#109 11/2025 ISSN: 2036-9468

CANCER WORLD

PRINCESS GHIDA

Where Hope Wears a Crown

Yeva Margaryan

Managing Editor

Prof. Adriana Albini
Prof. Lidia Schapira

Co-Editors-in-Chief

News Editor
[1]*Janet Fricker*

Illustrations
Liana Gogyan

Graphic Designer
Arpine Danielyan

CANCERWORLD
magazine is published
by OncoDaily (P53 Inc)

Email: info@cancerworld.net
Tel: +1 978 7174884

ISSN: 2036-9468

NOT FOR SALE

Where leadership, legacy, and discovery meet the future of care

*Every issue of **CancerWorld** tells a story about connection, between science and humanity, between personal courage and collective change. The November edition celebrates those who lead with conviction, those who innovate with purpose, and those who remind us that progress in oncology is measured not only in survival rates but in the quality of the lives they restore.*

We open with two cover stories that mirror each other across continents and generations.

***HRH Princess Ghida Talal** of Jordan transforms personal tragedy into public mission, leading the **King Hussein Cancer Foundation and Center** with the conviction that access to care is a human right.*

*Our next cover story explores the legacy of **Prof. Umberto Veronesi**, whose founding of the **European School of Oncology** more than four decades ago built a bridge between knowledge and compassion. His belief that medicine must be taught as a human science remains ESO's compass today. As the School approaches its 50th anniversary, it continues to embody Prof. Veronesi's guiding principle, that learning to care is as essential as learning to cure.*

***MEP Tilly Metz** anchors this issue's policy focus with the three pillars of cancer policy: prevent, treat, support. She calls for a Europe where prevention stands alongside treatment and survivorship, where environmental health, HPV elimination, and equity are central to the Beating Cancer Plan.*

*Science and innovation are everywhere in this issue, not as abstractions, but as tools that bring care closer to the people who need it most. Research on the oral microbiome reveals that 27 bacterial and fungal species found in the mouth are linked to a higher risk of pancreatic cancer, hinting at a future where a simple mouth rinse might one day help identify risk early enough to save lives. In Sweden, a team at **Lund University** has trained an AI model on mammograms that can identify patients who could safely skip sentinel lymph node biopsy, sparing up to 40 percent of women from unnecessary axillary surgery.*

*That same spirit of technological partnership drives the reflections of **Amil Družić**, who explores how artificial intelligence is reshaping oncology practice, not by replacing doctors, but by amplifying their insight.*

*The story of innovation continues with **Prof. Ludmil Alexandrov**, the man decoding the origins of cancer. By mapping mutational signatures that reveal the fingerprints of causes such as tobacco or UV exposure, Alexandrov is transforming how we understand prevention itself.*

*We also take you to the **Uganda Cancer Institute**, where clinicians **Dr. Anthony Kayiira** and **Dr. Joyce Balagadde Kambugu** are pioneering fertility preservation services for young patients, proving that even in resource-limited settings, survivorship must mean living fully after cure.*

*Elsewhere, **Shrenik Shah** reminds us that life after cancer is as much about voice as it is about survival. Diagnosed with stage IV laryngeal cancer, he lost his natural voice but found a stronger one, the voice of advocacy, resilience, and purpose. Through technology, he speaks again, not just for himself but for countless survivors reclaiming identity after silence.*

And as survivors return to work, they face another test, the quiet discrimination that lingers long after treatment ends. Legislation such as the "right to be forgotten" marks progress, but culture still dictates whether survivors are welcomed back or written off.

In every corner of this issue, hope does not simply survive, it evolves. It wears many faces: a crown, a parliament, a laboratory, a hospital ward, all united by one enduring conviction that learning to care remains the truest form of progress.

Yeva Margaryan, Managing Editor, CancerWorld

PRINCESS GHIDA

WHERE HOPE WEARS A CROWN

Her Royal Highness Princess Ghida Talal of Jordan is widely recognized as one of the Arab world's leading voices in the fight for equitable cancer care and health justice.

Born in Lebanon and shaped by the resilience forged during her nation's civil war years, Princess Ghida's early experiences instilled in her a deep sense of purpose and empathy. After earning a degree in international politics and economics with distinction from Georgetown University, she began a distinguished career in journalism, reporting for Reuters, ABC News, and the Financial Times from some of the world's most turbulent regions, before being appointed Press Secretary to the late King Hussein of Jordan.

Her life took a profound turn when her husband, Prince Talal bin Muhammad, was diagnosed with cancer, a personal battle that became the catalyst for her lifelong mission to transform cancer care across Jordan and the Arab world. Under her leadership, King Hussein Cancer Foundation and Center (KHCF and KHCC) have treated tens of thousands of patients, forged pioneering partnerships with leading global institutions, and championed a powerful principle: that access to treatment is not a privilege but a human right.

Today, Princess Ghida continues to inspire with her dedication, humanity, and unwavering belief that compassion, science, and solidarity together can change the course of cancer for generations to come.

You grew up during the Lebanese civil war in a politically prominent family. How did those early experiences shape your sense of responsibility and resilience?

When you grow up as a teenager in a war-torn country, you have no choice but to confront realities you never imagined: why people go to war, why lives are taken so senselessly. Those years taught me self-reliance and thrust me into the world of adults far too soon.

I also come from a family deeply immersed in public life where politics and philanthropy were part of daily conversation. From them, I learned to place a high value on knowledge, dedication, and public service. There was always so much politics around our house that I assumed it was part of every child's upbringing. With politics, you learn early about victories and defeats, and from each, you draw lessons that give you the strength and perspective to face life.

At Georgetown University, you studied international politics and economics with distinction. Looking back, how did your academic path prepare you for the role you eventually embraced in global health and cancer advocacy?

Georgetown was the ideal university for me. It offered a well-rounded yet specialized education. Coming from the Arab world, I was naturally drawn to politics and wanted to understand the forces that were tearing my region and specifically, my country, Lebanon apart. But in truth, what you study is only part of what shapes you. What matters even more are the habits you form, the discipline of the mind and the friendships you make.

At Georgetown, politics was taught from a truly global perspective. The School of Foreign Service, where I studied, was the first of its kind in the United States and in the world. Another great strength of Georgetown is its diversity. You study alongside classmates from every corner of the world, and you learn from their experiences just as they learn from yours. That global outlook shaped how I approached my work later, and it is, in many ways, the essence of Georgetown.

Journalism was your first career — from ABC News to Reuters and the Financial Times. What lessons did those years in the field teach you about truth, communication, and leadership?

I was drawn to journalism because I wanted to challenge the untruths and biases that so often appeared in the media about my part of the world. In journalism, truth must remain sacred. Once you compromise it, you lose your credibility and your integrity.

I learned to follow stories wherever they took me, even in the most difficult circumstances. I covered Beirut for Reuters during the height of the car bombings between rival factions in 1988, then moved to the other side of the globe – to South America - to work with the Sunday Times of London. While based in Argentina, I covered rebellions within army barracks in Buenos Aires and travelled to Paraguay to report on the military coup that toppled South America's longest-ruling

dictator, Alfredo Stroessner.

In 1991, King Hussein asked you to establish the International Press Office and serve as his Press Secretary. What were the most memorable and challenging moments of working so closely with the late King?

It was the greatest privilege of my life to work with King Hussein. He was humanity and humility personified, a man who led with compassion and treated everyone with respect.

What moved me most was how deeply he cared for his people. The Hashemite family has always been close to the Jordanian people, listening to their concerns and standing by them in times of need. King Hussein carried that sense of responsibility in his heart every day, just as King Abdullah continues to do today. Working by his side was an unforgettable education in leadership, humility, and humanity.

Your life took a profound turn when your husband, Prince Talal, was diagnosed with lymphoma at such a young age. How did that personal battle with cancer redefine your priorities?

Overnight, our lives were turned upside down when my husband was diagnosed with cancer. Life as we knew it changed completely. Suddenly, nothing else mattered — not plans, not routines, not ambitions. All that mattered was his battle for life.

Priorities shifted instantly, and everything that once seemed important faded into the background. You find yourself living in a different rhythm, almost in a bubble, where the world keeps moving but your focus narrows to the only real priority: helping the person you love survive.

You once said that being by the side of cancer patients has given meaning to your life. Could you share the moment when you realized this was your true mission?

Our battle with cancer changed everything for me. It gave me a deep sense of purpose as I was desperate to make sure that patients and their families facing cancer in our region had the same chance at life that we had.

I remember sitting in the hospital while my husband was undergoing treatment and thinking about all the women in our part of the world who didn't have that privilege. I thought of their fear, their helplessness and their pain. That was the moment I knew I had to help change this reality and ensure that hope and survival were possible for everyone, not just for the few who could afford it.

When you took on leadership of KHCF and KHCC in 2001, the cancer landscape in the Middle East was extremely bleak. What were the biggest obstacles you faced at the beginning?

When I established KHCF and KHCC, the cancer landscape in Jordan and in our region was bleak. There was almost nothing — no proper facilities and no place for patients to turn to, no specialized oncologists and healthcare professionals, nothing.

One of the biggest challenges was reversing the medical brain drain. In the beginning, we reached out to talented Jordanian and Arab doctors who had found success abroad and asked them to return to Jordan. With their belief in our mission and direct participation in our efforts, we were able to quickly build a highly qualified and highly specialized medical team.

The other challenge was the stigma. Before our Center was established, cancer had been equated with death, to the extent that people were afraid even to say the word. After 25 years of awareness and education, I can say with pride that we have made a real dent in that taboo. Today, people speak openly about cancer and fight their cancer with patience and optimism.

Today KHCC is regarded as one of the most advanced cancer institutions in the region, with strong international partnerships. What do you consider its proudest achievements under your leadership?

Our proudest achievement is that we have treated more than 70,000 patients with the most advanced care, giving tens of thousands of people a real chance at life. We have built KHCC into a true center of excellence, offering advanced treatments such as immunotherapy, bone marrow transplants, CAR T-cell therapy, robotic surgery, and other groundbreaking procedures that were once only available abroad.

But what makes me most proud is that we never turn anyone away. Whether it is a refugee or someone

with no means to pay, every person is treated with the same care and dignity. This commitment to humanity is what led us to establish the Goodwill Funds - special funds dedicated to supporting underprivileged patients who could not otherwise afford treatment. Through these funds, the Center has been able to cover the costs of care for thousands of patients, ensuring that no one is ever denied treatment because of financial hardship.
The harmony between medical excellence and compassion and humanity is what truly defines KHCC.

How have collaborations with institutions like MD Anderson, St. Jude, and the NCI helped KHCC transform into a global leader in cancer care?

Our international medical partnerships have been central to KHCC's success and are a true mark of credibility. Our very first partner was St. Jude Children's Research Hospital, and that collaboration set the tone for everything that followed. We went on to learn from and work with the best cancer centers in the world, including MD Anderson Cancer Center and the National Cancer Institute. These partnerships helped us raise our standards, strengthen our expertise, and position KHCC as a global leader in cancer care. We continue to seek new collaborations that serve our mission and help us deliver the most advanced treatment to our patients.

Philanthropy and fundraising are central to sustaining KHCF/KHCC. What has been your most inspiring experience in mobilizing support for cancer patients in Jordan and beyond?

What has inspired me most is seeing an entire community come together in the fight against cancer. From the very beginning, we wanted this to be more than just an institutional effort, we wanted it to be a national, collective movement.

Over the years, we have seen people from all walks of life contribute - children donating their pocket money, families sponsoring patients, companies and philanthropists standing by our side. It is a reminder that just as cancer is not bound by borders, neither is compassion.

Across the Middle East, stigma around cancer remains a barrier. How have you worked to break that stigma and change public perception?

One of the most powerful ways to break stigma is through example, by showing that survival and life after cancer are possible. At KHCC, the quality of care and the stories of our survivors have changed how people see cancer. KHCC's survival rates are commensurate with Western standards.

We have also worked to engage every part of society: for example, our breast cancer awareness efforts are targeted toward women and men. We have seen firsthand that when an entire community stands together, the fear and shame surrounding cancer begin to fade, and hope takes their place.

Delivering cancer care in countries affected by conflict — whether Iraq, Syria, or Gaza — is uniquely challenging. What role do you believe institutions like KHCC can play in supporting patients from war-torn regions?

From the start, we've considered it our duty to care for every cancer patient who needs our help, no matter where they come from. We have treated patients from Iraq, Syria, Palestine, and beyond, and after the Beirut blast, we sent much needed cancer medications to 8 hospitals across Lebanon. In times of crisis, KHCC is always ready to help and support cancer patients everywhere.

What have you learned about the intersection of politics, conflict, and health while advocating for cancer care in the Arab world?

In many parts of the world, cancer is often placed at the bottom of the list of national priorities, even though it is just as lethal as any other crisis. Yet, there is no more urgent or universal cause than cancer. It touches every family, every community, and every country.

I have made it my mission to keep cancer at the forefront and to remind policymakers and the public that saving lives from cancer is not a luxury that should only be addressed after our more "pressing" challenges. It is an urgent moral obligation.

You represented Jordan at the UN General Assembly meeting on non-communicable diseases. How do you see cancer fitting into the broader global health agenda?

Even as the world faces one crisis after another, we cannot afford to lose focus on cancer. It's a silent epidemic that continues to take countless lives. Cancer must stay at the top of the global health agenda as it is not only a medical challenge, but also a humanitarian one.

As a woman leader from the Middle East at the forefront of health advocacy, what barriers have you encountered, and what message do you share with young women aspiring to leadership?

It is a given that all women experience sexism at some point in their lives. But at KHCF and KHCC, many of our most important leadership positions are held by women, which makes me deeply proud. My message to young women is this: believe in your voice, trust your strength, and never let anyone convince you that there is anything you cannot achieve.

The Iraq Scholar Rescue Project is one of your lesser known but remarkable contributions. How did it feel to help scholars at risk rebuild their lives and careers?

Supporting the scholars and academics of our region was an absolute imperative. Through the Iraq Scholar Rescue Project, we wanted to give them safety, dignity, and the chance to rebuild their futures, and, most importantly, to keep their talent rooted here at home, in the Arab world. Helping them start again was deeply moving, because in protecting them, we were also safeguarding the region's intellectual future.

Cancer care is advancing rapidly with immunotherapy, AI, and precision medicine. How do you envision KHCC positioning itself in this new era of innovation?

We are proud that KHCC has always led our region in adopting the latest innovations in cancer care, even within relatively limited resources. Immunotherapy and precision medicine have been part of our treatment protocols for years, giving our patients access to the most advanced and personalized care available. Our goal is always to harness innovation to improve outcomes and enhance efficiency.

Most recently, we established our Artificial Intelligence and Data Innovation Office to ensure that new technologies, especially AI, are fully integrated into our clinical and research work.

If you could secure one major policy change across the Arab region to transform cancer outcomes, what would it be?

If I could push for one major policy change, it would be real investment in cancer research across the Arab world. We have the talent and the resources, but we need enhanced collaboration to be at the forefront of global discovery.

And, just as importantly, we must finally take a firm stand against tobacco. With some of the highest smoking rates in the world, we need not only laws but enforcement that treat tobacco as the true enemy of our people's health.

Another major priority that is very close to my heart — and one that should be at the top of Arab policy agendas — is mental health. At KHCC, we have established a comprehensive psycho-social department dedicated to supporting all our cancer patients from the very moment they are diagnosed. We recognize how deeply they need emotional and psychological care alongside their medical treatment. Sadly, millions around the world still suffer in silence — and that is neither right nor fair. We must remember that there is no health without mental health.

Balancing your roles as a mother, a leader, and a global advocate cannot have been easy. What has kept you grounded through the years?

Every time I walk into KHCC, I'm reminded of why I do what I do. When you are by the side of cancer patients - seeing their courage, their hope, and their faith - it grounds you instantly. It reminds you that this work is about people, about life itself.

Finally, who should I interview next?

I strongly recommend that you interview Dr. Hagop Kantarjian, Professor and Chair of the Department of Leukemia at the MD Anderson Cancer Center. Often referred to as the "King of Leukemia," Dr. Kantarjian is one of the most accomplished and respected oncologists in the world, with one of the highest publication records in his field. Born in Lebanon, he has combined brilliance in science with deep humanity and humility. Despite his extraordinary achievements, he remains remarkably grounded — a true giant in medicine and a role model for generations of physicians and scientists around the globe.

PREVENT TREAT SUPPORT

An Interview with MEP Tilly Metz

By Yeva Margaryan

Since joining the European Parliament in 2018, Tilly Metz has emerged as one of the most prominent voices in European health and cancer policy. Representing Luxembourg for the Greens/EFA group, she has played a central role in advancing the EU's agenda on cancer prevention, patient rights, and equitable access to care. In 2024, she was named among OncoDaily's "100 Influential Women in Oncology: Key Opinion Leaders to Follow on Social Media", recognising her advocacy for cancer patients, mental health, and rare disease communities. Earlier this year, she was ranked third in the "EU Parliamentary Influence Index 2025" by Burson, underscoring her growing impact on EU policy and public health.

We at CancerWorld were honoured to sit down with Tilly Metz to discuss some of the most pressing and forward-looking questions in cancer care and policy, from prevention and research to patient equality and the future of Europe's Beating Cancer Plan.

The full interview follows below.

The Politics of Cancer Prevention

MEP Metz, you've been a strong voice for health and cancer policy in the European Parliament. Looking back,what experiences most shaped this perspective, and how do they guide your priorities today?

Every 9 seconds, someone in the EU hears the words: "You have cancer." It's hard to find anyone who hasn't been affected, whether directly or through a loved one. For me, the real question isn't why I prioritise health and cancer, but rather how some policymakers still don't.

What drives me is the knowledge that we can act. We've made progress in treating cancer, but prevention is still lagging behind, despite the tools already at our disposal. That includes tackling environmental risks, banning harmful substances, and advocating for healthier, more sustainable lifestyles. We have a clear opportunity and responsibility to act.

As we move from planning to implementation, what policy tools at EU level are most important to accelerate progress?

Proactive EU health measures, also on prevention.

That includes regulations to reduce the main risk factors: from tobacco and alcohol to harmful chemicals. We need to create healthier environments that support better lifestyles. The shift to sustainable agriculture and industry is also crucial, because human and environmental health are fundamentally connected.

Joint EU procurement is another key tool, which helps ensure access to affordable, high-quality treatment for all patients, regardless of where they live. Cancer treatments can be expensive that is why EU action to help ensure affordability is necessary.

HPV Elimination: Science, Trust, and Political Will

Vaccination and screening remain the core pillars of prevention. Based on the latest data, including ECDC monitoring and the HPV Elimination Atlas, what trends concern you most, and where do you see reasons for optimism?

There's still a real need to strengthen public awareness. Campaigns that encourage healthier habits and reduce exposure to risk factors, such as pollution, tobacco and unhealthy diets, are essential. Of course, accompanied by adequate legislation.

At the same time, we're seeing positive developments. Many Member States are making significant progress on HPV vaccination and screening coverage. The trends are encouraging, but not consistent enough across Europe. We need to close the gaps and accelerate progress.

Beyond infrastructure and funding, how can policymakers and civil society tackle misinformation and cultural barriers that prevent some communities from embracing HPV prevention?

We need committed and courageous policymakers, willing to stand up for the truth, for facts, for science, and for the public good, even when it's

politically inconvenient.

We should follow the example of people like Véronique Trillet-Lenoir, who stood firm in the face of misinformation and put public health and people first.

For example, on HPV, the facts are crystal clear:
- Infection is common;
- Most infections resolve naturally without causing harm;
- A few persistent infections can lead to cancer;
- HPV vaccination can prevent those cancers.

The only enduring truth is that everything is connected, especially when it comes to cancer: human health and planetary health are inseparable.

We have the science. It just needs to be communicated clearly and consistently, especially to the communities where access and trust are lacking.

Europe's Beating Cancer Plan has set ambitious goals, but sustaining political momentum is always a challenge. How can we ensure HPV elimination remains a priority across different EU institutions and political cycles?

We must make HPV elimination a cross-party and cross-institutional mission, one that stands above short-term politics.

For example, through working groups with representatives from different political families, ensuring continuity even when political cycles shift, such as the MEPs Against Cancer Interest Group or the Intergroup on Cancer and Rare Diseases in the European Parliament.

Building a Fair, Patient-Centred Approach to Cancer Prevention, Treatment, and Survivorship.

What role do you see for patient advocacy networks in holding governments accountable for progress towards elimination targets?

Patient organisations play a critical role, not only by raising awareness, but by holding governments accountable.

They keep political pressure alive, by reminding us all the consequences of political inaction. Whether it's environmental exposure, dangerous substances in our food or water, or gaps in healthcare access.

Overall, advocacy networks help ensure that these issues stay on the agenda.

Beyond HPV, you have been active in shaping wider cancer policy at EU level. Which initiatives are you currently championing that you would like our readers to know about?

I'm proud to be a Vice-Chair of the MEPs Against Cancer (MAC) Interest Group, founded in 2005.

We focus on three pillars:
- Preventing cancer before it starts;
- Improving access to high-quality treatments;
- Supporting life after cancer, by ensuring survivors' rights and wellbeing are fully respected.

I also launched an intergroup on Cancer and Rare Diseases with my fellow MEPs. Finally, I was appointed a shadow rapporteur on the SANT Committee report on the implementation of the European's Beating Cancer Plan.

Cancer inequalities remain a pressing issue across Europe. How can the EU better integrate equity into all aspects of cancer policy, prevention, treatment, and survivorship?

Equity must be at the heart of everything we do.

That means ensuring a better and fairer access to screening, treatment, and support services, especially for marginalised or underserved communities. No one should be denied care because of where they live or what they can afford.

It also means guaranteeing affordable medicines.

And we must take a holistic approach: health equity, social justice, and environmental protection are all interconnected.

What is your key message to healthcare professionals, decision-makers, and patients in the fight against cancer?

The solutions are within reach, but we need political will and financial commitment to make them reality.

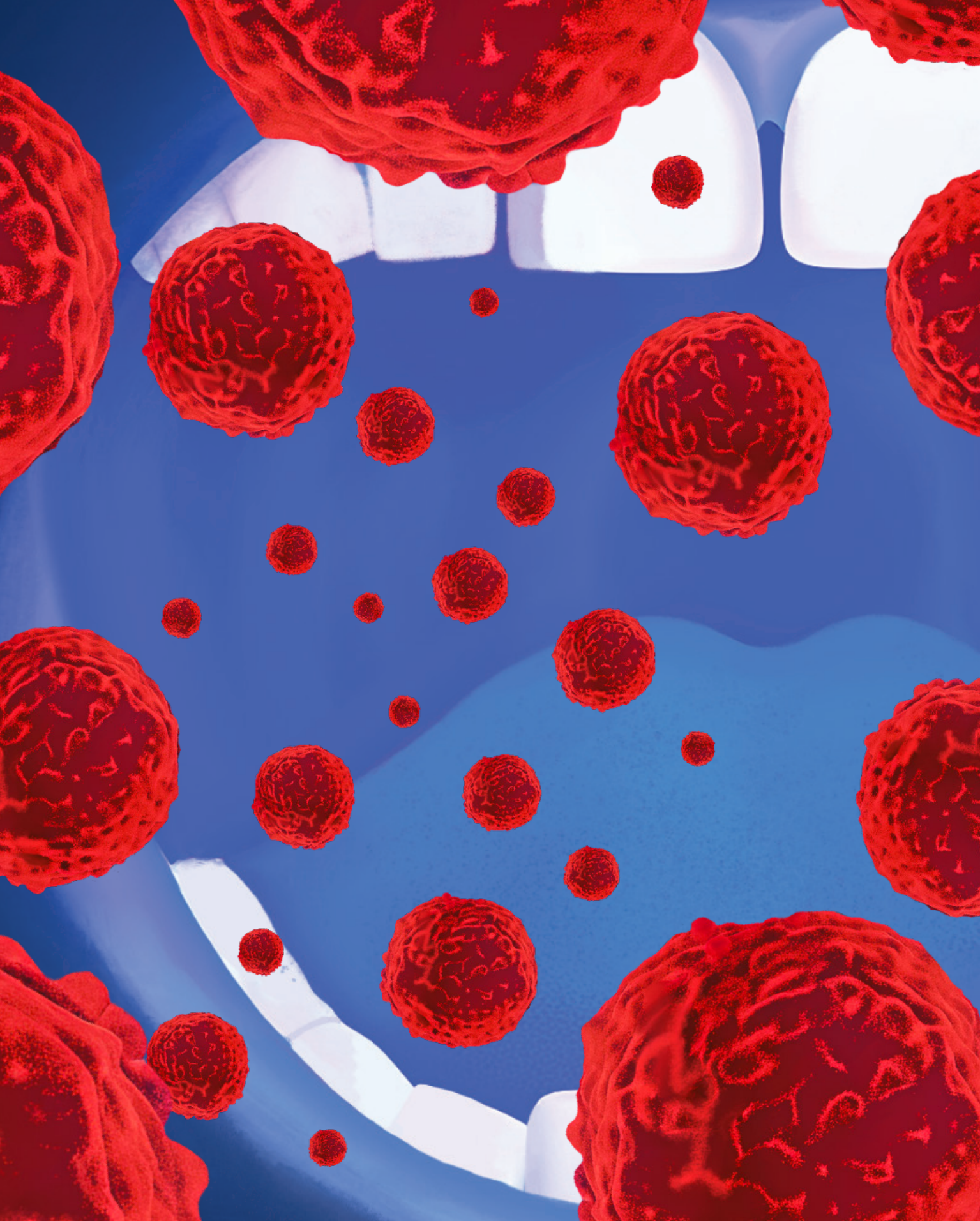
We must act on all three fronts:

- Prevention: by regulating tobacco, alcohol, unhealthy foods, and harmful products, and by addressing environmental pollution.
- Treatment: by ensuring equal access to world-class cancer centres and affordable medicines, and by harmonising care standards through training for healthcare professionals.
- Survivorship: by defending patients' rights in the workplace and society, and offering suited support services.

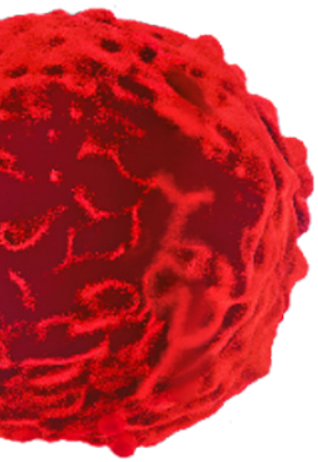
Looking ahead, what does success look like for you, both at the European level in reaching 2030 goals such as HPV elimination, and more personally in terms of the impact you hope to make during your current term in the European Parliament?

Reaching the targets we have set.
Helping push prevention higher on the political agenda.
Contributing to a healthier and fairer Europe.

Tilly Metz embodies a new generation of European health leadership, one that unites science, compassion, and political resolve. Her work reminds us that Europe's fight against cancer is as much a moral and political mission as a medical one, and that true progress depends on the collective choices we make long before diagnosis.



THE ORAL MICROBIOME



AS A NON-INVASIVE BIOMARKER FOR EARLY DETECTION OF PANCREATIC CANCER RISK

By Janet Fricker

Twenty-seven species of bacteria and fungi among the hundreds that reside in human mouths have been collectively linked to people having a **3.5 times greater risk of developing pancreatic cancer.** Among these, the study, published online in *JAMA Oncology*, 18 September, identified three kinds of bacteria associated with periodontal disease.

"Our study provides concrete scientific evidence that oral bacteria and fungi play an important role in the development of pancreatic cancer," Jiyoung Ahn, the co-senior author, from NYU Grossman School of Medicine, New York, tells *CancerWorld*.

Addressing the clinical significance of the findings, co-senior author Richard Hayes adds, "By profiling bacterial and fungal populations in the mouth, oncologists may be able to flag those most in need of pancreatic cancer screening."

While smoking, obesity, pancreatitis, and genetics are known to be risk factors for pancreatic cancer, these causes explain less than 30% of all pancreatic cancers. "To reduce the pancreatic cancer burden, there is a critical need to improve scientific knowledge on the specific causes of this disease and to provide guidance for preventive measures," write Ahn, Hayes, and colleagues.

Experts have long observed that **people with poor oral health are more vulnerable to developing pancreatic cancer** (and also head and neck cancers) than those with healthier mouths. In 2018, in a study published in *Gut,* Ahn and colleagues demonstrated using 16S ribosomal RNA amplicon sequencing to measure bacteria in oral samples that the presence of *P gingivalis* was associated with pancreatic cancer. Then last year, a different team of investigators, led by Gabriel Nussbaum, were able to show in a study published in *Gut,* that in mouse models, radiolabelled *P gingivalis* can travel directly from the mouth to the pancreas. Nussbaum and colleagues went on to show induction of pancreatic metaplasia through repetitive administration of the bacterium, and that exposure accelerated progression from pancreatic intraepithelial neoplasia to adenocarcinoma.

With existing evidence based on low resolution 16S ribosomal RNA-based microbiome profiling, Ahn and colleagues set out to achieve high-resolution bacterial species quantification using whole genome sequencing to pinpoint more specific species associated with pancreatic cancer. "In our earlier study, there were technical limitations as we were only doing partial sequencing, looking at approximately 500 bacterial fragments in the 16S gene. Advances in technology have allowed us to undertake whole genome sequencing of all the bacteria and fungi in the mouth," explains Ahn.

For the prospective nested case control study, the team assessed data from two ongoing investigations (the American Cancer Society Cancer Prevention Study-II Nutrition Cohort and the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial) that had been established to track people across America in order to help better understand how diet, lifestyle, medical history, and many other factors are involved in cancer development. Shortly after enrolment, participants rinsed their mouths with mouthwash to provide 'spit' samples that were preserved to provide opportunities for investigating the types and number of microbes at a later date. Researchers then followed participants for an average of nine years, verifying incident cancers through medical records, state cancer registries, or death certificates.

Of the 122,000 cohort participants providing 'spit' samples, the team identified 445 subjects who went on to be diagnosed with histologically confirmed incident primary pancreatic adenocarcinoma. For comparison, 455 control subjects (without pancreatic cancer) were 1:1 frequency matched based on coming from the same cohort, being within the same five-year age band, having the same sex, race, and ethnicity, and the same time since collection of the 'spit' sample.

For both cancer patients and controls, the oral bacterial and fungal microbiome were profiled using whole-genome shotgun sequencing and internal transcribed spacer (ITS) sequencing, respectively. Associations between pancreatic cancer and periodontal pathogens were evaluated using logistic regression, with investigators accounting for factors known to play a role in developing the condition, such as age, race, and smoking habits. The bacterial and fungal taxa between pancreatic cancer patients and control participants were then compared.

Since the link between periodontal disease and pancreatic cancer had already been identified (see below), the team focused first on the association (via logistic regression) of pathogens known to be associated with periodontal disease. These were periodontal pathogens of the red complex (*Treponema denticola,Porphyromonas gingivalis, and Tannerella forsythia*) and orange complex (*Fusobacterium nucleatum,* Fusobacterium *periodonticum, Prevotella intermedia, P nigrescens, Parvimonas micra, Eubacterium nodatum,* Campylobacter showae*, and* Capnocytophaga *gracilis*).

Results showed:

- Three oral bacterial periodontal pathogens were associated with increased risk of pancreatic cancer—*P gingivalis* (OR, 1.27; 95% CI, 1.03-1.57); *E nodatum* (OR 1.42, 95% CI 1.14-1.76); and *P micra* (OR, 1.36; 95% CI, 1.09-1.70).
- In a bacteriome-wide scan, the researchers pinpointed another 20 oral bacteria associated with pancreatic cancer — 13 with an increased risk of the disease and eight with a decreased risk.
- With regard to the fungal microbiome, the genus *Candida* was identified as a risk factor for pancreatic cancer, including *Candida tropicalis* (1.43-fold, 95% CI 1.00-2.03) and unspecified Candida (1.34-fold, 95% CI 1.05-1.70).
- Since multiple microbes associated with risk emerged in the study, the team developed a **Microbial Risk Score (MRS)** that included the presence and abundance 27 oral species that had been identified as relevant (23 bacterial species and 4 fungal species) to provide each individual with a 'risk profile' based on their oral microbiome. When applying the score, they showed that people with high-risk microbial profiles were more than three times more likely to develop pancreatic cancer in comparison to those with low scores (multivariate odds ratio per 1-SD increase in MRS, 3.44; 95% CI, 2.63-4.51).

"Collectively, the oral microbiome community may exert systemic effects on pancreatic cancer, with oral microbial dysbiosis [imbalance of the microbiome] contributing an etiological link between oral health status and pancreatic cancer development," conclude the authors.

The associated microbial risk score, they add, offers a promising tool to identify individuals at high risk of pancreatic cancer who would benefit from screening. The findings, adds Ahn, underscore the importance of good oral health and regular dental checkups to prevent development of pancreatic cancer.

In the future, probiotics containing beneficial bacteria could be developed to promote a healthy microbiome. "But already, there's a lot people can do. Stopping smoking and avoiding heavy alcohol use both have a beneficial effect on the microbiome," says Ahn.

Next, the team hope to investigate the pancreatic tumour microbiome (using surgical samples) and explore how its composition relates to the oral microbiome and responses to treatment.

The connection between oral microbes and cancer also applies to head and neck cancers. In a parallel nested case-controlled study, published last year in JAMA Oncology, Ahn, Hayes, and colleagues showed (using the same patient cohorts) that 13 oral bacterial species were differentially associated with the development of squamous cell cancer head and neck cancers. Interestingly, in this case no significant associations were found between fungal species and subsequent head and neck cancers.

Independent Expert Comment

Dr. Dominique Michaud

Epidemiologist Dominique Michaud, who has long studied periodontal disease and pancreatic cancer links, commented on the findings for CancerWorld. Michaud, from the Department of Public Health & Community Medicine, Tufts University School of Medicine, Massachusetts, is the author of a number of papers exploring the link between periodontal disease and pancreatic cancer, including one of the first studies on this topic, published in *J Natl Cancer* Inst in 2007, and a study reporting an association between antibodies to periodontal disease pathogens and risk of pancreatic cancer, published in *Gut* in 2013.

Could you comment on the overall significance of the study and what you see as the clinical significance of the findings?

There are still many questions about the causal role of bacteria and fungi in gastrointestinal cancers. The findings from this study suggest there are associations between certain oral bacteria and fungi and the risk of pancreatic cancer, but these may be reflecting periodontal disease conditions and overall immune response, and may not be causal. It is too soon to apply these findings to a clinical setting for early detection, or to determine who is at higher risk; much more work is needed for these next steps. I do not think it is time to start taking probiotics to address these issues. I agree that people need to make oral health a priority to reduce risk of developing periodontal disease, which is known to be linked to numerous chronic diseases.

What do you see as the unanswered questions arising from the study and what further research would you like to see undertaken?

Other observational studies will need to replicate the microbial risk score developed in this study. One study is not sufficient to determine whether a new score can be useful in a clinical setting and it is premature to suggest this could be used as a tool for early detection of pancreatic cancer given that many people with periodontal disease (prevalence 50% or more) will have these bacteria present in their saliva, whereas very few people develop pancreatic cancer (age-adjusted incidence rate is 5 per 100,000 people). While the results from this new study are compelling, and will certainly motivate future research on the topic, I am uncertain whether we will be able to rely solely on saliva to identify high-risk individuals.

MEET THE MAN DECODING THE ORIGINS OF CANCER

By Victoria Forster

Many people diagnosed with cancer often wonder what "caused" their disease and whether they could have done anything to prevent it. Typically, the risk of developing cancer is determined by a combination of genetics and environmental exposures, causing errors in DNA called mutations. DNA sequencing of tumor cells to identify mutations is now fairly routine and affordable, often guiding treatment decisions. And now, by studying the patterns of mutations in this sequencing data, scientists can increasingly identify what is likely to have caused cancer.

"A mutational signature is essentially a fingerprint, and it can tell you about the exposure that caused the cancer," said Ludmil Alexandrov, Professor of bioengineering and cellular and molecular medicine at UC San Diego, and member of UC San Diego Moores Cancer Center.

Causes and Effects

Some of the first mutation signatures to be identified over a decade ago[1] were those linked to various components of tobacco smoke, linked to a higher risk of over a dozen types of cancer, and UV radiation, the main cause of skin cancers.

"Different carcinogens generate different mutational signatures. Smoking tobacco cigarettes, for example, mutates the lungs and esophagus of a person with a very specific pattern," said Alexandrov.

Signatures were also identified related to aging and defects affecting BRCA genes, hereditary mutations linked to familial breast, ovarian, and pancreatic cancers. In the present day, the number of signatures has expanded significantly as more tumor samples are sequenced.

"We have analyzed around 100,000 patients with in-depth sequencing, and we think that the signatures that are common across cancers and across populations have been captured," said Alexandrov. "There are over 100 signatures identified, but we only know what causes about half of these."

Alexandrov explains that the process for directly proving that a signature is caused by a particular exposure, rather than just a hypothesized association, involves laboratory work.

"We discover an association, come up with a hypothesis for which exposure/s may be causing that signature, and then go to experimental systems where you can expose cell lines or human organoids to these carcinogens," said Alexandrov, noting that sometimes animal models are also used.

Colorectal Cancer in Young People

Mutation signatures are starting to address some of the most pressing questions in cancer biology, for example, why young people are experiencing a sharp rise in colorectal cancers. Some colorectal cancers have been previously linked to exposure to strains of bacteria which produce a toxin called colibactin, and mutation signatures caused by colibactin were identified in 2020[2,3].

Alexandrov recently analyzed a cohort of colorectal tumors from both young and older people[4], making a surprising discovery.

The colibactin signatures were 3.3 times more common in people under 40 than in people over 70. The team was able to analyze the evolution of these tumors, showing that many of them had colibactin-related signatures originating from decades before the patients were diagnosed.

"We estimated that infection with colibactin-producing bacteria in young children can put some people decades ahead of schedule for the normal development of colorectal cancer," said Alexandrov. "The bacteria are there during microbiome development in some children and are mutating their cells, including colorectal stem cells, which are then getting driver mutations."

The researchers stress in their paper that more work is needed to definitively prove causation between early-life colibactin exposure and colorectal cancer development. However, if a link is proven, preventative measures could be engaged to reduce exposure to colibactin-producing bacteria in childhood, or identify those who have already been exposed, potentially tackling the rise of cases in younger people.

"It's a very exciting story for us, because it can allow early detection from stool samples. That's what we are exploring – if a person has a colibactin signature,

perhaps they should start ongoing regular screening at age 20 or 30," said Alexandrov.

Lung Cancer in Non-Smokers

Another longstanding puzzle has been the rise in lung cancer cases in people who have never smoked, now comprising around a quarter of all lung cancers. Researchers have known for a while that these cancers might carry different mutations from those found in smokers, but until now what caused them was a bit of a mystery.

"We're seeing this problematic trend that never-smokers are increasingly getting lung cancer, but we haven't understood why," said Alexandrov.

A recent paper[5], which Alexandrov co-led, analyzed lung tumor samples from almost 900 people who had never smoked, spread across four continents. They found that patients living in areas with higher air pollution had distinct mutational signatures linked to cancer in their lung tumors, some of which were associated with tobacco smoking despite them never having smoked.

"Our research shows that air pollution is strongly associated with the same types of DNA mutations we typically associate with smoking," said Alexandrov. The never-smokers with lung cancer also had a higher number of mutations overall, particularly in genes known to drive the evolution of cancer.

Shedding Light on Unusual Manifestations of Cancer

Mutation signatures can be used as a tool in figuring out unusual cancer cases. Recently, Alexandrov's team heard about a group of beauty pageant contestants getting skin cancers on their fingers[6]. The young women were at an unusual age to get skin cancer, and their fingers, a rare place to get the disease. The team hypothesized that machines used in nail salons to set nail gel polish might be responsible, knowing that they generated UV radiation[7].

"This was an experimental study, looking at machines which generate UV A radiation to set certain types of nail polish," said Alexandrov. "So, we bought one to do experiments with them and we saw a lot of results where the UVA was generating mutations in cultured cells."

The researchers exposed cell lines, including human skin cells, to the nail polish drying machines. The mutation signatures identified were similar to those found in sequencing data from an online repository of skin cancers.

"These machines are commonly used, and if you use them once a month or so, it's probably not adding much cancer risk. But if you're using it multiple times a day, as these beauty pageant contestants may have been, the risk will be much higher," said Alexandrov.

Discovering New Signatures

Alexandrov also talks about how cancer sequencing data so far has mostly come from people residing in "Western" countries, leading to most of the signatures that are common across cancers and populations being captured. However, rarer signatures are still being discovered as sequencing data from different populations is being analyzed.

"There's a bias in our sampling with most samples coming from the US, Western Europe and some from Japan, Australia, etc. When we look at other populations, we often uncover new signatures," said Alexandrov.

A recent analysis of lung cancer samples found a signature of a compound called aristolochic acid, found in some traditional Chinese medicines, in a small number of cases, almost exclusively from people living in Taiwan.

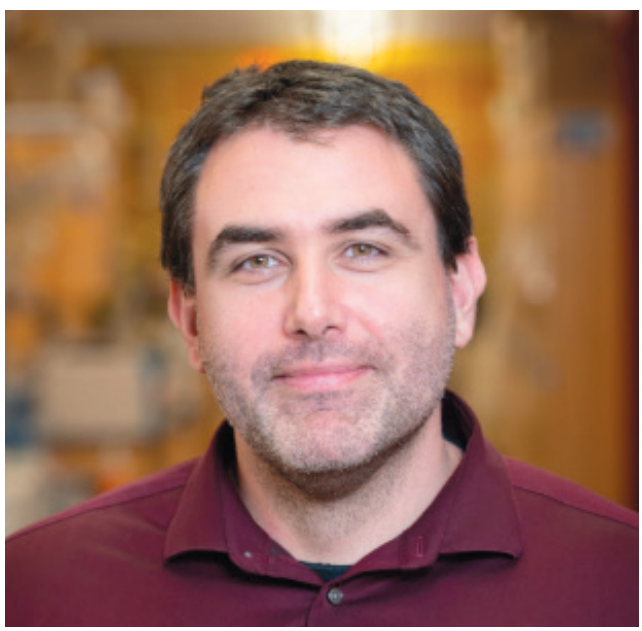
"From a cancer prevention perspective, we can identify a number of carcinogens that require public regulation, such as aristolochic acid. These medicines are available in Taiwan and my understanding is that they are banned in the U.S. This is an example of prevention that requires government action, policy, compliance – it's all very complicated," said Alexandrov.

The Future

A lot of the translational impact of Alexandrov's work relates to the question; 'Once you've figured out what causes cancer, what do you do with this information?' Alexandrov details three potential translational impacts. One is prevention by regulation, the example being restricting substances, including carcinogens, such as the example of traditional medicines containing aristolochic acid. But tackling global air pollution to reduce the incidence of lung cancer in never-smokers is a task of a very different magnitude.

The second is increased screening leading to early detection. This already happens for people with known hereditary mutations in DNA repair genes, and starting this for people found to have been exposed to colibactin early in life seems to be an achievable goal.

The third is for people with cancer who have mutational signatures in their tumors indicating faulty DNA repair processes. For these patients, there is a range of targeted therapies now that are particularly effective for these patients, including PARP inhibitors, platinum chemotherapies and immunotherapies, depending on the nature of the deficiency.



Prof Alexandrov. Photo credits: David Baillot/UC San Diego Jacobs School of Engineering

For the immediate future, Alexandrov is leading a team shortlisted for a prestigious cancer "Grand Challenge[8]," a funding competition where superstar international teams are awarded with up to $25 million dollars to significantly boost their field.

References

1. Alexandrov LB, Nik-Zainal S, Wedge DC, et al. Signatures of mutational processes in human cancer. Nature. 2013;500(7463):415-421. doi:10.1038/nature12477

2. Pleguezuelos-Manzano C, Puschhof J, Rosendahl Huber A, et al. Mutational signature in colorectal cancer caused by genotoxic pks+ E. coli. Nature. 2020;580(7802):269-273. doi:10.1038/s41586-020-2080-8

3. Dziubańska-Kusibab PJ, Berger H, Battistini F, et al. Colibactin DNA-damage signature indicates mutational impact in colorectal cancer. Nat Med. 2020;26(7):1063-1069. doi:10.1038/s41591-020-0908-2

4. Díaz-Gay M, dos Santos W, Moody S, et al. Geographic and age variations in mutational processes in colorectal cancer. Nature. 2025;643(8070):230-240. doi:10.1038/s41586-025-09025-8

5. Díaz-Gay M, Zhang T, Hoang PH, et al. The mutagenic forces shaping the genomes of lung cancer in never smokers. Nature. 2025;644(8075):133-144. doi:10.1038/s41586-025-09219-0

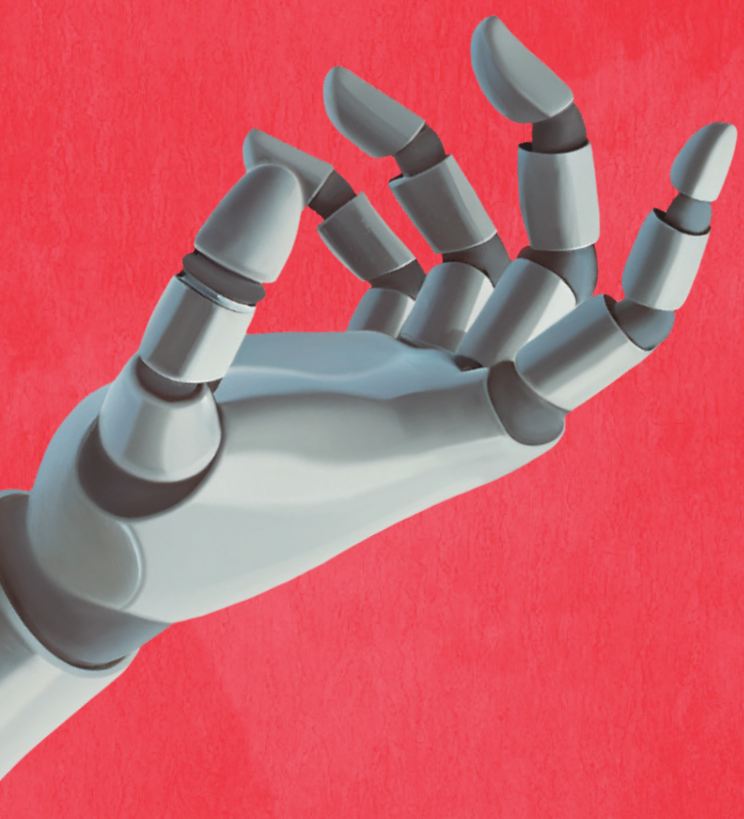
6. UV nail dryers used in gel manicures may increase skin cancer risk, study finds - CBS News. February 13, 2023. Accessed October 17, 2025. https://www.cbsnews.com/news/uv-nail-dryer-gel-manicures-skin-cancer-study/

7. Zhivagui M, Hoda A, Valenzuela N, et al. DNA damage and somatic mutations in mammalian cells after irradiation with a nail polish dryer. Nat Commun. 2023;14(1):276. doi:10.1038/s41467-023-35876-8

8. Meet the finalists looking to take on cancer's toughest challenges | Cancer Grand Challenges. September 24, 2025. Accessed October 15, 2025. https://www.cancergrandchallenges.org/meet-the-finalists-looking-to-take-on-cancers-toughest-challenges

AI CONSULTS IN ONCOLOGY CLINICAL DECISION SUPPORT

By Amil Družić



Imagine an oncologist stepping out of tumor board and into clinic with a complex case at hand. The patient's tumor has multiple high-risk features, genomic mutations, and borderline indications for therapy. In the past, the doctor might sift through guidelines, trial data, and pathology reports alone – but today he also consults an AI "colleague" for backup. This AI doesn't make the decision, but it offers evidence-based insights gleaned from vast data, helping the clinician consider critical details that might otherwise be missed.

From Hype to Help: AI as the Oncologist's Assistant

Early experiments with AI in oncology – like IBM's Watson for Oncology – generated buzz by promising to recommend treatments from big data. In practice, however, many such systems struggled to gain clinician trust or improve outcomes. They often relied on curated guidelines and literature without integrating the full picture of an individual patient. The lesson learned was that AI works best as a consultant, not a replacement, and only when grounded in validated clinical evidence.

In fact, the early mainstream wave of AI, driven by generative models, reinforced this point: these systems can draft convincing answers to medical questions, while also highlighting the need for guardrails—so responses stay accurate, contextual, and evidence-based.

- ASCO (Guidelines Assistant on Vertex AI/ Gemini)

Recognizing the need for reliability, oncology leaders have begun harnessing such AI within strict evidence-based confines. For example, the American Society of Clinical Oncology (ASCO) partnered with Google Cloud to develop a Guidelines Assistant on Vertex AI (Gemini) that lets clinicians query ASCO's guideline library and receive instant, citation-linked answers drawn only from vetted content. It delivers the convenience of an assistant without the usual noise—evidence at your fingertips, not a free-form recommender.

- OpenAI (Penda Health EHR-Embedded AI Consult)

Outside oncology, a real-world, EHR-embedded "AI consult" from Penda Health and OpenAI showed what good looks like: a simple traffic-light interface (green/yellow/red) that fires only at decision points and preserves clinician autonomy. In a pragmatic evaluation across 39,849 visits in 15 clinics, clinicians using the tool made 16% fewer diagnostic errors and 13% fewer treatment errors than controls—evidence that workflow-native decision support can reduce real clinical errors. For oncology, the value lies in the method: tight triggers, minimal cognitive load, a clear rationale, and an active rollout.

Building on these lessons, today's emerging AI tools take a more pragmatic approach. Rather than offering generic advice, they serve up specific, clinically validated guidance at key decision points—much like a trusted colleague rounding with the team. Critically, the most promising AI decision-support tools are those built and tested with real patient data and aligned with established protocols.

Oncologists are understandably cautious—any AI suggestion must be anchored in something tangible, like a published trial or a guideline. This is why recent "AI consult" systems focus on narrow but impactful tasks: predicting therapy benefit, flagging high-risk features, or aggregating patient data for review. These are not sci-fi algorithms operating in a vacuum; they are sophisticated extensions of the tumor board, able to synthesize pathology, imaging, genomic, and clinical information into actionable insights. Below, we explore a few such examples currently shaping oncology practice. Among them, ArteraAI is guideline-level validated, while the others remain research- or early-clinical-stage with promising evidence.

Multimodal AI Tools Coming of Age

— ArteraAI Prostate Test

One striking example is the ArteraAI Prostate Test – an AI-driven tool that has already made its way into clinical guidelines. ArteraAI's system analyzes a prostate cancer patient's digitized biopsy histology alongside clinical variables to predict how the patient will fare with different treatment options. In effect, it produces a personalized risk report: will this man benefit from adding short-term hormone (androgen deprivation) therapy to radiation, or can he safely opt out of the extra treatment?

This AI model was trained and validated on thousands of patients from large randomized phase III trials, with long-term follow-up, so its predictions aren't abstract probabilities – they're grounded in real outcomes data. The core model is multimodal: it combines pathology images with clinical data. In published evaluations, this approach outperformed conventional NCCN-style risk grouping in predicting long-term prostate cancer outcomes, showing roughly a 9–15% relative improvement

in discriminatory performance (i.e., the ability to separate higher-risk from lower-risk patients for endpoints like progression and metastasis) compared with traditional clinical risk tools. In other words, the AI proved more adept than standard clinical criteria at forecasting which patients are likely to relapse or die of their cancer over time.

Critically, ArteraAI's algorithm also identified a biologically and clinically meaningful subgroup: intermediate-risk prostate cancer patients who truly benefit from adding short-term androgen deprivation therapy (ADT) to radiotherapy, versus those who gain little from the added hormones. In patients predicted to benefit, intensification with ADT improves long-term control; in patients predicted not to benefit, the extra hormones – and their side effects – can potentially be avoided.

This level of evidence was strong enough that in 2024 the National Comprehensive Cancer Network (NCCN) cited the ArteraAI Prostate Test in its Prostate Cancer Guidelines as a prognostic and predictive adjunct for localized disease. That listing is widely described as the first AI-enabled biomarker of its kind to be incorporated into NCCN prostate oncology guidance. For clinicians and patients, this offers a new level of confidence: an AI consult, based on the patient's own tumor pathology and clinical profile, helps stratify risk and personalize therapy choice. The doctor still makes the call, but now with an AI-derived analysis of who is most likely to benefit from treatment intensification – and who might safely avoid unnecessary toxicity.

— Predictors (Research-Stage): H&E Slide–Based Models in NSCLC Immunotherapy

On the lung cancer front, similar experimental AI consults are tackling one of the toughest questions: which patients will respond to immunotherapy. Checkpoint inhibitors (PD-1/PD-L1 blockers) have transformed the treatment of advanced non–small cell lung cancer (NSCLC), but only about 20–30% of patients experience durable benefit. Oncologists today lean on imperfect biomarkers – PD-L1 expression levels, tumor mutational burden (TMB), and similar measures – to guess who might respond.

Multimodal AI models are now being developed to improve this decision point by learning from diverse patient data. For example, researchers have shown that deep learning algorithms can analyze routine diagnostic material – the same H&E pathology slides already produced for standard-of-care biopsy – to detect hidden morphologic and microenvironmental patterns predictive of immunotherapy response. In a recent multicenter study spanning several hospitals, a deep learning model that extracted features from H&E tumor specimens emerged as an independent predictor of response to PD-1/PD-L1 immunotherapy and of progression-free survival, even after adjusting for PD-L1 status, TMB, and other known covariates. In practical terms, this means that a digitized biopsy, when processed by AI, might reveal whether a patient's tumor looks "immune-responsive" or "immune-cold" in ways that are not obvious to the human eye.

If prospectively validated in interventional trials, such a tool could flag patients unlikely to respond to checkpoint inhibitors before they embark on months of treatment – a valuable "second opinion" to help decide whether to proceed with expensive, immune-based therapy or pivot earlier to an alternative strategy. But at present this remains investigational: these H&E-based immunotherapy predictors have strong retrospective and external validation data, yet they have not been adopted into major NSCLC guidelines, and clinicians are not (yet) using them to deny or escalate therapy on their own.

— NSCLC Immunotherapy: CT Radiomics (QVT) (Research-Stage)

Other AI efforts in NSCLC are combining data from medical imaging and clinical labs to further refine immunotherapy decisions. One example is AI-based radiomic analysis of standard CT scans. These approaches quantify tumor characteristics that are effectively invisible to the naked eye – such as the tortuosity and "chaoticness" of blood vessels feeding the tumor – and link them to immunotherapy outcomes.

In one notable 2023 study and related multicenter reports, investigators described a CT imaging biomarker called quantitative vessel tortuosity (QVT). Tumors with highly tortuous, disorganized vasculature were more likely to be non-responders to PD-1/PD-L1 checkpoint inhibitors and to have shorter survival, even after accounting for PD-L1 levels and other clinical factors. In other words, the vascular "fingerprint" on a baseline CT scan carried

a predictive signal about who would and would not benefit from immunotherapy.

If prospectively validated, these kinds of imaging-derived predictors – taken together with clinical context – move us closer to an AI that can say, "Given this patient's scan and profile, immunotherapy has a low chance of success – consider an alternative or an intensified approach." It's important to emphasize that these radiomic and multimodal predictors are still research- or early-clinical-stage. None of them are replacing established biomarkers like PD-L1 in current practice. But they illustrate what an "AI consult" could soon look like: a synthesis of imaging, pathology, and genomic data to support a yes/no immunotherapy decision and to better stratify patients for clinical trials.

The Integrated Oncology "Copilot" at the Point of Care

Perhaps the most ambitious use of AI in clinical decision support is appearing at the hospital or clinic level, where AI acts as a continuously updated data synthesizer for every patient case. Consider the approach taken by Yonsei Cancer Center in South Korea: they developed an in-house, AI-enabled clinical decision support system that continuously pulls each patient's pathology reports, radiology images, genomic test results, prior treatments, and clinical history into one unified dashboard. This platform – described as the Yonsei Cancer Data Library – is not built for a single tumor type or a single decision point. It is intended to support oncology care broadly across the center.

The system aggregates more than 800 structured data elements per patient and refreshes in near-real time as new results come in. When an oncologist opens this dashboard, they see a longitudinal timeline of the patient's cancer journey: key lab trends, imaging milestones, molecular markers, prior lines of therapy, and outcomes – all organized and visualized by AI. The interface can surface potential red flags, such as a slow drift away from guideline-concordant care, or a concerning pattern (like steadily rising tumor markers) that might warrant intervention sooner rather than later.

In Yonsei's initial experience, oncology staff reported high satisfaction (scores above 4 out of 5) with this integrated AI-assisted workflow. By letting AI quietly manage the data deluge in the background, clinicians reported being freer to focus on interpreting the insights and talking with patients, rather than clicking through scattered PDFs and siloed record systems. This kind of multimodal clinical decision support system is essentially an AI copilot for the entire oncology team. It doesn't diagnose or decide, but it helps ensure that no critical piece of pathology, imaging, genomics, labs, or symptom history is lost in the noise when building a treatment plan.

In practice, systems like this can rapidly retrieve how a patient's tumor genomic profile maps to available targeted therapies or open clinical trials, while simultaneously reminding the clinician of past toxicity issues documented in the chart. Some centers are now piloting in-silico forecasting on top of this infrastructure – for example, generating individualized survival curves or risk projections under different standard-of-care regimens, trained on large institutional outcome datasets. That kind of projection can support difficult conversations about prognosis and treatment intensity.

Crucially, these copilots are designed to stay anchored to clinical guidelines and institutional protocols. The AI is not inventing experimental treatments; it is matching patient-specific data to evidence-based options and flagging when care may be drifting from best practice. For oncologists who are juggling increasingly complex cases and ever-expanding data streams, that kind of context at the point of care is becoming less "nice to have" and more essential.

Conclusion: A Future of Informed Decision-Making, Not Autopilot

Across these examples runs a common theme: AI in oncology decision support works best when it augments the clinician's judgment with multi-dimensional analysis, rather than trying to automate the decision itself. Whether it's a specialized tool that interprets a prostate biopsy to estimate who

truly benefits from adding short-term hormone therapy to radiation, a research-stage model that stratifies which lung cancer patients are likely (or unlikely) to respond to PD-1/PD-L1 immunotherapy, or a hospital-wide platform that unifies pathology, imaging, genomics, labs, and prior treatments into a single continuously updated dashboard, the aim is the same. These AI consults act as intelligent advisors, grounded in real clinical data, that strengthen the clinician's hand at the moment of decision. They surface things a busy human might miss: subtle morphology on an H&E slide, complex risk curves derived from thousands of trial patients, or a quiet reminder that today's plan is drifting from evidence-based best practice.

For oncologists, the promise of these multimodal AI systems is more confidence and clarity in choosing the right treatment for the right patient at the right time. Some of the most credible tools have undergone peer-reviewed validation and, in certain cases, have now been incorporated into major guidelines — for example, an AI-enabled prostate cancer test (ArteraAI) that appears in the NCCN Prostate Cancer Guidelines to help distinguish which localized patients truly need short-term androgen deprivation therapy with radiotherapy and which might safely avoid it. Others, like deep learning–based immunotherapy response predictors in advanced non–small cell lung cancer or CT radiomics biomarkers such as quantitative vessel tortuosity, are still in prospective evaluation and are not yet standard of care, but they are already outperforming classic single biomarkers (like PD-L1 alone) in multicenter validation studies. No doubt challenges remain — integrating AI into workflow, training clinicians, guarding against algorithmic bias, and ensuring interpretability and auditability — but the trajectory is set.

In the clinic of tomorrow, an oncologist facing a high-stakes decision will not be forced to choose between skimming dozens of siloed PDFs or relying on intuition alone. Instead, with a single "AI consult," they will be able to pull forward distilled evidence from millions of data points and prior cases, summarized in a clinically meaningful way. The final judgment will still rest with the human oncologist – but it will be made with a clearer view of risk, benefit, and precedent.

In sum, the oncology AI consult is moving from futuristic concept to practical reality. By embracing multimodal data and focusing on validated, guideline-aware algorithms where they exist, these tools are beginning to deliver on the long-promised vision of precision support in cancer care. They are not here to replace the art of oncology. They are here to sharpen it – to make sure that when an oncologist sits with a patient and says, "Here's what I recommend, and here's why," that answer reflects not just experience, but the best available evidence, assembled instantly and tailored to that one person. As these systems continue to mature, oncologists can look forward to making treatment decisions with greater insight and assurance, knowing that no matter how fast the field grows, they have an ever-ready digital ally to help navigate the complexity.

Dr. Amil Družić

Author's Note

The momentum in oncology AI has become impossible to ignore. In November 2025, the European Society for Medical Oncology will host its first standalone ESMO AI & Digital Oncology Congress—a dedicated forum for exploring how artificial intelligence and digital tools are reshaping

cancer care. Its very existence underscores how rapidly this field is moving into mainstream oncology.

As a physician specialising in oncology and radiotherapy with a deep interest in technology, I have followed these developments closely. In partnership with the Association of Oncologists in Bosnia and Herzegovina, we conducted a national survey examining how—and in what ways—oncologists use digital and AI tools in everyday practice, spanning research, clinical decision support, scientific writing, communication, and public awareness. I will present these findings at the ESMO AI & Digital Oncology Congress.

From my perspective, it's an incredibly exciting time to be at the intersection of oncology and digital innovation. We are witnessing a convergence of need and opportunity: clinicians overwhelmed by data and options, and technology that's finally capable of meaningfully assisting with that burden. My background in clinical oncology and research has shown me the value of evidence-based decision-making, and AI, when applied responsibly, is poised to enhance that process. The key will be to ensure these tools are developed with oncologists, not just for them – aligning with real-world workflow and high standards of clinical evidence.

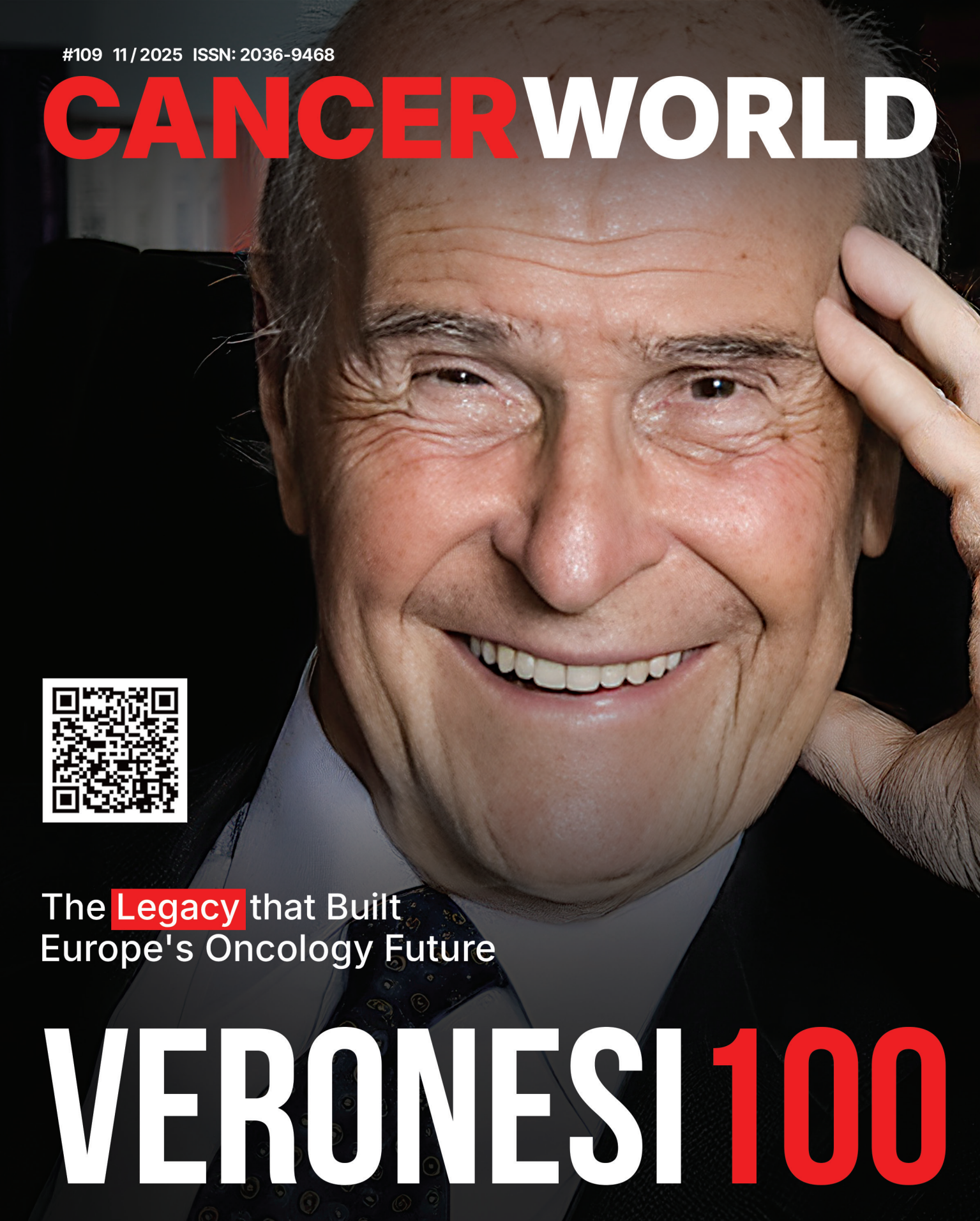
I am optimistic that with continued collaboration between clinicians, researchers, and tech experts, we will navigate the challenges (data quality, bias, integration) and unlock AI's full potential in cancer care. The discussions at forums like the ESMO AI & Digital Oncology Congress, and the feedback from front-line oncologists in surveys and studies, all point to a common goal: using AI to make cancer treatment smarter, more personalised, and more efficient—without losing the human touch that defines medicine. In the end, the future of oncology will not be about AI autopilot but about informed decision-making, with AI as a powerful ally to help us help our patients better. Put simply: AI will not replace oncologists—but it will redefine their capabilities, enabling them to synthesize vast amounts of clinical data with unprecedented speed and precision.

References

- ASCO Post – How the AI-Powered ASCO Guidelines Assistant Is Improving Clinical Decision-Making(https://ascopost.com/issues/september-25-2025/how-the-ai-powered-asco-guidelines-assistant-is-improving-clinical-decision-making/)
- ASCO Post – ASCO and Google Cloud AI-Powered Tool (https://ascopost.com/issues/june-10-2025/asco-and-google-cloud-ai-powered-tool/)
- OpenAI – Pioneering an AI clinical copilot with Penda Health (https://openai.com/index/ai-clinical-copilot-penda-health/)
- Penda Health – AI-Enabled Care overview (https://www.pendahealth.com/ai-enabled-care)
- OpenAI/Penda – Methods PDF (https://cdn.openai.com/pdf/a794887b-5a77-4207-bb62-e52c900463f1/penda_paper.pdf)
- Targeted Oncology – NCCN recommends first AI prognostic tool in prostate cancer (https://www.targetedonc.com/view/nccn-recommends-first-ai-prognostic-tool-in-prostate-cancer)
- Urology Times – ArteraAI test included in NCCN Guidelines (https://www.urologytimes.com/view/arteraai-prostate-cancer-test-included-in-nccn-guidelines)
- ArteraAI – For Patients (test overview) (https://artera.ai/for-patients)
- JAMA Oncology – Deep Learning Model for NSCLC ICI response (https://jamanetwork.com/journals/jamaoncology/fullarticle/2828578)
- PubMed – NSCLC ICI response DL model (https://pubmed.ncbi.nlm.nih.gov/39724105/)
- Winship/Emory – AI biomarker predicts ICI response in lung cancer (https://winshipcancer.emory.edu/newsroom/articles/2023/new-ai-based-biomarker-can-help-predict-immunotherapy-response-for-patients-with-lung-cancer.php)
- ASCO Post – News brief on QVT biomarker (https://ascopost.com/news/january-2023/new-ai-based-biomarker-may-help-predict-immunotherapy-response-for-patients-with-nsclc/)
- Stony Brook – Summary of Science Advances work (https://ai.stonybrook.edu/about-us/News/new-ai-based-biomarker-can-help-predict-immunotherapy-response-patients-lung-cancer)
- npj Digital Medicine – Yonsei Cancer Data Library (Nature) (https://www.nature.com/articles/s41746-025-01508-2)
- PubMed Central – Yonsei Cancer Data Library full text (https://pmc.ncbi.nlm.nih.gov/articles/PMC11868524/)
- ESMO – AI & Digital Oncology Congress 2025 (https://www.esmo.org/meeting-calendar/esmo-ai-and-digital-oncology-congress-2025)
- ESMO – Registration page (https://www.esmo.org/meeting-calendar/esmo-ai-and-digital-oncology-congress-2025/registration)

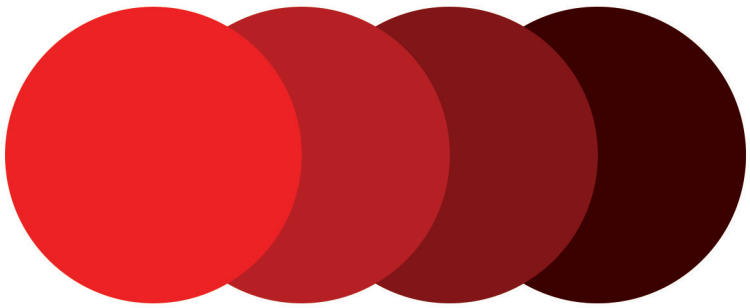
#109 11/2025 ISSN: 2036-9468

CANCER WORLD



The Legacy that Built Europe's Oncology Future

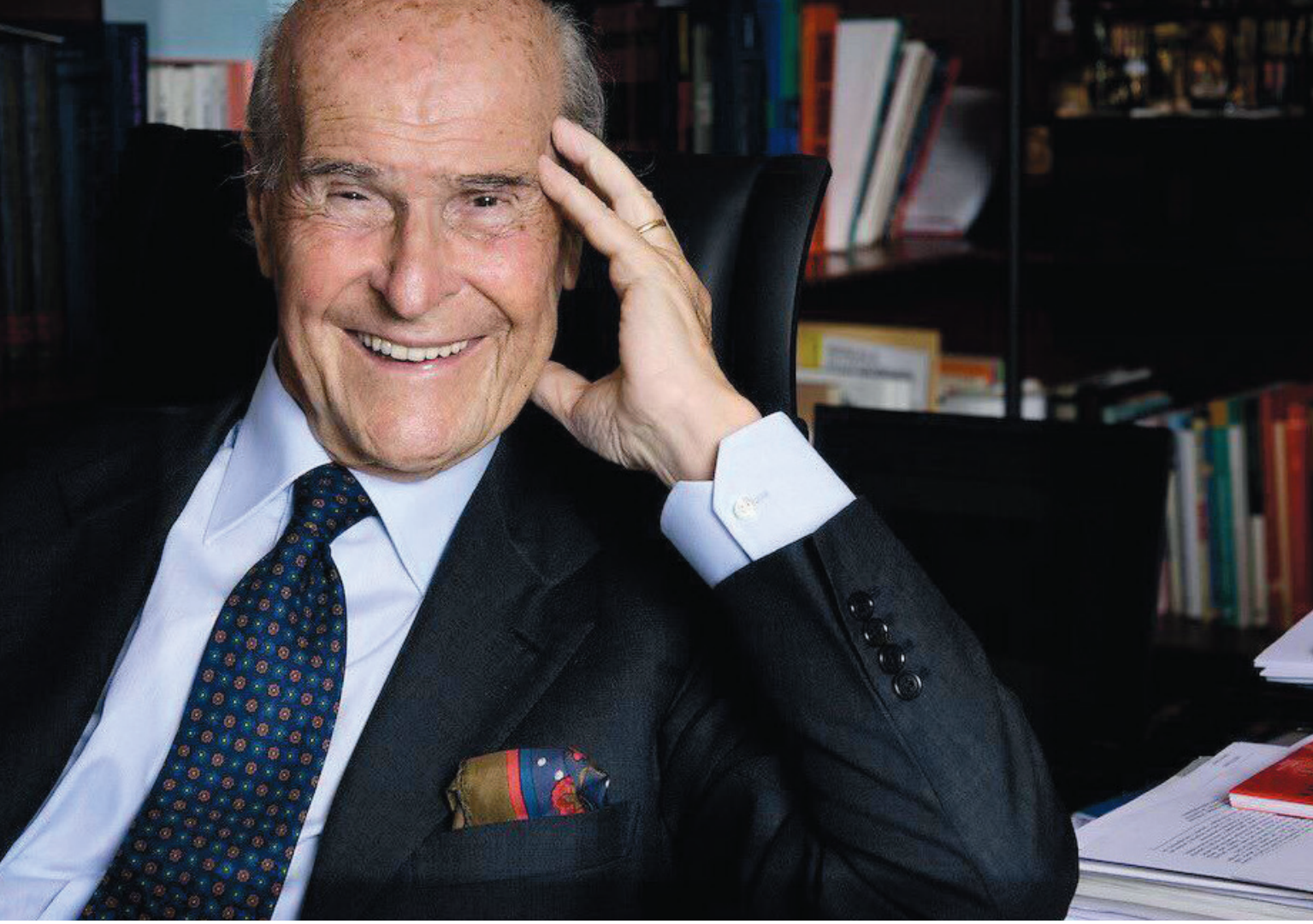
VERONESI 100



HEMOSTASIS TODAY

Your Daily Updates
on Hemostasis and Thrombosis

https://hemostasistoday.com



UMBERTO VERONESI

AND THE EUROPEAN SCHOOL OF ONCOLOGY

By Alberto Costa

The idea of creating a "European School of Oncology" came to Umberto Veronesi in the mid-1970s, when the Americans announced the effective implementation of the strategic plan against cancer signed by President Nixon in 1973, the National Cancer Act. He presented his project for the first time in 1981 at the General Assembly of ESSO in Lausanne.

The United States believed then that if they had managed to land on the moon, they could also conquer cancer, because they believed it was just a matter of investment and organization. Instead of dispersing investments among individual states, they concentrated all resources in a single federal research institute, the legendary NCI (National Cancer Institute), headquartered in Bethesda, a suburb of Washington.

The influx of government investment was so

massive that within a few years, Bethesda became the world capital of cancer research and began to drain brainpower from every corner of the planet.

The Europeans lacked the political and administrative structure to do the same (the Brussels Commission was infinitely weaker than it is today in terms of coordinating investments), but European oncologists understood the message, especially because they had been making significant contributions to cancer research in those years. The British and French were far ahead in the development of new drugs, but the Italians also played their part, discovering the most powerful anti-tumor drug for breast cancer, Adriamycin, produced by Farmitalia; inventing the concept of adjuvant chemotherapy (Gianni Bonadonna) and revolutionizing breast cancer surgery by confirming the possibility of conserving the breast (Umberto Veronesi, 1980).

Talk began of joining forces and creating a "European oncology". The British immediately got started, creating the main communication tool, a monthly journal called the "European Journal of Cancer," which quickly became the main point of reference for the publication of the most important scientific results. The French, Belgians, Dutch, and Italians (Silvio Garattini) established a joint clinical research center in Brussels, the EORTC (European Organization for Research and Treatment of Cancer), which has just celebrated its 60th anniversary. The Germans offered the Heidelberg laboratories to host the EMBO (European Molecular Biology Organization), which concentrated much of the experimental research and led its leader, Harold zur Hausen, to the Nobel Prize for the discovery of the viral origin (human papillomavirus) of certain types of cancer.

Veronesi immediately understood that Italy was in danger of remaining too far behind in this process of "Europeanization" of oncology, and he was quick to propose the establishment of a European School. Everyone recognized Italy as having created the first medical universities (Padua, Bologna, Pavia).

The final push, as often happens, came from a woman. The Roman Princess Laudomia (Domietta) Del Drago discovered only after arriving in London for surgery that Milan was the place where she could be treated while preserving her breast. It was the same English surgeon, very honest, who advised her to return home. Everything went well, and when Domietta asked Veronesi what he could do to "Repay her debt," Umberto told her of his dream of a European School of Oncology.

As a worldly woman, Domietta Del Drago immediately approved the initiative, donated the first 200 million lire to get it started, and signed before a notary in October 1982 the constitution of a non-profit association called the European School of Oncology (ESO).

The foundation was joined by English radiotherapist Michael Peckham, Belgian urologist Louis Denis, Dutch oncologist Bob Pinedo, and the leader of Swiss oncology, Franco Cavalli.

The first pilot course was held a couple of years later at Pomerio castle on Lake Como. Veronesi was very keen on the concept of "residential" teaching and wanted teachers and students to spend as much time together as possible to ensure the maximum "transfer of knowledge" from one brain to the other, as Umberto used to say.

The rest is history, and in a few years, in 2031, ESO will celebrate its 50th anniversary. The legacy of the Necchi Campiglio family ensures its full financial independence and makes the School the only European oncology training institution completely independent of any form of commercial sponsorship.

ESO's alumni now number over 15,000, many of whom are members of its Alumni College, and many have since become directors of oncology departments or even institute directors. The School has always made every effort to maintain gender equality among its students, a multidisciplinary approach (surgeons, radiologists, physicians, psychologists, nurses, pathologists, etc.), and an equal distribution between the Western and Eastern parts of the Old Continent.

From the very beginning, ESO's motto has been "learning to care," indicating its firm commitment to teaching human medicine and not just the treatment of the disease. This was always the will of its founder and creator, Umberto Veronesi, who dedicated every possible effort and attention to the School until the end of his days.

Cancer is like a stallion: either you ride the stallion, or the stallion is going to ride on you.

Shrenik Shah

Stage IV Laryngeal Cancer Survivor, 6x TEDx Speaker & Global Goodwill Ambassador

The VOICE

THAT TRANSCENDS SOUND

When I step on the stage, an exhilarating hush envelops the audience, filled with anticipation.

My journey is a powerful testament to resilience, amplified by my innovative use of assistive technology and life experience. Over 10,000 days since cancer silenced my voice, my story demonstrates that purpose can triumph over silence.

Twenty-seven years ago, after being diagnosed with advanced vocal cord cancer and facing a complete larynx removal, I, as a chemistry graduate from Ahmedabad, India, chose hope over despair.

I Lost My Voice

The daily life becomes SILENT without SPOKEN WORDS, causing catastrophic situations filled with sheer helplessness, personally, socially, professionally, financially, for the self, and family.

I encountered such an alarming problem 28 years ago at 44, at the peak of my entrepreneurial career as an international marketer, where vocal communication is essential.

I lost my natural voice for a lifetime to stage IV vocal cord cancer (never smoked, consumed tobacco, non-alcoholic, and strict vegetarian) back in September '97. For three long months, I was forced to communicate using pen and paper, which was cumbersome and deeply frustrating. I was advised to speak by placing a hand-held "electrolarynx," a device, under my chin and pressing the button. I learned by myself, practising for a week.

Undergoing Cancer Treatment in India

Despite all the challenges that I have to face due to my illness, I was fortunate to receive my treatment in India. Here we have the most advanced and highly dedicated cancer treatment centres and infrastructures available, right from diagnosis to performing comprehensive all-organ complex procedures, including advanced robotic surgeries and radiation therapy, including Proton therapy, Clinical and pathological, liquid biopsy, as well as advanced Chemotherapies. The skills of our oncologists are on par with those available globally.

I Found my Voice

In 2011 found my voice — not the one I was born with, but the one that speaks louder, travels farther, and touches hearts across borders. Losing my natural voice didn't silence me; it taught me that true expression comes from the soul, not the vocal cords.

When I began my journey as a public speaker, the road was anything but smooth. Speaking without a natural voice often meant wrestling with doubt, and sometimes, doubt spoke louder than faith. The irony was cruel: my voice, now reborn through technology and willpower, was initially rejected by audiences who couldn't look past the difference.

But instead of retreating, I chose to embrace that rejection. I made it fuel for my determination. Each "no" became a spark that strengthened my courage, refined my message, and deepened my connection with others. Over time, the very voice once dismissed became my greatest strength, the voice that built an enterprise, inspired thousands, and proved that silence, too, can roar.

Counselling my first cancer patient in 2011 changed everything. Since then, I've had the privilege of connecting with countless people across the world — patients, survivors, caregivers — each reminding me why I began.

Sometimes I still wonder, Is my message reaching? Is it making a difference? And then I read a single message that says, **"Your story gave me hope."** Those words echo louder than any applause.

I am now celebrating the 29th year of my re-engineered life 2.0, a stage IV laryngeal cancer survivor with no vocal cords and no excuses. Through my talks and workshops, I've had the honour of impacting over 100,000 lives globally. From standing on six TEDx stages, one of which ranked among the **top 10 TEDx talks worldwide**, to watching my journey light up **Times Square in New York**, each milestone reminds me that purpose speaks louder than sound.

That journey has led me to serve as a Global Goodwill Ambassador, Leadership Coach, and Patient Advocate, among other roles. I'm deeply humbled to have been recognised with the Patient Leader Hero Award (USA), chosen from over 21,000 global nominations. Yet, beyond every accolade lies a single, unshakable truth that even a voiceless story can still move hearts, shape hope, and redefine what it means to be truly heard.

At seventy-three, I stand with gratitude, still SPEAKING, still learning, and still believing that courage, once found, can move the world.
I often remind people that "silence may steal a voice, but it can't steal a story." My mission is to create spaces where those facing life's hardest challenges can find strength, purpose, and belonging. Because I believe that "every ending reveals a lever", a chance to lift ourselves toward new beginnings. My goal is simple yet profound: to help millions transform fear into purposeful action.

So, when you listen to me speak, listen closely — for in the space where sound once lived, you might just hear a voice powerful enough to bend the future... and perhaps your own story, too.

Call to Action

- **Voice Rehabilitation:** I urge cancer hospitals and policymakers to make post-laryngectomy voice rehabilitation mandatory. My 10,000-day journey with the bionic voice stands as living proof of what's possible when recovery includes the power to communicate.
- **Corporate Inclusivity:** Encourage workplaces to offer platforms and speaking opportunities for survivors, empowering them to rebuild independent, sustainable lives — personally, socially, and financially.
- **Awareness & Advocacy:** Launch stronger campaigns on cancer prevention, survivorship, and life beyond treatment — because healing does not end when treatment does.

OncoDaily

Connecting the Dots of Global Oncology

OncoDaily has grown far beyond a news platform – providing tools for thousands of professionals across continents not just to stay informed, but to stay connected. OncoDaily continues to evolve with one idea at its core - that sharing knowledge, access, and visibility makes oncology stronger for everyone.

OncoCalculators

The practical side of cancer care finds its place in OncoCalculators - a collection of clinical tools designed to make decision-making faster, simpler, and more precise in everyday practice:

oncodaily.com/calculators

OncoGrants

OncoGrants bridges ambition with opportunity, gathering research funding calls, fellowships, and awards from around the world in one daily-updated hub:

oncodaily.com/grants

OncoCalendar

Through the daily updated OncoCalendar, readers can trace the pulse of the field - from global congresses to focused symposia - a living guide to where the next big discussion in oncology is happening:

oncodaily.com/calendar

Oncologists

And soon, Oncologists will take this mission further - a dynamic database spotlighting oncologists and cancer experts worldwide. This initiative will build the largest living map of the oncology community:

oncodaily.com/oncologists

THE OTHER FIGHT

Confronting Workplace DiscriminationAgainst Cancer Survivors

By Zhanna Chakhalyan

Workplace discrimination remains one of the most persistent and underrecognized challenges faced by individuals diagnosed with cancer. While advances in treatment have significantly improved survival rates and quality of life, many patients and survivors encounter a different kind of battle when returning to or remaining in the workforce.

According to the Organisation for Economic Co-operation and Development, only **64%** of survivors manage to return to work—a range from **24%** to **94%**, depending on cancer type, treatment side effects, and support systems.

In this article, we will discuss how cancer-related discrimination is influenced by factors such as age, gender, ethnicity, and cancer type. We will also delve into the statistics surrounding this issue, shed light on the "five-year rule", and explore how discrimination varies across different countries and job sectors.

What is Workplace Discrimination?

Workplace discrimination refers to unfair or unequal treatment of an employee or job applicant based on characteristics such as race, gender, age, religion, disability, sexual orientation, or other protected attributes. It can occur in various aspects of employment, including hiring, promotion, pay, job assignments, training, and termination. Discrimination may be direct (explicit and intentional) or indirect (resulting from policies or practices that disproportionately disadvantage certain groups).

In his *Work and Illness*: The Cancer Patient book, Barofsky argues that employers often discriminate against employees with cancer to avoid interacting with individuals they perceive as part of an undesirable group—even when such actions risk financial loss through litigation and legal sanctions.

On the other hand, over thirty years ago, Fobair and Hays reported that discrimination in the workplace against individuals living with cancer was often **self-imposed**, driven by internalized stigma, passive coping styles, and diminished self-esteem. Around the same time, Skipper argued that many employers actively discriminated against employees with cancer—**denying promotions, withholding benefits, or refusing to provide reasonable accommodations**. In some cases, employers even refused to hire individuals living with cancer, viewing them as **a burden to productivity and company resources**.

Legal Protections for Employees with Cancer

Around the world, most modern anti-discrimination laws now recognize cancer as a protected condition—either explicitly or under broader disability and equality frameworks—making it illegal for employers to treat workers less favorably because of their diagnosis or recovery.

United States and Canada

In the U.S., the data tell a mixed story. Surveys show that reports of workplace discrimination among cancer survivors have declined over the past few decades. Yet the problem persists. "About 7% of U.S. cancer survivors who were employed during or after treatment reported experiencing job discrimination due to their cancer" (Pamela N. Schultz et al., *Cancer Survivors: Work-Related Issues*). More recent findings suggest the figure could be significantly higher: according to the Chronic Disease Coalition, 37% of survivors said they faced unfair treatment at work after completing treatment.

A 2021 analysis by David R. Strauser, Ph.D., and colleagues at the University of Illinois at Urbana–

Champaign, reviewed thousands of cancer-related complaints filed with the Equal Employment Opportunity Commission (EEOC). All had been fully investigated—some validated, others dismissed for lack of evidence. "**About 26.6% of the complaints from younger cancer survivors were found to have merit. For older cancer survivors, the success rate was even higher—31.4% of their claims were considered valid**" *(Yates, 2021, University of Illinois News Bureau)*. The findings reveal both progress and persistence: while many survivors find legal recourse, too many still face bias as they attempt to return to work.

In the United States, protection stems primarily from the Americans with Disabilities Act (ADA), which classifies cancer as a disability when it substantially limits major life activities—or could, if it recurs. The ADA bars discrimination and requires employers with 15 or more workers to provide reasonable accommodations, such as flexible schedules or medical leave. The Family and Medical Leave Act (FMLA) adds another safeguard, guaranteeing job-protected leave for treatment or recovery. Many states extend these rights further, creating a patchwork of strong—if uneven—protections.

Canada's system is similar, built on a network of federal and provincial human rights laws. The Canadian Human Rights Act and each provincial Human Rights Code prohibit discrimination based on disability, explicitly covering cancer. Employers must accommodate workers to the point of "undue hardship," whether that means reduced workloads, remote options, or extended medical leave. These protections extend beyond treatment itself—penalizing someone for a past diagnosis is also a violation of law.

While overt workplace bias has diminished, subtler barriers remain: missed promotions, quiet exclusion, or doubts about long-term productivity. The legal frameworks in both countries are clear, but survivors' experiences suggest that enforcing fairness requires more than legislation—it demands a cultural shift toward empathy, flexibility, and genuine inclusion.

United Kingdom

In the UK, workplace bias remains a concern for cancer survivors. A 2018 Macmillan Cancer Support survey of 1,500 UK cancer patients found that **1 in 5 (about 20%) who returned to work after diagnosis faced discrimination at work**.

This includes being passed over for promotion, denied reasonable adjustments, or even forced out. Earlier UK surveys showed higher figures – for example, in 2010–2013 up to 37% of returning workers reported some form of discrimination or unfair treatment by employers/colleagues. The improvement by 2018 suggests growing awareness and legal enforcement (under the Equality Act 2010),under this law, **any person with cancer is considered as having a disability from the point of diagnosis** – even if the cancer is in remission or cured.

The main acts that protect cancer survivors or patients from discrimination are **The Equality Act (applicable in England, Scotland, and Wales) and the Disability Discrimination Act 1995** (in Northern Ireland) specifically protect people with cancer in employment, job applications, and other work-related contexts. Notably, this protection is lifelong: **even if a person's cancer goes into remission or they are years beyond treatment, they remain protected** from discrimination arising from their past cancer.
The improvement by 2018 suggests growing awareness and legal enforcement (under the Equality Act 2010), yet a significant minority **still encounter workplace discrimination**.

European Union

In the European Union, discrimination on the basis of disability is prohibited under the EU Employment Equality Directive (2000/78/EC), which all member states have implemented through national legislation. While the Directive does not enumerate specific conditions, the Court of Justice of the European Union has ruled that serious illnesses may qualify as disabilities when they result in long-term impairments.

Cancer is broadly recognized across Europe as a condition that can constitute a disability, particularly when it leads to lasting limitations. Accordingly, cancer patients and survivors are generally protected under national disability discrimination laws in EU member states. As the European Cancer Organisation notes, "In some countries in Europe,

Champaign, reviewed thousands of cancer-related complaints filed with the Equal Employment Opportunity Commission (EEOC). All had been fully investigated—some validated, others dismissed for lack of evidence. "**About 26.6% of the complaints from younger cancer survivors were found to have merit. For older cancer survivors, the success rate was even higher—31.4% of their claims were considered valid**" *(Yates, 2021, University of Illinois News Bureau)*. The findings reveal both progress and persistence: while many survivors find legal recourse, too many still face bias as they attempt to return to work.

In the United States, protection stems primarily from the Americans with Disabilities Act (ADA), which classifies cancer as a disability when it substantially limits major life activities—or could, if it recurs. The ADA bars discrimination and requires employers with 15 or more workers to provide reasonable accommodations, such as flexible schedules or medical leave. The Family and Medical Leave Act (FMLA) adds another safeguard, guaranteeing job-protected leave for treatment or recovery. Many states extend these rights further, creating a patchwork of strong—if uneven—protections.

Canada's system is similar, built on a network of federal and provincial human rights laws. The Canadian Human Rights Act and each provincial Human Rights Code prohibit discrimination based on disability, explicitly covering cancer. Employers must accommodate workers to the point of "undue hardship," whether that means reduced workloads, remote options, or extended medical leave. These protections extend beyond treatment itself—penalizing someone for a past diagnosis is also a violation of law.

While overt workplace bias has diminished, subtler barriers remain: missed promotions, quiet exclusion, or doubts about long-term productivity. The legal frameworks in both countries are clear, but survivors' experiences suggest that enforcing fairness requires more than legislation—it demands a cultural shift toward empathy, flexibility, and genuine inclusion.

Asia-Pacific

The treatment of cancer patients and survivors can vary greatly depending on the culture of a country. In Japan, for example, cancer survivors have faced significant workplace discrimination. A 2012 survey by Aflac revealed that **10% of cancer patients were fired due to their diagnosis, while about 30% experienced salary cuts or demotions after disclosing their condition**.

Some companies even explicitly rejected job applicants with a history of cancer, highlighting the strong stigma surrounding the illness.

Later on a 2016 revision of the Basic Plan for Cancer Control urged employers to "strive" to help survivors balance work and treatment, unfortunately Japan has not ratified the UN Convention on the Rights of Persons with Disabilities, so therefore, employers may dismiss chronically ill workers under Article 14 of the Labor Standards Act for "non-performance". According to Sungkeun Shim at al, 24.0% of South Korean survivors (included as an analog in Asia) lost their jobs after cancer, with 20.7% citing workplace discrimination – underscoring a broader Asian context of survivor job loss.

Across Asia-Pacific, fear of discrimination is very high. In a 2017 multinational survey, **37% of employees** worldwide expressed concern about workplace discrimination against people with cancer – but in Asia–Pacific, that figure climbed to **49%**.

This suggests that nearly half of respondents in that region anticipated or feared bias against cancer-affected coworkers. Actual reported experiences in many Asia-Pacific countries are not well quantified, but anecdotal reports (e.g., in India and China) echo themes of job loss, forced early retirement, or demotion after a cancer diagnosis, indicating that discrimination is a widespread issue in the region (even if exact percentages are unknown).

Before recent legal changes, it was common for Japanese companies to explicitly reject job applicants with a cancer history or even terminate employees upon diagnosis.

"Thirty percent of cancer patients reported that their salary was reduced by up to 70% after their diagnosis, effectively pressuring them out of the workforce."

— Triage Cancer's 2015 survey, Cancer & Employment: International Series – Japan

Latin America

Emerging data from Latin America indicate that workplace discrimination against cancer survivors remains a significant concern. In a prospective study conducted in Brazil, **about 10.7% of women with breast cancer reported experiencing employer discrimination**, including unfair treatment or a lack of reasonable accommodation, within two years of diagnosis.

Among the 67 women who were working 24 months after diagnosis, **11.9% reduced their workload** from full-time to part-time, while 3% increased their workload from part-time to full-time. Although many participants reported receiving some level of employer support, only **approximately 29%** were offered formal work adjustments. Those who did not receive such support often described feeling penalized for their illness.

This study underscores that while most breast cancer survivors in Brazil eventually return to work, a significant minority continue to experience discrimination and reduced opportunities following treatment.

Comprehensive statistics from other Latin American countries remain limited, but available evidence suggests similar patterns across middle-income nations. Cancer survivors are often pressured to leave their jobs or face barriers to re-employment due to persistent misconceptions about their health and productivity. Patient advocacy groups in Mexico and Argentina have reported numerous cases of survivors being pushed out of the workforce following treatment, although formal prevalence data are scarce.

According to Luciana C. G. Landeiro et al. (2018) in Return to Work After Breast Cancer Diagnosis, the Brazilian findings likely reflect a broader regional trend, with an estimated **10–15% of cancer survivors** in Latin America experiencing workplace bias, a figure that underscores the need for more systematic research and policy attention across the region.

Africa

Reliable data from African nations remain limited, but available evidence suggests that workplace discrimination against cancer patients is a significant and underreported problem. In South Africa, for instance, Maimela C. et al. (2021) observed that many employees with cancer face unfair treatment in the workplace — *"not because they are unable to work, but merely because they have cancer."*

Survivors have reported being denied reasonable accommodations or even dismissed once their employer learns of the diagnosis, although precise prevalence data are lacking. The absence of continent-wide surveys makes it difficult to quantify the scale of the issue, but persistent stigma and limited employer awareness likely contribute to widespread discrimination.

According to Bradshaw D. et al. (2009) *in The Burden of Non-Communicable Diseases in South Africa*, an estimated **one in four South Africans** is living with cancer, a striking figure that reflects the disease's reach across both younger and older populations. This high prevalence, combined with already elevated unemployment levels, particularly among youth — which the National Union of Metalworkers of South Africa (NUMSA) reports at **47.5%** — underscores the compounded social and economic impact of cancer-related stigma in the region.

Middle East

Cultural stigma in parts of the Middle East often leads to underreporting of workplace discrimination, as many patients choose to conceal their illness. According to Badihian, Shervin et al., 48.4% of patients said they would not inform their coworkers if they had cancer, specifically to avoid potential workplace discrimination or "problems at work." This finding suggests that nearly half of patients fear negative repercussions in their professional lives.

Although documented cases of explicit discrimination—such as termination or demotion—are rarely publicized, the prevalence of non-disclosure points to a significant, largely hidden problem.

Gulf Region and Beyond

Across much of the Middle East, formal research on workplace outcomes for cancer survivors remains

scarce. Nonetheless, awareness of the issue is growing. In the Gulf states, including the United Arab Emirates and Saudi Arabia,recent labor law reforms have explicitly prohibited the dismissal of employees undergoing medical treatment for cancer.

Despite these advances, anecdotal reports indicate that survivors may still face subtle forms of bias—such as pressure to resign, exclusion from promotions, or reduced career opportunities due to health-related misconceptions. While no precise prevalence data are available, the prevailing climate of non-disclosure suggests that many survivors continue to anticipate or experience workplace discrimination, highlighting the urgent need for stronger legal protections and cultural change across the region.

Workplace discrimination remains a significant and often overlooked challenge for individuals affected by cancer. While advances in medicine have transformed cancer from a terminal diagnosis into a manageable condition for many, survivors still face substantial barriers when it comes to employment. As we've seen across various global regions, experiences vary widely based on legal protections, cultural attitudes, and the presence (or absence) of supportive workplace practices.

A clear understanding of one's legal rights, the pursuit of appropriate workplace accommodations, and open communication with healthcare providers and employers are essential to navigating employment after a cancer diagnosis. Empowered and informed survivors—alongside proactive advocacy—remain central to advancing equitable treatment, strengthening legislative frameworks, and fostering truly inclusive workplaces. Although the path toward eliminating workplace discrimination is complex, sustained awareness, education, and rigorous enforcement of legal protections continue to move society closer to a future in which a cancer diagnosis no longer endangers a person's livelihood or dignity.

Cancer Discrimination Court Cases

Court cases from around the world reveal how legal systems respond when workers are dismissed, misled, or denied reasonable accommodations due to their illness. These cases highlight the ongoing struggle for equal rights and protection for cancer patients in employment.

United Kingdom: Wainwright v. Cennox Plc (2025)

In the 2025 UK case *Wainwright v. Cennox Plc*, a manager on sick leave for breast cancer treatment discovered her role had been permanently filled without her knowledge, and the employer misled her about it. A tribunal later ruled this amounted to discriminatory constructive dismissal, **awarding her £1.2 million in damages**.

USA, Blythe Asher v. NBCUniversal/E! (2016)

In Blythe Asher v. NBCUniversal/E! (2016), Blythe Asher—a senior executive at E! News—filed a lawsuit alleging she was fired during breast cancer treatment due to her "sickly appearance." She claimed disability discrimination, retaliation, and wrongful termination in violation of California law. The case, filed in Los Angeles County Superior Court, drew media attention for highlighting workplace bias against high-level employees with cancer.

Africa (South Africa): Matinketsa v. Dis-Chem (2024)

In the 2024 South African case *Matinketsa v. Dis-Chem*, Refilwe Matinketsa, a warehouse worker and bowel cancer survivor, was dismissed after she could no longer perform heavy lifting due to lasting impairments. Though temporarily reassigned to light duties, no permanent position was available. She challenged the dismissal as discrimination, but the CCMA found it justified. The employer had explored accommodations and followed proper procedures. The termination was deemed lawful, showing that dismissal may be permitted if a cancer survivor cannot fulfill core job duties despite reasonable adjustments.

Middle East (Israel): Oren-Blazer v. Teva Pharmaceuticals (2013)

In the 2013 Israeli case *Oren-Blazer v. Teva Pharmaceuticals*, Ilana Oren-Blazer was dismissed shortly after being diagnosed with a malignant brain tumor. The court found the termination

discriminatory, awarding **her estate $600,000** and setting a key precedent against cancer-based dismissal in the region.

FAQs

1. Can my employer fire me because I have cancer?

In many countries, **no**. Cancer is legally recognized as a disability or serious health condition, and most labor laws prohibit discrimination based on health status. You cannot be legally fired just because of your diagnosis. However, laws vary—check your local labor or disability protection laws.

2. Do I have to tell my employer I have cancer?

No, unless you are requesting **workplace accommodations** or taking medical leave. Disclosure is your choice. However, without disclosing your diagnosis, your employer may not be legally obligated to provide certain support.

3. What are "reasonable accommodations" and how do I request them?

These are changes or adjustments to help you perform your job during or after treatment (e.g., flexible hours, remote work, longer breaks). Write a formal request (email is fine), mention that it's related to a medical condition, and if needed, include a note from your doctor. Keep a copy of all communication.

4. I feel I'm being treated unfairly. What should I do first?

Start by **documenting everything—dates**, names, what was said/done. If you feel safe, speak to HR or your manager. Use calm, factual language.

If internal steps don't work, consult a legal advisor or reach out to a government agency or NGO.

5. Who can I contact for legal help?

- **United States:** Equal Employment Opportunity Commission (EEOC), Cancer Legal Resource Center **United Kingdom**: ACAS, Citizens Advice
- **Australia:** Fair Work Commission, Human Rights Commission
- **Other Countries:** Look for disability rights groups, local cancer NGOs, labor unions, or legal aid services.

6. What if I'm demoted, excluded from meetings, or bullied after disclosing my diagnosis?

This may count as **harassment or indirect discrimination**. Document it. Talk to HR or a manager if possible. If nothing changes, file a complaint with the relevant authority in your country or speak to a lawyer.

7. Can I take time off work for treatment?

Yes. Most countries have laws allowing **medical leave**, especially for serious illness. Whether it's paid or unpaid varies, but your job may be protected during treatment. Provide a medical certificate if required.

8. What if I live in a country with weak legal protections?

Check if your country has ratified the **UN Convention on the Rights of Persons with Disabilities**. Contact international labor organizations or NGOs, and connect with cancer patient groups for advice and advocacy help. In many places, awareness is growing and informal support networks exist.

9. How do I cope emotionally with discrimination at work?

It's completely valid to feel stressed, hurt, or isolated. Reach out to:

- Oncology social workers
- Mental health counselors
- Cancer support groups (online or local)
- Friends, family, or spiritual communities

You're not alone—and your dignity matters just as much as your health.

10. What if I just want to change jobs instead of fighting it?

That's also valid. Sometimes the healthiest option is a fresh start. But even then, consider speaking with a lawyer or agency so that your previous employer is held accountable—this can help prevent future discrimination for others.

Fertility NEWS

Daily Voice Of Fertility & Reproductive Health

https://fertility.news

SURVIVING CHILDHOOD CANCER IN UGANDA

THE DUAL BATTLE FOR LIFE AND FERTILITY

By Esther Nakkazi

At 17, Annet Namubiru's life changed drastically. Then a secondary school student, she began to fall ill without anyone understanding why.

"I was at school and started feeling weak and tired," she recalls. "As you know, when a girl of 17 or 18 falls sick, people start thinking of pregnancy." Her menstrual period came—but never stopped. "It just didn't go away," she says. "Everyone thought maybe I had done something wrong."

The school doctor tested her for malaria and other common illnesses like brucellosis, but each time, the results were negative. "He told me I was fine, maybe I just didn't want to study," Namubiru says. But she knew something was seriously wrong.

Soon, she could barely walk up the hill to fetch food from the school dining hall. "I would rest halfway before continuing," she says. "I was too weak even to attend class." The bleeding worsened—from her gums, her nose, and through unexplained bruises that appeared as dark patches on her skin. Alarmed, the doctor ordered a complete blood count.

"When the results came back, he was scared," Namubiru recalls. "He said, 'I don't know what you're suffering from, but whatever it is, it's serious. You need to go to Mulago Referral Hospital immediately.'" Her hemoglobin level was just 5. "He was surprised I was still walking," she says. An ambulance took her to Mulago, and her parents were called.

After several tests, doctors suggested a bone marrow examination. The results confirmed leukemia, a type of blood cancer.

"When my mother saw the word 'leukemia,' she said, 'No, it can't be. No one in our family has ever had cancer.' But then a doctor confirmed it. It hit me hard. I was young, I had dreams, and suddenly everything turned into survival."

People Said, 'She Has Cancer, She's Going to Die'

Namubiru was referred to the Uganda Cancer Institute (UCI) in Uganda's capital Kampala, where she began intense treatment. "The treatment was brutal," she says. "You stop eating, you get wounds in the mouth, you lose your hair and strength. I spent about three months bedridden."
Outside the hospital, rumors spread. "People said, 'She has cancer, she's going to die,'" she recalls.
Her family faced enormous emotional and financial strain. "My mother stayed in Kampala to take care of me for six months, leaving my father and siblings at home," she says.

"At one point, my parents even thought of selling our home in Iganga to pay for my treatment. But one of my father's friends said, 'You'll remain in poverty. **That child is going to die anyway**."

Cancer-Free, But Not Free

Despite everything, Namubiru's treatment worked. Returning to school brought new challenges. "When you go back, everything feels different," she explains. "You're traumatized, afraid of infections. I resumed after a year, but mentally and emotionally, I wasn't the same."

Even after being declared cancer-free, fear lingered. "Any time I caught a flu, I thought, 'Oh my God, it's back,'" she says. "They told me to take medication for two years. Even after finishing, I refused to stop. I thought I would die without it."

Annet Namubiru. Photo credits: Palliative Care Association of Uganda

Namubiru, now a mother of three, emphasizes the need for mental health support and public awareness. "People still think cancer is a death sentence," she says. "They tell caretakers things like, 'Why waste money? She's going to die anyway.' That ignorance hurts. The UCI also needs to follow up on survivors."

Namubiru also talks about the difficulties of navigating long-term health needs—such as family planning. Ten years after her cancer treatment, a doctor required her to return to her oncologist for authorization of the family planning method she should use.

For survivors like Namubiru, the next frontier is not just survival—but the right to a full, fertile life.

Fertility and the Survivorship Journey

For many cancer survivors, reproductive health becomes a central concern. In African societies, the inability to start a family can have profound personal and social consequences. As survival improves, questions about life after treatment—especially fertility—are growing louder.

Dr. Anthony Kayiira, one of Uganda's few oncofertility specialists, describes his work as standing at the intersection of oncology and reproductive medicine. "Oncofertility is the intersection of oncology and reproductive medicine—protecting a patient's ability to have biological children before, during, and after cancer treatment," he explains.

Dr. Kayiira leads IVF and andrology services at Mulago Specialized Women & Neonatal Hospital and serves as a Senior Clinical Research Fellow in oncofertility at the Uganda Cancer Institute. His role spans three things: risk-stratifying children and adolescents for treatment-related gonadal damage; counseling families and coordinating fertility preservation where feasible; and building systems—protocols, training, and research—to make this care routine rather than exceptional.

"In Uganda and much of Africa, fertility is tightly linked to identity, marriageability, and social standing," he says. "As survival improves, I kept meeting young people who beat cancer but were blindsided by infertility. Those conversations—and parents asking, 'Will my child one day be able to have a family?'—pushed me to dedicate my clinical and research work to closing that gap."

In Uganda, oncofertility services are still developing: post-pubertal girls can undergo egg retrieval and cryopreservation, and post-pubertal boys can bank sperm, while preservation of ovarian or testicular tissue for prepubertal children is not yet available locally, though it is practiced internationally. "We need a national clinical pathway, trained teams, and reliable cryostorage infrastructure," Dr. Kayiira explains. "The cost to establish ovarian tissue cryo capacity is not astronomical—it's a low six-figure investment—but the impact would be life-changing."

A 2021 study by Dr. Kayiira and colleagues revealed that 46% of female survivors and 21% of male survivors experienced infertility in their first attempts to have children. Nearly half reported dissatisfaction with the inability to have biological children, and 79% could not recall discussing fertility during treatment or follow-up care.

"We expected elevated risk, but the magnitude was sobering," Dr. Kayiira says. "It reveals systemic gaps—late or absent fertility discussions, limited preservation options, fragmented referrals, and poor survivorship follow-up. It's a call to embed fertility counseling at diagnosis, not years later when options are fewer."

Dr. Anthony Kayiira speaking at the the 5th Conference on cancer and palliative care held 10-12th September, 2025 at Speke Resort, Munyonyo in Uganda. Photo credits: Palliative Care Association of Uganda

"Discussions about fertility should begin at diagnosis," Dr. Kayiira advises. "Rapid-start pathways allow immediate sperm or egg collection. Even when opportunities are missed, we can learn from each case to improve care for future patients." "It's not rocket science," he adds. "We can assess risk based on the chemotherapy regimen, radiation exposure, age, and pubertal status. Patients are then classified as low, intermediate, or high risk. High- and intermediate-risk patients should be referred to an oncofertility specialist immediately."

The Mulago Specialized Women and Neonatal Hospital—part of the Mulago National Referral Hospital—provides fertility preservation for cancer

survivors, offering egg and sperm freezing free of charge to safeguard reproductive options before treatment.

He and his team are piloting decision aids and standardized counseling tools in oncology clinics. "Fertility risk should be flagged in every cancer ward the same way we flag infection or malnutrition," he says. "Once the first few successful preservations happen locally, momentum will accelerate."

"Every child deserves a future that includes the possibility of having children," Dr. Kayiira says. "Even with current limitations, fertility preservation is achievable. With support and infrastructure, children can still have the opportunity to start families in the future."

Building a Survivor-Centered System

Dr. Joyce Balagadde Kambugu, the Head of the Division of Pediatric Oncology and Hematology, of the Uganda Cancer Institute and the President of SIOP Africa, emphasizes the need for holistic survivorship programs. "We do not have statistics. We do not know the proportion, where they are, their needs, the stigma they face, or the struggles of their families—siblings, integration into society. We really don't know everything," she says.

Education, she argues, is a symbol of hope. "Most of the children we see at the Cancer Institute want to go back to school. Even when they are strong enough, we often don't let them because we think their immunity is suppressed."

Survivorship care, she says, must begin at diagnosis. "We need to prepare children for surviving, even if it is just one or two years. For example, if a child is 10 years old and in Primary Five (P5), we must begin interventions during treatment, arrange for teachers to come to the ward, and create safe spaces for exams."

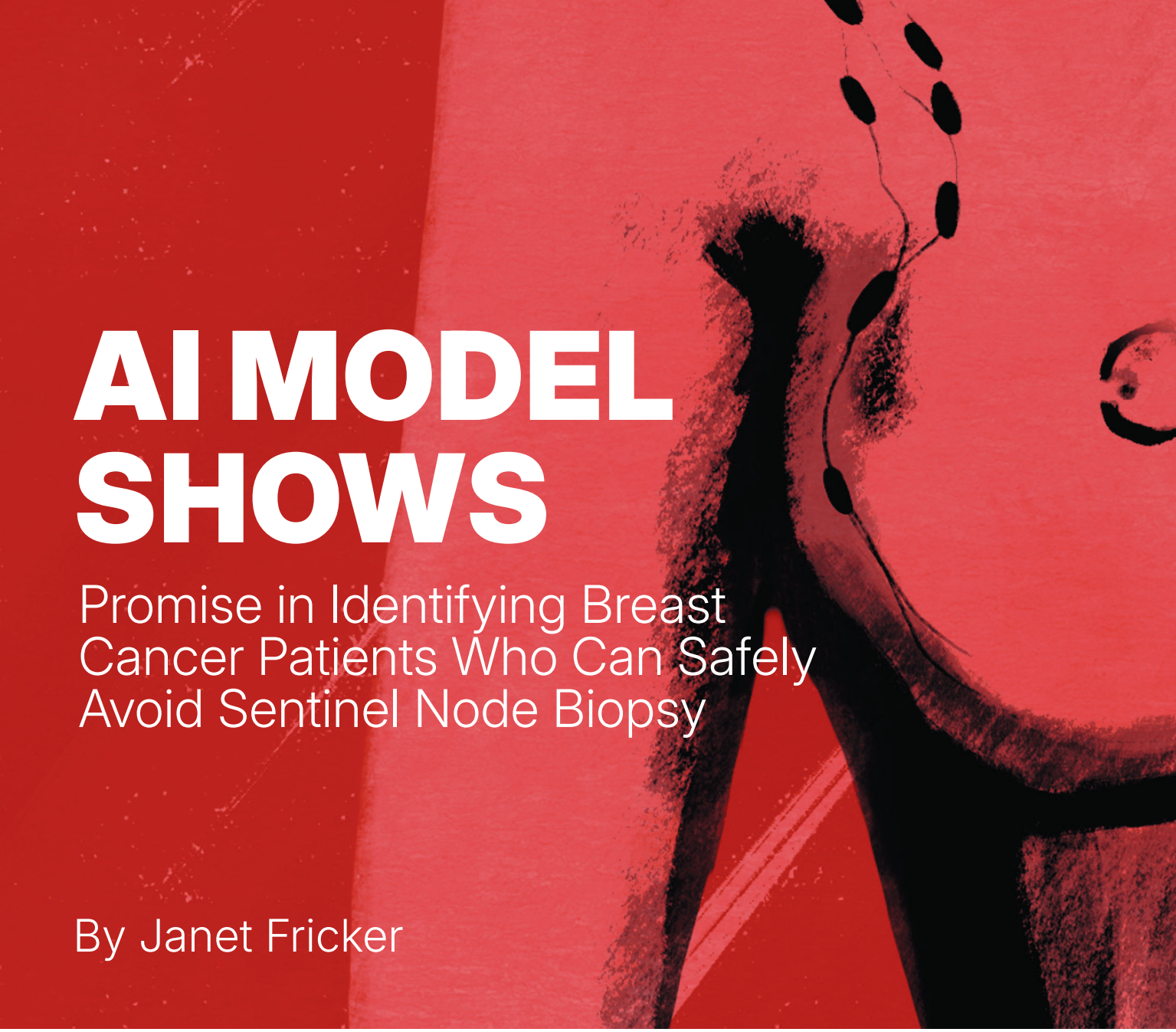
Dr. Balagadde Kambugu also stresses reproductive health planning. "We need to think about fertility from the beginning. Are you a teenager? You should have early information about potential risks and options, including sperm or ovarian preservation. Families should be part of the decision-making process."

Giving survivors a voice is equally important. "When they are together, they can guide us on how to improve care, advocate through schools and civil society initiatives, and influence policy," she says. This vision is already taking shape in Uganda through a collaboration with the Uganda Child Cancer Foundation. "We started a proper registry about a year ago to track children who have completed treatment," Dr. Balagadde Kambugu explains. "We can now invite them to forums, involve them in awareness campaigns, and monitor their clinical follow-up."

Adolescents require particular attention. "They have unique needs and should have custody over decisions affecting them. We are creating spaces where teenagers can speak privately about fertility, contraception, and other concerns," Dr. Balagadde Kambugu says. Dedicated adolescent clinics are expected to begin in January 2026, with the new 350-bed UCI hospital in 2027 featuring fully separated male and female adolescent units.

"Survivorship is not just about survival," she concludes. "It's about ensuring quality of life, education, and future opportunities for every child who fights cancer. We may not have all the resources yet, but we have started, and we are planning carefully to build a system that truly supports children through and beyond cancer."

Dr Joyce Balagadde-Kambugu speaking at the the 5th Conference on cancer and palliative care held 10-12th September, 2025 at Speke Resort, Munyonyo in Uganda. Photo credits: Palliative Care Association of Uganda



AI MODEL SHOWS

Promise in Identifying Breast Cancer Patients Who Can Safely Avoid Sentinel Node Biopsy

By Janet Fricker

An AI model has been trained using mammograms to identify breast cancer patients who could be spared from unnecessary lymph node biopsy procedures. The study, published in *NPJ Digital Medicine*, 10 July, found that the introduction of the AI model could allow **over 40% of current axillary surgical procedures to be avoided.**

"Our findings suggest that routine mammograms, particularly full-breast images, can enhance preoperative nodal status prediction. The approach could be easily implemented as a routine diagnostic procedure preoperatively and avoid complications associated with lymph node biopsy," explains corresponding author Lisa Rydén, who is Professor of Surgery at Lund University, Sweden.

Currently, all breast cancer patients (with a few exceptions) are recommended to undergo sentinel node biopsy. Sentinel node biopsy is a surgical procedure that uses a radiotracer or blue dye to identify the first in a chain of lymph nodes in the

axilla where lymphatic fluid from the tumour drains. The rationale behind the procedure (performed during breast surgery) is that if the first lymph node is cancer-free, subsequent lymph nodes will also be cancer free, thereby avoiding the need for axillary clearance (where all lymph nodes are removed), which leads to complications such as shoulder problems and lymphoedema (swelling of the arm).

"But even sentinel node biopsy comes with side effects which are similar to those experienced after axillary clearance, but at a lower rate. And for surgeons, operating times would be shorter if they didn't need to use tracers," Rydén tells CancerWorld.

The spread of breast cancer to the axilla affects approximately **one in five breast cancer patients**, with the remainder having no trace of cancer in the lymph nodes and therefore deriving no therapeutic benefit from the procedure. Although there has been a move toward de-escalation of axillary surgery, reliable non-invasive methods for accurately assessing the risk of axillary lymph node metastasis have been lacking.

Rydén and colleagues set out to devise an AI decision-support tool that could be used to predict the likelihood of axillary lymph node metastasis and identify patients who could safely forgo sentinel node biopsy. "We developed our algorithm in three steps," explains Daqu Zhang, the first author of the study. "Firstly, the AI model went through **tens of thousands of mammograms** to learn their basic structure, such as edges, texture, and shapes. The AI model was then trained to find specific clues for cancer, such as the boundaries of tumours. And finally, it was given a 'holistic mindset' by including other important patient information, like age and tumour type, in order to more accurately predict the risk of metastasis."

For the study, 1,265 women with clinically node negative (CNO) T1-T2 invasive breast tumours from three Swedish institutions who underwent surgery as a primary treatment between 2009 and 2017 were retrospectively included in the supervised learning cohort. Of these, 1,039 women (from sites 1 and 2) were included in the development set, 123 (from site 2) in the independent test set, and 103 (from site 3) in the external test set.

An innovative aspect of the study was the introduction of 'Transformer neck', an AI technique that allows the model to identify information regarding the risk of metastasis from the whole mammogram and not just the part containing the tumour.

Results showed that, in comparison to models using only clinical variables, incorporating full-breast mammograms with preoperative clinical variables improved the receiver operating characteristic (ROC) area under the curve (AUC) from 0.690 to 0.774. Put in context, AUC is a measure used to evaluate the capability to detect disease of interest (in this case, nodal metastasis) and the ability to correctly exclude healthy patients. "A value of 1.0 is considered perfect, while a value of > 0.7 is considered good, and > 0.8 very good," explains Rydén.

Furthermore, if the model had been used in a breast cancer population with the same characteristics, the team would have been able to reduce the number of sentinel lymph node biopsy procedures undertaken by 41.7% (13.0–62.6%).

"These results highlight the great value of routine mammograms in staging LNM [lymph node metastasis] before surgery and aiding in preoperative patient stratification for axillary management by increasing the SLNB [sentinel node biopsy] reduction rate from 27% to 42%," conclude the authors. "The innovative design of the Transformer neck, leveraging the attention mechanism, enhanced global feature extraction by emphasising important features in high-resolution, full-breast mammograms."

Limitations of the study, write the authors, include the lack of diverse ethnic groups and that the external test set was not representative of clinical predictors for nodal status (like tumour size).

Further external validation is currently being undertaken with international collaborators. The investigators hope to add other data sources to the model, including gene expression data and images depicting histopathological sections of the breast tumour.

In the future, the authors believe that the AI algorithm could be used during routine mammography screening to assess the risk of lymph node metastasis. "Our article focuses on the spread to the lymph nodes, but in ongoing international studies the image pattern could also be used to predict the prognosis," says Rydén.

Independent Expert Comment

Douglas Flora, an oncologist and the Executive Medical Director of Oncology Services at St. Elizabeth Healthcare Cancer Center, Edgewood, Kentucky, with a special interest in the future of AI in cancer care, discusses the implications of the study with CancerWorld.

Dr. Douglas Flora

Could you comment on the overall significance of the study and what you see as the clinical importance of the findings?

The study demonstrates a significant advance in non-invasive risk stratification for early-stage, clinically node-negative (cN0) breast cancer patients. Its main contribution is successfully leveraging routine full-breast digital mammograms—a widely available and low-cost imaging modality—as a rich source of predictive information for axillary lymph node metastasis (LNM). The use of advanced deep learning (DL) techniques, specifically the Vision Transformer architecture, was crucial. This model improved the ability to predict LNM by recognising subtle patterns across the entire image (the 'full-breast') rather than just focusing on the tumour region of interest (ROI). This technique boosted performance significantly over models using only clinical variables, fundamentally elevating the mammogram from a detection tool to a powerful prognostic indicator.

From the clinical perspective, the most critical implication is the potential for de-escalation of axillary surgery. Reduction in Sentinel Lymph Node Biopsy (SLNB): the combined model (PreopClinic + FullMammo), operating under the stringent clinical constraint of maintaining a sensitivity of 90%, suggested a SLNB reduction rate of 41.7%.

This means the tool could safely identify a large proportion of patients who might potentially omit SLNB, reducing the burden of postoperative complications without compromising oncologic safety.

The DL model proved as informative as key postoperative pathological indicators, such as pathological tumour size and multifocality. By accurately estimating risk factors before surgery, the model enables truly preoperative risk stratification, which is essential for informed surgical planning and patient counselling.

What do you see as the unanswered questions arising from the study?

The study itself highlights several important limitations and unknowns:

- Site-Dependent Variability: The model's added predictive value varied considerably between the three Swedish institutions (Site 1, Site 2, and Site 3). The underlying causes for this are not yet identified but may relate to temporal shifts in diagnosis (e.g., earlier detection over time), differences in mammography equipment/vendors, or subtle variations in clinical workup protocols.
- External Validation Representativeness: The external test set (Site 3) was statistically unrepresentative of the development cohort in terms of key predictors like tumour size and LNM prevalence, limiting the generalisability of the external validation attempt.
- True Preoperative Data: The study used postoperative pathological assessment data (histological grade, type, molecular profile) as 'preoperative predictors,' which, while often available from core needle biopsy, is an assumption. The accuracy using only actual core needle biopsy measurements in a real-time clinical setting needs confirmation.
- Biological Basis of Global Features: While the Transformer identified important tumour and peri-tumour regions, the exact biological or microenvironmental changes in the breast tissue corresponding to the 'global imaging

patterns' associated with LNM and LVI remain biologically uninterpreted.

What further research would you like to see undertaken?

I'd like to see the following research:

- Prospective Multicenter Validation Trial: A large-scale, prospective clinical trial is necessary to definitively validate the reported SLNB reduction rate. This trial should explicitly include diverse patient cohorts, different geographical regions, and a broad range of mammography equipment vendors to robustly address observed site-dependent variability.
- Mechanistic Feature Analysis (Biomarker Correlation): Research should employ advanced explainable AI (XAI) to map the AI-identified global imaging patterns to known biological phenomena. This involves correlating the image features with gene expression, immune cell infiltration, or other markers of the tumour microenvironment to understand why the model is predictive.
- Multimodal Data Fusion: Future models should incorporate the full-breast mammography features with other readily available preoperative data, specifically core-needle biopsy data (histology, molecular) and potentially sonographic features, to create a truly multimodal, high-performing prognostic tool.
- Long-Term Outcome Analysis: Validation must extend beyond immediate nodal status prediction to long-term oncologic outcomes, such as local recurrence and disease-free survival, for patients who safely omitted SLNB based on AI scores.

What would you say to cancer patients concerned about the findings of this study?

This is very encouraging research that points potentially toward a smarter, gentler way to manage breast cancer in future. For many women with early-stage breast cancer, the SLNB is a necessary step, but for about two-thirds the results are negative, meaning surgery was solely for staging. This study shows that a new AI tool can now look at standard mammograms and spot subtle, previously invisible patterns that strongly predict whether lymph nodes are cancer-free.
The key takeaway is that this technology suggested it could safely identify over 40% of patients who might someday be able to skip the SLNB entirely. This means we are moving closer to a future where we can personalise treatment even further, potentially avoiding unnecessary surgery and reducing risk of side effects,without compromising safety. While this tool is still in the research phase (needing testing in large-scale clinical trials before it becomes a standard part of care), it represents a significant step forward in making breast cancer treatment more precise and less invasive.

How is AI likely to be incorporated into oncology in the future?

AI integration into oncology is expected to proceed along three main tracks:

- Augmented Diagnostics and Triage (The Co-Pilot): AI will become an essential partner for clinicians. In imaging (radiology) and tissue analysis (pathology), AI models will autonomously screen studies, flag subtle anomalies, and quantify disease features (e.g., predicting tumour size from mammograms, as seen in this study, or rapidly grading tumour aggressiveness). This will increase diagnostic speed, reduce false negatives, and allow human specialists to focus attention on the most complex cases.
- Personalised Prognostication and Treatment Selection (The Navigator): AI will move beyond diagnosis to become a predictive engine. It will integrate complex data streams—genomics, clinical variables, and radiomics (image-derived features)—to create highly individualised risk scores. This will enable clinicians to select optimal treatments (e.g., which chemotherapy, which targeted agent, or, as in this study, whether surgery can be safely omitted) and predict the likelihood of treatment response and toxicity.
- Operational Efficiency and Access (The System Optimiser): AI will enhance the functioning of the entire healthcare system. This includes optimising patient flow, managing resource allocation (e.g., scheduling biopsies, OR time), automating administrative tasks, and identifying and mitigating structural barriers to timely care. Ultimately, AI will drive overall efficiency and improve equitable access to high-quality treatment.

ONCODAILY MEDICAL JOURNAL

Peer-reviewed
Open-access
Scientific journal

doi.org/10.69690/odmj
oncodailyjournal.com
ISSN: 3067-6444