



Chemistry Department
2020 Summer Research Program

Research Group of Mac Gilliland

Research in the Gilliland lab is centered on using mass spectrometry to solve clinical and biological problems. The two current areas of research are: (1) Using paper spray mass spectrometry for the detection and quantification of antiretrovirals used to treat HIV; (2) Development of an assay to detect 3-bromotyrosine as a diagnostic biomarker for children with eosinophilic esophagitis.

(1) Antiretroviral therapy (ARV) potently suppresses HIV replication, and daily adherence to ARV medications is critical for effective HIV treatment. Adherence is traditionally monitored from blood or plasma samples obtained via venipuncture, but dried blood spots (DBS) have emerged as an alternative sampling method due to their ease of sample collection, low sample volume (<20 μ L), and low cost. In addition, analytes in dried blood spots remain stable over long periods of time at ambient temperature, and safety for DBS is improved over liquid blood samples because many pathogens are deactivated when blood is dried on paper.¹ Liquid chromatography (LC) coupled with tandem mass spectrometry (MS/MS) is often the tool of choice for quantification of ARVs in DBS. LC-MS/MS is a sensitive and selective technique but often requires significant sample preparation. Paper spray mass spectrometry eliminates the need for sample preparation and enables extraction and ionization directly from DBS, and paper spray from DBS has been demonstrated for other drugs in DBS but has yet to be applied to ARVs.^{2,3} The first goal of the Gilliland lab will be to quantify ARVs in DBS using paper spray MS.

(2) Eosinophilic esophagitis (EoE) is a chronic allergic disease characterized by high infiltration of eosinophils (a type of white blood cells) into the epithelium of the esophagus and is estimated to affect 56 out of every 100,000 children in the United States.⁴⁻⁷ Symptoms of EoE include regurgitation, vomiting, and difficulty swallowing, commonly progressing to fibrotic changes in the esophagus including narrowing of the esophagus. These symptoms can be difficult to manage, especially in a pediatric population. Endoscopy with biopsy is currently the only way to diagnose EoE, but this procedure is invasive and expensive. A non-invasive alternative to this procedure would be greatly beneficial. Urinary levels of 3-bromotyrosine (3-BT) have been shown to correlate with disease activity in patients with EoE.⁸ LC-MS/MS is an ideal tool for this type of analysis. Therefore, the second goal of the Gilliland lab will be to develop a sample preparation protocol and LC-MS/MS method to monitor 3-BT in urine. Once developed, the assay will be used to study the effectiveness of different EoE treatments in a pediatric population.

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