

Press Release

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DarwinHealth Introduces Quantum Cancer Biology: A Cell-State Systems Biology Framework for Precision Oncology

New paradigm integrates single-cell transcriptomics, regulatory network inference, and AI to decode—and therapeutically target—the multiple, co-existing cancer cell states that drive resistance in pancreatic cancer, glioblastoma, and other lethal malignancies

NEW YORK, NY (August 26, 2026) — **DarwinHealth**, a New York-based, AI-centric biotechnology company, today announced the introduction of **Quantum Cancer Biology: A Cell-State Systems Biology Framework for Precision Oncology**, a transformative scientific paradigm designed to address one of oncology's greatest unsolved challenges: why the world's deadliest cancers continue to evade even the most advanced targeted therapies.

The announcement accompanies the publication in ***Nature Genetics*** (<https://www.nature.com/articles/s41588-026-02714-8>) of a new perspective led by Dr. Andrea Califano and Dr. Kenneth P. Olive, driven by first author Dr. Pasquale Laise, PhD, alongside co-first authors Mikko Turunen, PhD, and Alvaro Curiel-Garcia, PhD.

The study, conducted at Columbia University, presents original research findings and argues that the next revolution in oncology will not come from discovering a single “miracle drug,” but from longitudinally decoding the multiple malignant cellular states that coexist within advanced, treatment-resistant tumors in individual patients.

The framework, undergirded by the company's proprietary VIPER technology, licensed by Columbia exclusively to DarwinHealth, is supported by pioneering research led by DarwinHealth scientists Pasquale Laise, Mariano J. Alvarez, Andrea Califano, and their collaborators. Their single-cell systems biology studies, including the just published ***Nature Genetics*** report, demonstrate that pancreatic cancers comprise not one, but multiple, biologically distinct malignant cell states, each governed by unique regulatory programs and therapeutic vulnerabilities.

From a landscape-changing perspective, this is the first study to convincingly show that vulnerabilities and desired drug responses among multiple cancer cell states that coexist in an individual patient's tumor (in this case, pancreatic cancer) are virtually identically conserved in patients with the same kind of cancer. In other words, at the time of disease onset, all patients with a particular kind of cancer—pancreatic cancer, glioblastoma, breast cancer, melanoma, prostate cancer, and many others—harbor a recurring, predictable, and co-existing mix of multiple cancer cell state abnormalities, all of which must be targeted relatively simultaneously to achieve optimal treatment results.

By extension, enduring treatment responses—and most importantly, definitive cures—especially for our most lethal and resistant tumors, will likely come, not from any single bullet, but from decoding the cancer cell states and then deploying multi-drug combinations directed at each abnormal state early in the treatment course. As the study shows, both decoding and targeting strategies can be systematically identified using AI-based algorithms, such as those developed and commercialized by DarwinHealth.

Together, the advances reported in *Nature Genetics* establish the scientific foundations and drug development roadmaps for a new generation of precision oncology treatments based not simply on identifying genetic mutations, but on decoding the regulatory architecture that determines how every malignant cell behaves—and how it can be therapeutically eliminated. Based on these recent results, as well as previous and yet-to-come studies, these technologies developed and refined by DarwinHealth are paving the way to more universal and more effective combination therapies for cancers shown to be resistant to current treatments and, therefore, responsible for invariably high mortality rates, frequently in excess of 90%.

Beyond Precision Oncology

For decades, precision oncology has largely defined tumors by their genomic mutations, with therapies designed to inhibit individual oncogenic drivers. While this strategy has produced important clinical advances, durable responses in highly resistant cancers such as pancreatic cancer and glioblastoma remain uncommon because tumors continually evolve new, resistant cellular populations.

Quantum Cancer Biology proposes a fundamentally different view.

Rather than treating cancer as a single disease, the framework recognizes each tumor as a dynamic ecosystem composed of multiple interacting malignant cell states. Each cellular state is controlled by its own regulatory circuitry, possesses its own survival mechanisms, and exhibits its own therapeutic sensitivities.

The central challenge, therefore, is not simply identifying a mutation—it is identifying—and in this case, using AI to decode—every clinically relevant cancer cell state within an individual patient's tumor and determining the optimal therapeutic strategy for each.

DarwinHealth co-founder Califano has also recently published a review in the journal *Cell*, “Fifteen challenges for generative AI applications to cell biology” ([https://www.cell.com/cell/fulltext/S0092-8674\(26\)00802-0](https://www.cell.com/cell/fulltext/S0092-8674(26)00802-0)), further illuminating the role of AI for network-based predictions to guide cancer treatment.

Making the Invisible Visible

DarwinHealth's drug discovery platform leverages single-cell transcriptomics, AI, and regulatory network inference to infer master regulatory protein activity. The company's technology rigorously validates the functional reality and causality of these cellular states through multi-modal integration with ATAC-seq, lineage tracing, and CRISPR perturbations.

Unlike conventional gene-expression profiling—which merely catalogs transcript abundance—DarwinHealth's systems biology framework pinpoints the causal drivers maintaining malignant states and identifies the molecular checkpoints most likely to collapse them.

This approach transforms complex tumor landscapes into high-resolution functional maps, revealing previously invisible targets for precision oncology.

Pancreatic Cancer as the Prototype

The power of this approach is illustrated by the original work just published in *Nature Genetics*.

Using regulatory network analysis of single-cell transcriptomic data, the investigators identified six highly conserved malignant pancreatic cancer cell states organized into three developmental lineages. Importantly, these regulatory states proved remarkably reproducible across independent patient cohorts, pancreatic cancer cell lines, and patient-derived xenograft models, providing a robust mechanistic taxonomy of pancreatic cancer heterogeneity.

Rather than merely describing tumor diversity, the investigators identified the Master Regulator proteins responsible for maintaining each malignant state and experimentally demonstrated that these regulatory programs represent therapeutically actionable cellular dependencies.

These findings provide a mechanistic roadmap for developing rational combination therapies capable of simultaneously targeting multiple malignant populations within a single tumor.

Toward Rational Combination Therapy for Cancer

Drug resistance remains the leading cause of mortality in patients with advanced cancer. When one therapeutic agent successfully eliminates drug-sensitive cells, resistant populations frequently survive, expand, and ultimately repopulate the tumor.

Quantum Cancer Biology reframes this problem.

Instead of asking which single drug best treats a tumor, the framework asks:

Which combination of therapeutics is required to eliminate every biologically distinct malignant cell state that exists within that patient's cancer?

By computationally identifying these states and their regulatory dependencies, DarwinHealth seeks to enable the rational design of multi-agent therapeutic strategies that address the complete cellular architecture of resistant cancers, rather than only their dominant populations. This concept aligns with the company's broader perspective on treating tumors as complex "oncosystems."

Leadership Perspectives

"The future of precision oncology lies in understanding the regulatory logic that determines cellular identity—not merely cataloging mutations or measuring gene expression. By reconstructing the regulatory networks that control individual cancer cell states, we can identify the molecular mechanisms that sustain them and, ultimately, the therapeutic strategies capable of disrupting them."

— **Andrea Califano, Dr.**

Co-Founder, DarwinHealth; President, New York Biohub; Clyde and Helen Wu Professor of Chemical Systems Biology, Columbia University

"Single-cell transcriptomics provides unprecedented resolution of tumor heterogeneity, but understanding how those cellular states are established and maintained requires systems-level analysis. By identifying the Master Regulator proteins controlling each malignant state, we can move from describing tumor diversity to defining actionable therapeutic vulnerabilities."

— **Pasquale Laise, PhD**

Senior Director, Single-Cell Systems Pharmacology, DarwinHealth

"For decades, oncology has searched for better drugs to treat individual cancers. Quantum Cancer Biology begins with a different premise: that many advanced tumors are not one cancer, but many biologically distinct cancers coexisting within the same patient. Our mission is to decode those hidden cellular states and transform that knowledge into rational—almost invariably, combination—therapeutic strategies that target the full complement of regulatory network derangements."

— **Gideon Bosker, MD**
Chief Executive Officer and Co-Founder, DarwinHealth

A New Framework for Precision Oncology

DarwinHealth believes that Quantum Cancer Biology: A Cell-State Systems Biology Framework for Precision Oncology represents a foundational advance in cancer systems biology.

By integrating single-cell transcriptomics, regulatory network inference, inferential artificial intelligence, and systems pharmacology, the framework seeks to identify the smallest rational combination of therapeutic interventions capable of targeting the full spectrum of malignant cellular states within each patient's tumor.

Initially developed and validated in pancreatic and brain cancer, the framework is now being extended across additional highly resistant malignancies—including glioblastoma and other aggressive solid tumors—with the goal of accelerating the development of more effective precision combination therapies.

As oncology enters an era defined by cellular resolution rather than population averages, DarwinHealth believes Quantum Cancer Biology provides the conceptual and computational foundation for decoding cancer's hidden complexity—and translating that knowledge into more durable therapeutic outcomes.

About DarwinHealth

Founded by **Gideon Bosker and Andrea Califano** in 2016, DarwinHealth is a New York City-based precision oncology company pioneering systems biology and artificial intelligence technologies that decode regulatory mechanisms governing cancer. By integrating regulatory network biology, single-cell analysis, and computational pharmacology, DarwinHealth develops predictive technologies to identify patient-specific therapeutic vulnerabilities and accelerate the development of next-generation precision cancer therapies.