# Early lung cancer detection

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Researchers from Northwestern University and NorthShore University HealthSystem (NorthShore) have developed a method to detect early signs of lung cancer by examining cheek cells in humans using pioneering biophotonics technology.

"By examining the lining of the cheek with this optical technology, we have the potential to prescreen patients at high risk for lung cancer, such as those who smoke, and identify the individuals who would likely benefit from more invasive and expensive tests versus those who don't need additional tests," said Hemant K. Roy, M.D., director of gastroenterology research at NorthShore.

The optical technique is called partial wave spectroscopic (PWS) microscopy and was developed by Vadim Backman, professor of biomedical engineering at Northwestern's McCormick School of Engineering and Applied Science. Backman and Roy earlier used PWS to assess the risk of colon and pancreatic cancers, also with promising results.

The lung cancer findings are published online today (Oct. 5) by the journal *Cancer Research*. The paper will appear in print in the Oct. 15 issue.

Lung cancer is the leading cause of cancer deaths in the United States. Survival rates are high with surgical resection (removal of the tumor) but only if detected at an early stage. Currently there are no recommended tests for large population screening to detect lung cancer early. The

disease is already advanced by the time most lung cancer patients develop symptoms. The five-year survival rate for lung cancer patients is only 15 percent.

PWS can detect cell features as small as 20 nanometers, uncovering differences in cells that appear normal using standard microscopy techniques. The PWS-based test makes use of the "field effect," a biological phenomenon in which cells located some distance from the malignant or pre-malignant tumor undergo molecular and other changes.

"Despite the fact that these cells appear to be normal using standard microscopy, which images micron-scale cell architecture, there are actually profound changes in the nanoscale architecture of the cell," Backman said. "PWS measures the disorder strength of the nanoscale organization of the cell, which we have determined to be one of the earliest signs of carcinogenesis and a strong marker for the presence of cancer in the organ."

"PWS is a paradigm shift, in that we don't need to examine the tumor itself to determine the presence of cancer," added Hariharan Subramanian, a research associate in Backman's lab who played a central role in the development of the technology.

After testing the technology in a small-scale trial, Roy and Backman focused the study on smokers, since smoking is the major risk factor related to 90 percent of lung cancer patients. "The basic idea is that smoking not only affects the lungs but the entire airway tract," Roy said.

The study was comprised of 135 participants including 63 smokers with lung cancer and control groups of 37 smokers with chronic obstructive pulmonary disease (COPD), 13 smokers without COPD and 22 non-smokers. The research was not confounded by the participants' demographic factors such as amount of smoking, age or gender.

Importantly, the test was equally sensitive to cancers of all stages, including early curable cancers.

The researchers swabbed the inside of patients' mouths, and then the cheek cells were applied to a slide, fixed in ethanol and optically scanned using PWS to measure the disorder strength of cell nanoarchitecture. Results were markedly elevated (greater than 50 percent) in patients with lung cancer compared to cancer-free smokers.

A further assessment of the performance characteristics of the "disorder strength" (as a biomarker) showed greater than 80 percent accuracy in discriminating cancer patients from individuals in the three control groups.

"The results are similar to other successful cancer screening techniques, such as the pap smear," Backman said. "Our goal is to develop a technique that can improve the detection of other cancers in order to provide early treatments, much as the pap smear has drastically improved survival rates for cervical cancer."

Additional large-scale validation trials are necessary for PWS. If it continues to prove effective in clinical trials at detecting cancer early, Backman and Roy believe PWS has the potential to be used as a prescreening method, identifying patients at highest risk who are likely to benefit from more comprehensive testing such as bronchoscopy or low-dose CT scans.

**More information:** The paper is titled "Optical Detection of Buccal Epithelial Nanoarchitectural Alterations in Patients Harboring Lung Cancer: Implications for Screening."