

Revolutionizing the way cancer is diagnosed

VolitionRx, a life sciences company, has developed an array of simple blood tests to improve the detection of a wide range of cancers at early stages, with the goal of dramatically improving survival rates in patients.

Cancer is a leading cause of mortality worldwide, accounting for approximately 13% of deaths each year. Despite advances in therapeutics, surgery remains the most reliable way to cure the disease. Unfortunately, many patients are diagnosed too late for this option, at a point when their cancer has already spread to other parts of the body. More accurate diagnostic tools are sorely needed to detect cancer at early stages, thereby improving outcomes for patients.

To address this need, VolitionRx has developed an array of non-invasive, accurate and cost-effective blood-based biomarker assays that can be combined in panels to diagnose a wide range of cancers. The company's revolutionary and patent-protected Nucleosomics platform measures and identifies changes to nucleosomes, units of the chromosome consisting of short strands of DNA wrapped around a core of eight histone proteins.

The quantity and characteristics of nucleosomes differ between cancer cells and normal cells, as well as between different types of cancer cells, even at early disease stages. VolitionRx's NuQ biomarker assays capture the nucleosomes and generate a colored signal if specific epigenetic alterations are present (Fig. 1).

A key advantage of Nucleosomics is that it could be easily incorporated in routine blood testing as part of a general health screen carried out by primary care physicians. The tests could be analyzed automatically with standard equipment at hospital laboratories. Moreover, the simple tests could be implemented in developing countries where high-tech imaging equipment is less accessible.

"We think of it as a high-tech application of a low-tech solution," said Mark Eccleston, VolitionRx's business development director. "Our goal is to make the tests as common and easy to use, for both patients and doctors, as existing diabetic and cholesterol blood tests."

Innovative assays

Nucleosomes inside diseased cells are characterized by unique epigenetic signatures—factors that affect gene activity without altering the DNA sequence. For example, cancer cells contain nucleosomes with unusual patterns of histone modifications, histone variants, DNA modifications and protein adducts. In addition, cancer cells turn over more frequently than normal cells, releasing a greater quantity of nucleosomes into the blood as they die.

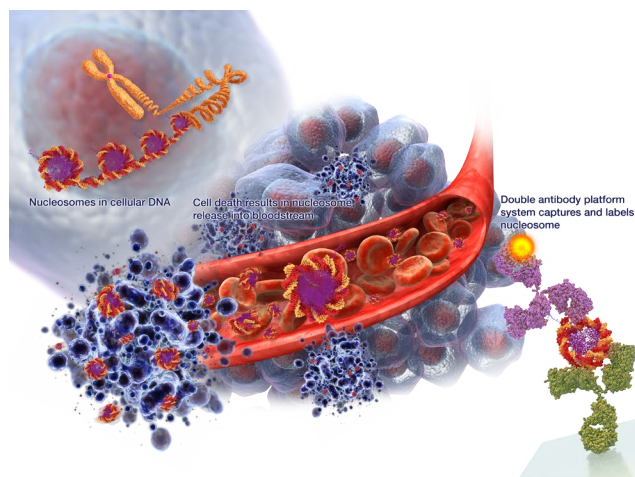


Figure 1: Diagnosing cancer by epigenetic profiling of cell free nucleosomes.

Using only a drop of blood, VolitionRx's NuQ suite of biomarker assays can quantify and identify disease-associated nucleosomes with modified histones, nucleotides, specific histone variants and protein adducts. Four or five assays can be combined to form a panel test for detecting specific diseases.

VolitionRx has developed a panel test for colorectal cancer, and it is developing tests for lung, pancreatic and aggressive prostate cancers. The company is now proving the efficacy of its NuQ-based tests in a number of clinical trials being carried out worldwide. Results from pilot studies in colorectal, pancreatic and lung cancer show greater than 90% sensitivity, or accuracy, in detecting patients with cancer at 90% specificity (i.e., 90% of healthy patients were correctly identified as such). The successful development of accurate diagnostic tests for a wide range of cancer types could have a major impact on public health.

Catching colorectal cancer

Tackling colorectal cancer and reducing the number of deaths requires early diagnosis. Although screening can reduce the number of deaths from colorectal cancer by up to 16%¹, higher compliance and improved test performance, particularly for detecting precancerous polyps—the precursor to colorectal cancer—could significantly improve survival rates.

Screening efforts in the UK currently rely on unappealing fecal tests that have achieved compliance in only 57% of the intended demographic. Moreover, the high percentage of false positives in fecal tests has resulted in long wait times for expensive follow-up colonoscopies, increasing anxiety among patients and putting a strain on the health care system.

To address this problem, VolitionRx has developed an accurate, patient-friendly NuQ-based colorectal cancer blood test, which is currently undergoing large clinical trials, including a 14,000-subject screening trial in Denmark. This test, which is at the most advanced stage of development, has demonstrated greater than 85% sensitivity for early-stage cancer, picks up about three-quarters of precursor polyps, and detects early- and late-stage disease with similar accuracy.

"If precancerous polyps can be detected in a screening program, they can be removed with relative ease, thereby removing that risk of developing colorectal cancer and reducing the actual incidence of the disease," Eccleston said. "By improving detection rates at early stages, our NuQ-based colorectal cancer blood test could dramatically improve patient outcomes and save the health care system a substantial amount of money."

The company expects to launch its colorectal cancer blood test in Europe in the second half of 2016, and then bring it to market in the United States and worldwide. VolitionRx envisions that its colorectal cancer blood test could initially be used in symptomatic patients and in tandem with currently available fecal tests to improve the accuracy of results and reduce the number of unnecessary colonoscopies. Ultimately, the blood test could replace stool-based tests and possibly colonoscopies in high-risk individuals who have not complied with screening efforts.

"The introduction of the blood test for colorectal cancer, and ultimately other diseases, would be the first step towards screening programs with massive public health benefit," Eccleston said. "By increasing screening compliance and radically improving diagnostic accuracy, our revolutionary technology will lead to earlier and more accurate detection of disease at its most treatable stage, allowing more effective intervention and better patient outcomes."

1. Hewitson, P. et al. *Am. J. Gastroenterol.* **103**, 1541–1549 (2008).

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