychological, emotional and/or spiritual burdens. Many cancer patients are experiencing delayed access to palliative care due to a lack of both facilities and experienced personnel, especially in outpatient clinics and small community hospitals.

Solution

The Orkdal Hospital introduces an integrated clinic to combine cancer and palliative care in the Orkdal region in Norway as part of an ongoing trial. It employs a multidisciplinary team of cancer and palliative care specialists which meets weekly to discuss and plan patient care, and ensure timely palliative care for patients who need it.

Objective

- Deliver better palliative care through improved coordination of cancer care within specialist and community care.
- Establish an integrated care center (clinic) which provides a platform where professionals with experience in palliative care can work together and share expertise.

Impact

Sustainability pillars addressed

People: **patient outcomes** | **caregiver wellbeing** | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

For people with cancer, receiving palliative care at the clinic has meant that:

- They spend less time travelling to access palliative care.
- They receive palliative care earlier in their care pathway.
- More people who want to die at home are able to do so.
- Compared with standard care, caregivers of people who were treated in the integrated clinic have reported a better quality of life.

Key considerations for stakeholders aiming to implement

- This delivery model of integrated outpatient cancer and palliative care is particularly relevant in rural regions allowing cancer patients access to palliative care earlier in the disease trajectory and closer to home.

2012
Establishment of the integrated clinic

2021
End of clinical trial in the Orkdal region

2012 — 2021

Integrated geriatric palliative care

Care pathway element
Palliation

Key trend
Precision Medicine & Biomarker Testing

Cancer
Various cancers

Innovation type
Process

Key beneficiaries
Geriatric cancer patients in the palliative phase

Developed / implemented by
Various hospitals.

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
National health systems

Sources and more information:
see List of references #129-131

About the innovation

Background & Challenge

Older people typically have greater adverse effects from cancer and cancer treatment due to age-related vulnerabilities, including medical, functional, cognitive, nutritional, and psychosocial issues. These vulnerabilities have been associated with negative health outcomes in older patients with cancer, including decreased health-related quality of life (QOL) and increased mortality, treatment-related complications, hospitalisations, and admissions to long-term care.

Solution

The integration of an oncogeriatric care approach into the routine management of older adults with cancer, based on a Comprehensive Geriatric Assessment (CGA) to enhance the care of those individuals who are more likely to have tangible benefits.

Objective

Improved quality of life and health-care delivery for this specific population.

Impact

Sustainability pillars addressed

People: **patient outcomes** | **caregiver wellbeing** | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

Patients receiving oncogeriatric care have:

- Better quality of life over 24 weeks compared to usual care.
- Significantly lower rates of severe toxicities compared to usual care.
- Significantly fewer ER presentations (-39%) and unplanned hospital admissions (-41%) at 24 weeks compared to usual care.
- Financial savings have been shown after the establishment of a geriatric oncology clinic in a cancer centre in Canada.

Key considerations for stakeholders aiming to implement

The inherent fragmentation of contemporary health-care systems and the scarcity of funding and resources are challenges typically faced when implementing oncogeriatric care models. Availability of a geriatrician to ensure continuity of care throughout the disease trajectory (before, during, and after anticancer therapy) may not be feasible in all settings (eg, cancer centres, academic hospitals, or community hospitals).

2021
studies show lower rates to toxicity in patients receiving systemic anticancer therapy in combination with oncogeriatric care.

2022
study shows that a comprehensive geriatric assessment of patients receiving systemic anticancer therapy improves quality of life and healthcare deliver

2021 — 2022

Home-based palliative care

Care pathway element
Palliation

Key trend
Out-of-hospital care

Cancer
Various cancers

Innovation type
Product & Process

Key beneficiaries
Patients, informal carers and community-based care professionals

Developed / implemented by
Brisbane South Palliative Care Collaborative

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Australian Government Department of Health and Ageing

Sources and more information:
see List of references #132-134

About the innovation

Background & Challenge

Many palliative patients would prefer to be cared for and to die at home. However, most of these people will not get their wish because the demand for palliative care is higher than community services can supply. These patients often require subcutaneously administered symptom relief. Non-specialist carers typically lack confidence and skills with this task.

Solution

Caring@home is a palliative care project aimed to fill this service gap by delivering innovative models of care via a range of education resources and training modules to individual carers and community palliative care services. It allows carers to take care of their loved ones by giving them the right knowledge, skill and confidence.

Objective

The project is designed to augment palliative care services at home. It involves their carers in breakthrough symptom management while the patient is still supported by nurses and their GP. It takes the crisis out of dying so patients can die comfortably at home.

Impact

Sustainability pillars addressed

People: **patient outcomes** | **caregiver wellbeing** | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- Research show that carers who have followed the caring@home programme feel equipped to take care of their family member. This is demonstrated by the fact most of the concerned family members have passed away peacefully at home, without complications, surrounded by family members in accordance with their wish.
- Hospital admissions to manage symptom relief can be avoided in many cases, reducing the burden on hospitals and healthcare professionals.

Key considerations for stakeholders aiming to implement

- Online education materials and apps should be translated to local cultural and language setting before implementation.
- Strong transformational leadership is required to enable successful implementation of caring@home in the local care setting.

2008
First research published on caring at home

2021
Study on use of a mobile app (CARiAD) to support carers with administering subcutaneous injections

Palliative care at home is available to all patients who wish to die at home.

2008 — 2021

Multidisciplinary tumour boards

Care pathway element
Healthcare system

Key trend
Digital Health & Digital Medicine

Cancer
Various cancers

Innovation type
Process

Key beneficiaries
Patients, healthcare professionals

Developed / implemented by
Hospitals, cancer research centres, local healthcare systems

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Hospitals, cancer research centres, local healthcare systems

Sources and more information:
see List of references #135-144

About the innovation

Background & Challenge

Cancer care is a complex path which requires collaboration between professionals to share the latest evidence and pool their expertise. Technological advances and the possibility of customizing patient treatment plans have further increased the need for regular interactions between healthcare professionals from various areas of expertise.

Solution

Tumour boards are multidisciplinary team meetings in which different specialists work together, closely sharing clinical decisions in cancer care. The composition is variable, depending on the type of tumour discussed. Multidisciplinary tumour boards offer significant benefits for both patient and professionals, and are increasingly implemented in hospitals. Digital solutions can enhance Tumour Board accessibility and efficiency.

Objective

- Provide a platform where professionals from different clinical specialties can work together to make decisions about the recommended clinical pathway for an individual patient.
- Enable and encourage multidisciplinary collaboration.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | **workforce wellbeing**

Prosperity: **workforce efficiency** | **social equity** | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- Improved diagnosis: multiple studies have shown an improvement in diagnostic and staging accuracy.
- Longer survival: improved survival for colorectal, head and neck, breast, oesophageal, and lung cancer.
- Increased satisfaction: improvement in both patients' (related to a better organization of investigations and to personal experience of care) and professionals' (improved teamwork communication and cooperation) satisfaction was described in some of the studies.
- Efficient processes: more efficient way of working and reduced patient visits to general practitioners to free up their time. When compared with 12 months of in-person MTB, 12 months of online MTB saw physician attendance increase by 46%. There was also a 20% increase in individual patient case presentations.

Key considerations for stakeholders aiming to implement

Creating a set of guidance documents and levels of evidence for decision making will give participants, third-party payers and institutions confidence in the decisions of the tumour board.

1. Evaluate the scope of the tumour board
2. Define leadership team, members and roles
3. Obtain approval of guidance documents from wider hospital or university group
4. Define the tumour board process
5. Establish data management process and platform
6. Continuously review and adapt the guidance documents and processes

Cancer care networks

Care pathway element
Healthcare system

Key trend
Digital Health & Digital Medicine

Cancer
Various cancers

Innovation type
Process

Key beneficiaries
Patients and healthcare professionals

Developed / implemented by
Various hospitals

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Various EU funding programmes as EU4Health, Horizon Europe and pharmaceutical companies

Sources and more information:
see List of references #145-148

About the innovation

Background & Challenge

Cancer care is fragmented: national health systems and even hospitals have their own way of delivering cancer care. This can make it difficult for patients to know where to get treatment. Plus, it hampers exchange of expertise (e.g., on ultra-rare cancers) and best practices (e.g., related to common challenges such as capturing insights, optimizing cancer care pathways in response to precision medicine, ensuring access to the latest product- and process innovations, and being at the forefront of health service research.

Solution

- Net4Care connects experts from cancer institutes in Southern and Eastern Europe to establish a Comprehensive Cancer Care Network
- CONNECT is a Norwegian public-private partnership connecting all stakeholders (patients, clinicians, companies, regulators, and payors) to jointly transform cancer care.
- COrOs is an Oncology Network of 18 oncology cancer centres in one of Italy's regions, which inform patients of where cancer care is available, thereby reducing diagnosis and treatments delays, and increasing the number of people treated in their own region.

Objective

Improving access to the best possible cancer care.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: **workforce efficiency** | social equity | affordability

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- Net4Care: Between 2023 - 2027 the network will introduce at least one financial tool for procurement of diagnostics and therapies, plus a functioning multi-country molecular tumor board.
- CONNECT: InPreD will provide equal access to clinical trials for advanced diagnostics, state-of-the art competence and technology; IMPRESS is a clinical trial designed to match patients to treatments based on a detailed molecular diagnostic; INSIGHT will develop a framework for using synthetic control data in small-scale one-armed clinical trials.
- COrOs: impact is measured in terms of process (e.g. presence of electronic booking systems) and outcomes (e.g. patient satisfaction). Between January 2020 and January 2021, the centres supported 10,688 people in accessing hospitals and specialist services.

Key considerations for stakeholders aiming to implement

- These initiatives help to shape the ecosystems that are necessary for healthcare system transformation, which supports the ambition of 'National Comprehensive Cancer Centre(s)' in all Member States and EU network by 2025.

Managing care using outcomes data

Care pathway element
Healthcare system

Key trend
Digital Health & Digital Medicine

Cancer
Various cancers

Innovation type
Process

Key beneficiaries
Patients

Developed / implemented by
Martini Clinic, Hamburg

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Martini Clinic, University Medical Centre Hamburg-Eppendorf

Sources and more information:
see List of references #149-151

About the innovation

Background & Challenge

Prostate cancer is a uniquely challenging and complex illness, with significant complications and unpredictable treatment outcomes. Despite advances made in recent years, it remains the fifth most common cause of death worldwide, the second most frequent cancer diagnosis in men and has low survival rates.

Solution

The Martini Clinic (part of University Medical Center Hamburg-Eppendorf, or UKE) is focused on optimizing clinical operations and improving prostate cancer patient outcomes through three operational principles: (1) specialization combined with high volumes, (2) a rigorous commitment to follow-up and evaluation of outcomes, and (3) strong patient orientation.

Objective

Establish the four phases of a virtuous cycle to achieve:

1. Superior medical outcomes
2. Exceptional patient satisfaction
3. Strong economic success
4. Impactful strategic investments

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | workforce wellbeing

Prosperity: **workforce efficiency** | social equity | affordability

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

Superior medical outcomes: results at the Martini-Klinik are significantly better than German averages – 94% of patients did not need incontinence pads (full continence) (vs. 57%), erectile dysfunction after 1-year was 35% (vs. 76%). Complication rates are also 15 times lower than the national average for ureteral injury and 62 times lower for sepsis. Exceptional patient satisfaction: the Martini-Klinik's three wards receive scores of 98.9%, 99.6%, and 100% (i.e., patients answering yes to "would you recommend this clinic to family and friends?") giving them the top three rankings in the UKE. Strong economic success: best performing entity of the UKE, generating a revenue of €32 million thanks to an optimized and efficient care pathway.

Key considerations for stakeholders aiming to implement

Word-of-mouth referrals are perhaps the most valuable form of "publicity". Therefore, the Martini-Klinik's consistently superior results and high patient satisfaction are essential to their economic viability.

2005
Martini Clinic founded

2020
Featured in Siemen's Healthineers Insights Series, Issue 7

2020 - 2023
Expansion of Clinic to newly built building

2005 — 2020 — 2020 — 2023

Simulation-based medical education (SBME)

Care pathway element
Healthcare system

Key trend
Artificial Intelligence & Machine Learning

Cancer
Various cancers, including lung cancer

Innovation type
Product & Process

Key beneficiaries
Healthcare professionals and patients

Developed / implemented by
Erasmus MC, MedicalVR, EVOCS Medical Image Communication & Thirona, Rooney et al. 2018 (Literature review)

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Koers23, Erasmus Medical Center (NL), eContour.org, RadOnc Questions LLC

Sources and more information:
see List of references #152-155

About the innovation

Background & Challenge

Medical education and training has traditionally been through textbooks and shadowing of HCPs in practice, often appealing to limited learning types. This can be improved by interactive environments to appeal to a combination of learning styles and replicate real world experiences seen in practice such as surgeries performed in the operating room.

Solution

Use technology (e.g., AI, VR) to develop a platform where physicians can learn about and prepare for the care they will give to the patient. For example in preparing for surgery, where virtual reality planning software for lung surgery enables 3D visualization to gain better insight into a patient's bronchial anatomy.

Objective

Use SBME in oncology care education and preparation to improve delivery of care to patients. Through this, provide educational materials and training to the healthcare workforce, enabling increased confidence among physicians when preparing for and treating patients.

Impact

Sustainability pillars addressed

People: **patient outcomes** | caregiver wellbeing | **workforce wellbeing**

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- In radiation education, statistically significant improvements in contouring ability was observed in 60% of relevant studies and 71% of the studies showed improvements in pre- and post-test scores.
- A pilot study investigated the technical feasibility of VR as an additional imaging tool for preoperative planning in ascending aortic surgery.
- Compared with conventional imaging, 80% of surgeons found that VR prepared them better for surgery.
- In 33% of cases, the preoperative decision was adjusted due to the 3D VR=based evaluation of the anatomy.
- 3D VR imaging was associated with improved anatomical understanding among surgeons.

Key considerations for stakeholders aiming to implement

Successfully used as a patient-specific preoperative planning tool, as well as education and training tool in numerous surgeries (i.e., aortic surgery, congenital heart diseases, lung segmentectomies).

2017
SBME systematic review initiation (articles published 1990 – 2017)

2018
Medical VR founded and product launch

2018
SBME published in the Int. J Radiation Oncology, Bio-Phys

2020
Use of Medical VR in multiple surgical TAs

2017 — 2018 — 2018 — 2020

Supporting informal caregivers

Care pathway element
Healthcare system

Key trend
Out-of-hospital care

Cancer
Various cancers

Innovation type
Process

Key beneficiaries
Informal carers

Developed / implemented by
Merck, the Swallows, The Open University, American Cancer Society, Digestive Cancers Europe, Bladder Cancer Advocacy Network and others

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Pharmaceutical Companies

Sources and more information:
see List of references #156-158

About the innovation

Background & Challenge

Caregivers are the very backbone of our healthcare system, yet often we do not acknowledge or systemically support them in their own times of need. They silently slip into the role of caregiver to a loved one with cancer, with no specific end date, and it can quickly and drastically drain their finances, mental and physical health, and social lives.

Solution

The Embracing Carers Initiative is dedicated to better understanding and supporting the emotional, financial and health implications of being an informal caregiver. Its focus is on raising awareness in the media, broadening stakeholder engagement, shaping policy, and engaging healthcare systems.

Objective

Bring care, wholistic support and attention to carers worldwide, by;

- Collaborating with organisations to support carer initiatives
- Driving greater visibility and awareness of carer challenges
- Supporting increased policy attention and action
- Creating innovative opportunities for healthcare system integration

Impact

Sustainability pillars addressed

People: **patient outcomes** | **caregiver wellbeing** | workforce wellbeing

Prosperity: workforce efficiency | social equity | **affordability**

Planet: waste generation | hazardous waste generation | CO_2 emission

Impact highlights

- Embracing Carers has developed a website with important resources for carers around the world, including for example carers stories, 10 tips for carers, Family Caregiver Toolbox, virtual toolkits for National Alliances for Caregiving, policy reports and research.

Key considerations for stakeholders aiming to implement

- The resources and information on the Embracing Carers website can be shared directly and via social media.
- Embracing Carers, along with its partners, has recognized five advocacy priorities that address universal needs for informal carers:
  - Safeguard the health and well-being of informal carers.
  - Minimize the financial burden placed on informal carers.
  - Enable access to user friendly information and education.
  - Support informal carers who are employed.
  - Invest in research to ensure carers' needs and contributions are recognized and addressed.

2017
Global survey of carers to understand their needs and the key issues and challenges they face

2017
Carer Toolkit with IACO for countries with little or no carer infrastructure

2018
global policy analysis to plot the level of carer support in different countries

2019
Embracing Carers videos featuring carers' stories, leading to a global call to action for increased carer self-identification

2021
Global Carer Well-Being Index covering 12 countries

2017 — 2017 — 2018 — 2019 — 2021

Reducing and offsetting surgery carbon emissions

Care pathway element
Healthcare system

Key trend
Environmental sustainability

Cancer
Bowel cancer

Innovation type
Process

Key beneficiaries
Healthcare professionals, citizens

Developed / implemented by
Solihull Hospital, University of Birmingham

Type of evidence of impact
No data available (yet)
Modelling
Real-world data

Financing
Solihull Hospital, University of Birmingham

Sources and more information:
see List of references #158

About the innovation

Background & Challenge

Hospitals have a surprisingly large carbon footprint. The UK's National Health Service (NHS) accounts for around 6% of the country's total CO_2 emissions. Per day, a hospital bed generates 0.5 kg of hazardous waste. An NHS Providers review in 2019 found that the system already disposed of 133,000 tonnes of plastic a year, of which 95% goes to waste.

Solution

Doctors at Solihull Hospital (University of Birmingham hospital) carried out a five-hour bowel cancer surgery that was completely carbon neutral. It was the world's first 'net-zero' operation. Emissions were reduced through a host of changes, including wearing reusable scrubs, altering the way anesthesia was administered (IV instead of gas) and reducing energy use (reviewed everything electrical from air conditioning to lights, not keeping these on overnight, and switching to energy efficient options like LED lighting.

Objective

Reduce CO_2 emissions to ensure a healthy future and have a positive impact on people's health in the medium and longer term.

Impact

Sustainability pillars addressed

People: patient outcomes | caregiver wellbeing | **workforce wellbeing**

Prosperity: workforce efficiency | social equity | affordability

Planet: waste generation | hazardous waste generation | **CO_2 emission**

Impact highlights

- The bowel cancer surgery was the world's first 'net-zero' operation.
- Emissions from the keyhole procedure were cut by 80 per cent, with the remainder countered by the two surgeons cycling and running to work - thereby offsetting the emissions that would have been released from them driving as usual. They also planted three trees in the hospital grounds to offset their carbon footprint.

Key considerations for stakeholders aiming to implement

- Turning off the lights and opting for plastic-free products can feel like a tiny tweak in our own lives, but for a massive organisation like the NHS these changes add up in a big way.
- Surgery accounts for a quarter of the emissions from a typical NHS trust, so the changes explored can have huge potential for making medicine greener.

2019
An NHS Providers review in 2019 found that the system already disposed of 133,000 tonnes of plastic a year, of which 95% goes to waste.

2022
World's first 'net-zero' cancer operation

2019 — 2022

Innovation can make cancer care more sustainable. And there is a critical need to make cancer care more sustainable.

Today, more than five patients are diagnosed with cancer every minute in Europe. The number of cancer patients continues to rise, setting cancer to become the leading cause of death in the EU by 2035.

The rising number of cancer diagnoses puts pressure on healthcare budgets and the health workforce, which in turn negatively affects patients and cancer outcomes. Yet, the impact of this trend reaches further than this, with the planet also being affected.

This report shows how innovation is the key to redesigning cancer care. Only by redesigning the way in which we deliver cancer care, we can allow for ongoing advances in patient outcomes (People), continued improvements in long-term affordability of and equal access to quality care (Prosperity), and a reduction in the environmental impact of cancer care (Planet).

Sustainable healthcare is and should always be a key part of the wider sustainability agenda, and sustainability should always be a key factor in healthcare policymaking. We call upon healthcare decision-makers to innovate for sustainable cancer care, so that we can continue to put cancer patients and outcomes first.

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