Biologistics of lung cancer screening and management: compact table top instrumentation and efficient logistics

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A. Research justification:

Cancer is an epidemic, at present 1 in 4 people has cancer, and this has been estimated to increase to 1 in 2 people in immediate near future. Early cancer can be treatable, therefore, detecting cancer in early stages is one of the best strategy in fighting the war against the cancer epidemic. However, to accomplish it there are immense challenges for the modern medical science and technology. In context to that, biologistics coupled with technology of early cancer detection and management is an important research topic towards saving lives from cancer epidemics. In this regard, significant interests have emerged out to understand the biological structures and processes occurring at the nanoscale, in particular, a strong correlation between the alteration in intracellular nano-architecture of the cell with the early-stages of progressive carcinogenesis due to the rearrangements of basic cell materials DNA, RNA, lipids and proteins.

With the last year FedEx's Biologistic partial support to the project, we have developed an optical experimental technique, based on mesoscopic light transport physics principles, namely the enhanced partial wave spectroscopy (EPWS), which is capable of efficiently detecting nanoscale alterations in a cell in early carcinogenesis. The preliminary results with the EPWS experiments from different types of human cancer cells: lung, colon, pancreas, esophagus, and ovary showed that we can detect the progression of carcinogenesis ultra-early by this fast optical imaging and quantifying the intracellular nanoscale alteration, i.e., nanoscale structural disorder in cells. Importantly, using the "field effect" properties of carcinogenesis, we can detect cancer from an easily accessible surrogate, far from the actual cancer site but on the same epithelial track. For example, using the field effect, we were able to detect lung cancer from buccal cells, colon cancer from rectal cells, and ovarian cancer from cervical cells. Our developed instrument at the Biophotonics Lab, Department of Physics and Materials Science, University of Memphis is presently a research level standard optical table top instrument. The sensitivity of our developed instrument is also very high for cellular level cancer detection. Scaling down of this EPWS instrument have already been started to make it as a portable system. This initial FedEx logistic grant has helped us in partial support for instrumentation and in generating lots of data and to apply for Federal (NIH and NSF)grants. Following are the papers and preprints published where the FedEx support were acknowledged. [1], [2].

In this second phase of the requested support for the project, we will concentrate on scaling down the EPWS instrument to a portable table top size and biologistic of early lung cancer through buccal/cheek cells using our instruments. In particular, biologistics involves buccal/cheek cells collection from patient, fixation and preservation, transportation of the fixed cells via temperature controlled environment, screening and management of lung cancer. Lung cancer has one of the highest mortality rate in the USA. Therefore, undertaking and continuation of this biologistic pilot research project for lung cancer screening and management is important and justified. Our research objectives are the following:

Objective 1: Scaling down the size of enhanced partial wave spectroscopy (EPWS) instrumentation to a compact table top size for fast, efficient screening of early lung cancer: We have already designed a lab optical table standard enhanced EPWS instrument which has been working well. We are in the process of scaling down this instrument size to a portable, table top size for most efficient practical applications.

Objective 2: Biologistics of sample collection, detection and screening of lung cancer: Efficient detection of lung cancer from buccal/cheek cells using the table top, highly sensitivity EPWS instrument. Other sub-aim of this project will be biologistics. In particular, buccal cell collections, fixation/preservation in solution, effective transportation of the buccal cells and lastly, to make an optimal biologistics for the process of efficient lung cancer detection.