



香港大學  
THE UNIVERSITY OF HONG KONG

## Laidlaw Scholars Programme 2021-22

### Research Proposal

Guidelines on how to prepare a research proposal:

- Identify a project of your choice and discuss the topic with your academic supervisor at HKU.
- Prepare a research proposal including the following details:

1. Title of research project:

A Step Towards Smart Innovation: User-Driven Development of Point-of-Care Devices

2. Research question:

Point-of-care (POC) allows clinicians/surgeons to achieve real-time diagnostic results at the patient site accurately. Such devices have been developed for over two decades, but the commercialization of these devices has not been entirely successful, primarily due to the technology-driven approach used by scientists. Hence, it is imperative to collect knowledge about potential technology users right before the development of instruments.

3. Summary of the work to be undertaken by the applicant (e.g., background information, location, history, context, limitation, methodology, and timeline)

Microfluidics is a technique to encapsulate reagents/samples and perform analyses in a faster and inexpensive way, thus, having a potential for the development of handheld and portable microsystems directly used for POC diagnostics. Current conventional technologies provide time consuming, costly, labor intensive and central lab-based solutions, limiting their applications. Microfluidics has been developed for decades and the technology has emerged as a powerful tool for POC diagnostics of providing, simple, robust, cost-effective, and portable diagnostics. Various microfluidics devices have been developed to achieve this goal. They present excellent data quality and substantial parameter control allowing process automation while preserving performance. These devices have extensive benefits ranging from faster reaction time, to enhanced temperature control, portability, easier automation and parallelization, and cost-effectiveness.

Miniaturization and integration of different tools has been attempted to produce handheld or standalone devices. POCs have many advantages over conventional clinical testing methods. Use of POCs can allow for the rapid, and accurate detection and testing of pathogens and diseases at test sites without requiring the need for going to hospitals for testing and diagnosis. POCs ensure that the samples are tested immediately and eliminate the time elapsed otherwise to take the sample to a laboratory for traditional testing. This can allow for rapid interventions which is essential for certain diseases. Rapid detection, and immediate treatment can help intervene the build-up of a disease in its preliminary stages and have both health, and financial benefits to the patient. The successes of POCs have been registered in research outcomes; however, the potentials of microfluidics technology have not been fully achieved in clinical settings.

Microfluidics has not gained confidence in clinical environment and has not made a breakthrough in the commercial industry worldwide. This project is important in its nature to identify the shortcomings and help find out the reasons for non-adeptness. Product development is a lengthy and expensive process and assessing the benefits of the future product or market is critical to supporting a continuation of a

particular program. Several technical challenges may appear during development that require trade off decisions which can minimize the original predicted benefits. It is believed that one of the preliminary barriers to commercialization of POC products has been the lack of understanding of user needs in a way that can be used to inform product-development decision-making. Previous research, for example, has shown that POC HIV viral load testing will meet the needs of 7-36% of the global market share. This wide range demonstrates the level of uncertainty around product investment and adoption, which could arise from lack of presentation of data about clinical accuracy, affordability, and potential market for the POC technology.

Country-level decision-makers will determine whether to adopt POC technologies, and which tests to introduce within the local health system which will depend largely on the projected benefits and costs of production. A well-functioning laboratory network and integration with clinical services are presumed to be major requirements for any successful POC testing program. This project will provide a chance to speak to researchers, key opinion leaders, and clinicians via personal/virtual meetings to collect information about current practices, openness towards new technology, and features expected in future POC devices. Besides collecting information about the significance of above aspects towards commercialization of POC technology, the project will focus on identifying the key barriers holding back the mass-implementation of this ground-breaking technology. This project will shape the microfluidic-based POC devices developed at HKU, and the data collected will be highly beneficial to the POC diagnostics community.

The project will be initiated at HKU and a list of potential users for Microfluidics devices will be prepared along with the understanding of the technology. The format of interaction will be decided based on pandemic situation and availability of target community. The lists will be divided into face-to-face meeting, emails, calls, hospital visits and virtual interaction means. The project aims to interact with, among many others, market share holders of biomedical technology to gain knowledge towards the type of products they invest in, the versatility they look for in investable products, and the risk limit they are willing to go up to. Further interaction will be done with the broader user community to get an idea of the price range, benefits, and features that can result in better commercialization of products and more importantly, assess the type of medical tests whose POC testing kits will be well-received. A detailed analysis will be carried out on the type of medical tests which hospitals and diagnostic centers carry out with increased frequency. This will aid in comparing those tests with their POC alternatives and used to improve the accuracy, effectiveness, and speed-of-detection of the POC alternatives, while meeting the user price range and the market/share-holder's investment criteria. The project can use both quantitative and qualitative data collection methods to obtain a better idea of the approach to follow. Quantitative data collection method can be used to conduct the market research, as well as testing existing ideas and predictions and learning about the users' medical test demands while also measuring general trends. The data will be mathematical and will have a high level of standardization. Qualitative data collection methods will be used to find new ideas and detecting problems. This approach can be used while interviewing the researchers, key opinion leaders and more. This will allow for detailed breakdowns and analysis of their opinions and can be used to better construct an optimal method for commercialization of POC technology and do get a broader view of features expected in POC devices. A diagnostic analysis can be done to justify the trends and observations of sales related data with marketing research and sales data analysis being carried out to assess the market conditions, and to assume the product's future performance and identify weaknesses.

The timeline for the research project is outlined below:

Week 1: Technology details provided by supervisor and research group.

Week 2: Drafting of list of personal to be contacted via each format.

Week 3-5: Weekly update on the findings of the discussions/meeting.

Week 6: Analysis of the findings and presentation of the details to the research group. Analysis of potential impact on the development of microfluidic based technologies in the group. Future challenges and directions.