Systems biology recommended as a clinical approach to cancer

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Four researchers at the Virginia Bioinformatics Institute (VBI) at Virginia Tech and their colleagues at the Wake Forest University School of Medicine are advocating the use of systems biology as an innovative clinical approach to cancer. This approach could result in the development of improved diagnostic tools and treatment options, as well as potential new drug targets to help combat the many potentially fatal types of the disease.

In an upcoming paper* in *Biochimica et Biophysica Acta*, the international journal of biochemistry, biophysics and molecular biology, the team highlights the usefulness of a systems biology approach in developing a comprehensive view of cancer diseases, which will help researchers better understand the complex processes related to cancer progression, diagnosis, and treatment. Systems biology brings together mathematical modeling, simulations, and quantitative experiments, allowing researchers to use the data of one of the approaches to repeatedly define the framework of the other approaches. Biochemical networks are central to biological function, while computer models provide a particularly useful way to understand their workings. Biochemical models are the ideal means to design and predict the effect of interventions, such as cancer treatments.

"One of the goals of this paper is to show the potential benefits that can result from moving the use of systems biology techniques closer to the clinic," explained VBI Professor Reinhard Laubenbacher. "We believe this kind of shift is very possible. For example, mathematical models

could integrate patient characteristics to help researchers determine the features of dynamic processes linked to cancer progression, diagnosis, and treatment. Systems biology has an increasingly important role in cancer research and treatment, especially as mathematical modelers, biologists, and clinicians continue working together. Through these transdisciplinary efforts, the needs of the clinic can directly impact work in the laboratory."

According to the researchers, before the functional differences between a cancer cell and a normal cell can be understood, an assessment of the overall biochemical network, not just the individual molecular mechanisms involved, is needed. A more complete picture of the system's dynamic characteristics can help contribute to the development of improved diagnostics and techniques that can disrupt the progression of the disease. They discuss three case studies related to diagnostics, therapy, and drug development in detail to demonstrate how a systems-level view can provide important insights related to the disease. The examples, which involve cases of breast cancer, B-cell lymphomas, and colorectal cancer, demonstrate the various kinds of clinical issues that can arise, as well as the use of different mathematical methods that can be used in a systems biology approach.

According to Wake Forest University Professor of Medicine Steve Akman, "The systems biology approach provides an opportunity for major advancements in our understanding of carcinogenesis. Cancer biologists are just beginning to understand what mathematicians, engineers, and computer scientists have long known - that the behavior of dynamic systems are more than just the sum of the individual components. The VBI-Wake Forest collaborative group was established in response to the realization that the potential applications of systems biology to the cancer problem will be effected only through collaborations between cancer biologists, mathematicians, engineers, and computer scientists."

More information: Reinhard Laubenbacher, Valerie Hower, Abdul Jarrah, Suzy V. Torti, Vladimir Shulaev, Pedro Mendes, Frank M. Torti, and Steven Akman (2009) A Systems Biology View of Cancer. *Biochimica et Biophysica Acta*, June 6, 2009, Epub ahead of print, doi: 10.1016/j.bbcan.2009.06.001

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