

Developing Global Access to Mass Spectrometry through Research Capacity Building Programs

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Introduction

For many communicable and non-communicable diseases, the development of therapeutics in low and middle-income countries (LMICs) is negligible due to lack of bioanalytical instrumentation. Our program has experience with research capacity building to conduct mentored research in clinical pharmacology and therapeutics in LMICs. Our HIV Research Training Program at the University of Zimbabwe seeks to utilize mass spectrometry-based assays to develop nanomedicine for HIV and tuberculosis and quantitate antiretrovirals in dried blood spots. Our Global Infectious Diseases Research Training Program with The University of the West Indies includes projects that seek new antivirals from local plants. Lastly, Emerging Global Leader Program with the University of Ibadan in Nigeria conducting clinical pharmacology research protocols to investigate interactions between antiretrovirals and antidepressants.

Methods

Each of the research training programs includes an experiential component where trainees visit our Mass Spectrometry Core and our Translational Pharmacology Laboratory Core to gain hands-on experience with sample extraction and quantification using our instrumentation. Trainees' visits are supported through grants from the Fogarty International Center at the National Institutes of Health. Ongoing projects include assay development for dolutegravir, efavirenz, fluoxetine, and *Myristica fragrans* essential oil extracts. The second phase of our capacity building program is to establish mass spectrometry facilities in these LMICs and continue technology transfer approaches to build in-country capacity. Trainees gain experience using liquid chromatography tandem mass spectrometry (LC-MS/MS) and/or gas chromatography-mass spectrometry (GC-MS) through the programs.

Preliminary Data

Each of the research training grants requires competitive application submissions to secure funding for the trainees and limited support for pilot research projects. Having been awarded 5 years of funding in each of these project areas we now seek academic-business partnerships that will lead to LMIC-based instrumentation cores. Initial success was achieved with instrument donation of a refurbished mass spectrometer. However, the pandemic has impacted the rate of globalization from an industry perspective for expanding access to this technology. Alternative funding sources are needed that allow grants to include funding requests for mass spectrometers as part of an overall attempt to create the needed resources for drug development, nurturing new pharmaceutical industry development and therapeutics research in LMICs. Several examples of pilot projects from the trainees will be discussed. For example, in Nigeria, a high prevalence of depression among people living with HIV has led to a pilot project to examine interactions between anti-retroviral drugs and the antidepressant fluoxetine using LC-MS/MS. Building upon a previous report between our laboratory and one at the University of Zimbabwe detailing an HPLC method for determination of nevirapine in plasma, current efforts are focused on developing an LC-MS/MS assay for levels of another anti-retroviral compound, dolutegravir. At Midlands State University in Zimbabwe, research on the microbiomes of infants treated with prophylactic ARV therapy because they are breast-feeding from mothers living with HIV has been conducted; an LC-MS/MS method is being developed to correlate ARV levels in stools with microbiome composition. In Jamaica, research into the essential oils of *Myristica fragans* revealed several dozen unique constituents, including several examples of isomeric compounds, using GC-MS on an Orbitrap MS.

Novel Aspect

Building capacity through training of pre-doctoral and post-doctoral researchers providing a globalization strategy for developing mass spectrometry cores in LMICs.

Conflict of Interest Disclosure

The authors declare no competing financial interest.