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The Development of Individualized Anemia Treatments Using Point of Care Diagnostics to Distinguish Anemia Caused by Infection or Chronic Inflammation

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Dr. Richard Watt, Department of Chemistry & Biochemistry

Evaluation of Academic Objectives.

Background: Anemia that accompanies inflammation is associated with negative outcomes for patients. Early intervention to treat anemia is an important step in improving the quality of life for anemic patients. Our lab proposed to develop simple diagnostic tests using a Lateral Flow Immunoassays (LFIs) to measure the presence of a hormone called hepcidin because hepcidin is the master regulator of iron homeostasis in the body and elevated hepcidin levels lead to anemia.

The overall goal of completing a functioning LFI for hepcidin has not yet been finished, however in the process of working towards this goal several very important developments have been achieved and are listed below:

- The development, provisional patent and licensing of an antibody pen.
- The development and provisional patent for a new LFI platform called the simple, empowering Lateral Flow Immunoassay or seLFI.
- The development and provisional patent for scanning LFI strips using a portable X-ray Fluorescence scanner.
- We have established a working relationship with DCN Diagnostics and standing job offers have been given to each of my students upon graduation.
- We have initiated collaboration with a company called Moyo Medical that is preparing LFIs for mothers in Africa to detect preeclampsia. We are hoping the seLFI will be a less expensive platform that will lower costs. Moyo Medical works with humanitarian donors and we hope to be able to make connections for future funding opportunities.

Student Participation and Academic Deliverables.

Undergraduate Student Participation: Two remarkable undergraduate students have participated on this project, Annie Armitstead and Lara Grether. Both students have attended the Advanced Lateral Flow Conference in San Diego in 2017 and 2018 and both presented posters in 2018. Both students presented talks at the 2018 CPMS Undergraduate Research Conference. Annie and Lara are inventors on the provisional patents for the antibody pen and the seLFI listed above. Both students will be authors on a paper in preparation describing the seLFI and antibody pen.

Graduate Student Participation: Naomi Flindt developed the method for using the X-ray Fluorescence scanner to read LFIs. She attended and presented a 2 poster at the Advanced Lateral Flow Conference in

San Diego in 2018. She is an inventor on the provisional patent for this discovery and will be an author on the paper in preparation describing this innovation.

Description of the Results of the Project:

In order to develop a hepcidin LFI, we started by reproducing a pregnancy test as a proof of concept that our method would work. We wanted to simplify and lower the cost of the normal LFI platform to work on printer paper. This involved developing a method to aldehyde functionalize paper so antibodies would stick. In the process we found this method worked very well and further simplified many other components of the LFI. This is what led us to develop the seLFI. In order to apply antibodies to the paper (normal LFIs use stripers that cost about \$15,000.00) we developed an antibody pen that works very efficiently. When this innovation was presented at the Advanced Lateral Flow Conference in 2018, the chief business development officer of DCN Diagnostics approached us about licensing the pen for their LFI starter kits. We are in the process of completing the assignment of the license to DCN. We are also discussing how the seLFI might be turned into a starter kit platform for others developing LFIs.

We are still in the process of developing the hepcidin LFI but have pursued some of these other development opportunities as we progress towards completing a hepcidin LFI.

Evaluation of the Mentoring Environment.

Working on this project and with these three students has been the most rewarding aspect of my research career here at BYU to this point. This was a new project in my lab and has blossomed beyond my best expectations. The students have learned a lot in the lab, had amazing experiences at the conferences, made valuable contacts with DCN and Moyo Medical and developed confidence in their academic training that they can compete in any future job environment.

Description of how the budget was spent:

All undergraduate students that participated in this project independently wrote and were awarded Undergraduate Research Awards from the Department of Chemistry and Biochemistry to support their salaries. This freed up money originally budgeted for salaries to be used to purchase supplies and support travel to the Advanced Lateral Flow Conference in 2017 and 2018. Antibodies are very expensive and so are some of the components (paper and filters) for assembling the LFIs. The MEG funds supported the supplies and antibodies and other aspects of laboratory research.

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