



Individualized Systems Medicine – Customizing Cancer Treatment in Real Time

Lack of response to treatment and drug resistance are frustrating and ongoing challenges in cancer care. Scientists now know that variations in a patient's genes can be at the root of these problems. Today, progressive treatment facilities are harnessing advances in technology to hone in not only on what those differences are, but also on what therapies might work for individual patients by testing drugs out first on the patient's cancer cells in the lab.

numbers in the hundreds), the test plates are kept in an incubator that mimics constant body temperature for three days, after which the drugs' effects on cell health are examined. Some of the cells die, some alter in function, and some are not affected at all. FIMM scientists are specifically looking for the effects on the cancer cells.

How the patient's cells responded to the various treatment options is compared to information



Krister Wennerberg
FIMM-EMBL Group Leader

“Combining genomics with drug testing on patient cells in the lab has provided us clues to existing drugs that could be repositioned for certain types of cancer, as well as new drugs and drug combinations that may have potential,” says Krister Wennerberg, FIMM-EMBL Group Leader and Head of the High Throughput Biomedicine Unit at FIMM.



The Institute for Molecular Medicine Finland (FIMM) at the University of Helsinki, uses this approach to adjust cancer treatment for patients in real time. “FIMM is dedicated to exploring what we call individualized systems medicine,” says Professor Olli Kallioniemi, the institute's director.

First used by FIMM researchers as a way to tailor treatments for patients with drug-resistant acute myeloid leukemia (AML), the novel iterative approach begins with taking a sample from the patient, such as blood or bone marrow, and separating out the cells for laboratory experiments. DNA sequencing is then performed to identify mutations and drug sensitivity and resistance testing is used to identify either approved or experimental medicines that have an effect on the patient's cancer cells.

FIMM scientists use an automated system based on acoustic technology called the Echo[®] liquid handler, which allows them to rapidly test combinations of therapies in a cost-effective manner. After mixing the patient's cells with precise concentrations of the different drugs (FIMM's library of compounds

about the individual's genetic alterations and to other available research data. This information is then given to the doctor who is treating the patient. In optimal cases, it can be used to develop a new individualized treatment scheme. FIMM also stores the information anonymously to assist with its ongoing research programs.

In one recent research breakthrough, the FIMM team used their approach to study cancer cells from cells from patients with chronic myelogenous leukemia (CML) and acute lymphoblastic leukemia (ALL) who had developed resistance to currently available treatments. Their drug screening approach made it possible to study the response of these cancer patients' leukemia cells to a large panel of drugs simultaneously. The research team identified axitinib, a tyrosine kinase inhibitor currently approved to treat patients with a form of advanced kidney cancer, as a promising therapeutic candidate because it effectively eliminated drug-resistant leukemia cells.¹

¹ Pemovska, T. *et al.* Axitinib effectively inhibits BCR-ABL1(-T315I) with a distinct binding conformation. *Nature* 2015, 519:102-105

“Our hope is that this personalized cancer care strategy will be used not only to provide real-time improvements in patient treatment, but also to facilitate product development in the industry by predicting the likelihood of success in clinical trials.”

Prof. Olli Kallioniemi

Mark Fischer-Colbrie, CEO of Labcyte, maker of the Echo liquid handlers, commented: “FIMM has demonstrated an effective model for personalized cancer treatment, and it is exciting to see other cancer centers following their innovative approach in this new era of precision medicine.”