Supervisor & Project Information Form

Please complete and return via email ONLY to gdip.hres@utoronto.ca by *Monday September 30, 2019*

Supervisor Information

MUST have unrestricted SGS appointment (appointment to supervise graduate students)

Name: Geoffrey Liu	**Email: geoffrey.liu@uhn.ca**
SGS Department: Departments of: Epidemiology (Dalla Lana School of Public Health), Medicine, Medical Biophysics, and Institute of Medical Science	**Field of Research:** Pharmacoepidemiology; clinical and molecular oncology
Research Institution affiliation (if applicable): Princess Margaret Cancer Centre (University Health Network)	**Location of Work:** MaRS, 101 College St, Toronto, ON
Student contact time (number of hours per week YOU are available to the student for any concerns or to review progress: 1h/wk in-person meeting + available by email as needed; student will have additional support from epidemiologist and scientific associate in the Liu Lab	

TITLE: Assessing point-of-care eNose testing to improve early detection of lung cancer and monitor disease progression during treatment.

DESCRIPTION (MAX 500 WORDS):

Background: Current lung cancer (LC)-screening efforts involve scanning high-risk individuals (i.e. heavy smokers) with low dose computed tomography (LDCT). While beneficial, these efforts do involve finite risks from ionizing radiation exposure and tend to have high false positive results, leading to unnecessary, invasive, and expensive follow-up procedures. Further screening methods for early detection of LC are warranted.

Volatile organic compounds (VOCs) from the blood and infectious microbes/pathogens within the lung itself are readily released in exhaled breath. Despite this potential plethora of diagnostic information, breath analysis is currently only routinely used for blood-alcohol level detection. Major advances in point-of-care testing and use of artificial intelligence can revolutionize the applications of this technology.

Recently developed electronic noses or "eNoses" can measure patterns of VOCs released in exhaled breath in real-time. The eNose device, SpiroNose®, has been shown to differentiate the breath from individuals with LC, asthma, and COPD with an impressive AUC of 0.88 in a small pilot study, but more controlled studies are warranted. This eNose technology is minimally invasive, inexpensive, and carries much lower risks than repeat LDCT scans and biopsies for early detection of LC. As the eNose measures biological output, screening with this technology first could decrease the number of benign nodules detected by subsequent LDCT, thus decreasing the number of unnecessary, expensive, and invasive follow-up procedures. The same device could theoretically be used to monitor LC patients' responses to treatment and disease progression.

Aim 1: Determine the performance characteristics of an eNose to differentiate between patients already undergoing LDCT screening for LC (but do not have LC), and early stage LC patients that are heavy smokers.

Aim 2: Determine the ability of an eNose to differentiate benign and malignant nodules discovered during LDCT screening.

Exploratory Aim 3: Explore whether changes in breathomic patterns can be used for monitoring timing of disease progression.

Methods: A prospective, observational, mixed-design study will be utilized. Cases will be early stage lung cancer patients who smoke and are being seen in the thoracic surgery clinics at University Health Network. Controls will consist of smokers in the LC-screening program and have not been diagnosed with LC. LC patients about to start immunotherapy at the Princess Margaret Cancer Centre will be consented for Exploratory Aim 3. Prospectively, individuals coming in for both LC screening or LC clinic will be consented to be analyzed by eNose. A baseline questionnaire

of clinico-demographic information will be administered, followed by the eNose, as per manufacturer's instructions. Data will be analyzed against clinical information. VOC signatures that can detect LC early in healthy smokers will be investigated (Aim 1). VOC signatures of individuals with benign and malignant nodules will also be compared (Aim 2). The LC-specific signature from Aim 1 will be tested on patients' breath tests at each return visit and compared to clinical LC restaging to determine ability to predict disease progression. Development of more appropriate disease-monitoring classifiers will also be explored (Exploratory Aim 3).

If human subjects are involved, have the appropriate Research Ethics Board approvals been obtained?

☒Yes   ☐No   ☐Application Submitted (Date: _____)

Do you expect this work will be published within the 20 months?

☒Yes   ☐No   ☐Uncertain / Other

_Student Roles & Responsibilities (__please be as specific as possible_**_)_**

Please indicate who will serve as the student's direct report for daily oversight (PI, PhD student, technician, etc...)

The GDipHR student will be responsible for overseeing data collection (currently ongoing) and analyzing the results of eNose tests in populations described above. The student will also be responsible for conducting a feasibility assessment of in-clinic implementation of the eNose as a regular screening/monitoring tool for clinical use. For analysis, the student will be working with a member of the Princess Margaret biostatistics team to design, conduct, and interpret appropriate statistical analyses for publication of results.

Dr. Erin Stewart (Scientific Associate) and Cathi Brown (Scientific Associate) will provide daily supervision in the Liu Lab.