Smartphone Quantitation of Stress and Neuroendocrine Hormones

Theme: Neuroscience & Mental Health
Reference: MRC19NMHBa Reis

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The measurement of stress and endocrine hormones is currently constrained by access to centralised analytical equipment. Diagnostics industry has failed to date to deliver diagnostics tests for NMH, with exception of rapid TSH tests that lack sensitivity and quantitation. We hypothesise that a simple rapid optical test for measuring hormone levels with the use of a smartphone would speed up diagnosis of endocrine disorders; reduce cost of intervention for patients undergoing therapeutics; enable health psychologists to make more rational decisions; enable neuroendocrine researchers to study more effectively the links of neuroendocrine system with chronic diseases; and provide clinically important information in areas of the world with poor laboratory services. To validate this, we will carry out an interdisciplinary project focused on 3 main activities.

Firstly, we will synthesise and screen new physical, biosensing reporter molecules generating an optical signal upon displacement of hormone from the binding cavity in the receptor (antibody or aptamer), enabling one-step quantitation of hormones. We will prioritise 'switch-on' fluorescence reporters that can be easily incorporated in a disposable device and provide optimum signal-to-noise ratio; however a 'switch-off' reporter can be incorporated into non-invasive devices (e.g. a patch for continuous monitoring of hormone from sweat). The targeted hormones will be based on a SWOT analysis, NHS statistics data and expertise of supervisory team, but the initial focus will be a displacement assay for cortisol quantitation. We will characterise the probes using molecular and spectrophotometer imaging techniques and in-flow NMR.

Secondly, we will integrate the new displacement assays into miniaturised devices (3D printed, photolitography and melt-extrusion). The design of the device will be driven by the targeted sample to be measured and sensitivity of the test, as hormones are present at very distinct concentrations in different human body fluids. For example, the "Lab-on-a-stick" approach pioneered by Reis et al (Lab on a Chip, 2016) can be quickly adapted to one-step quantitation of hormones from saliva, urine and a finger-prick, but probably not suited to quantitation from sweat – for which a microfluidic device embedded within a 'skin patch' would be more appropriate. We will access state-of-the-art nano- and micro-fabrication facility, surface characterisation and microscopy and imaging facilities. Manufacturing and performance of the devices will be facilitated with CAD, Computational Fluid Dynamics (CFD) simulation tools and optical imaging and fluorescence imaging, including confocal microscopy.

Thirdly, we aim at testing the methodology in endocrinology and health psychology, and benchmark it against current analytical methodology (ELISA and MS). We aim to test the methodology with healthy patient samples and carry out testing in a small group of volunteers.

IMPORTANT: In order to apply for this project, you should apply using the DTP's online application form: https://cardiff.onlinesurveys.ac.uk/gw4-biomed-mrc-dtp-student-2019

More information on the application process may be found here:
http://www.gw4biomed.ac.uk/doctoral-students/

APPLICATIONS OPEN ON 24 SEPTEMBER AND CLOSE ON 23 NOVEMBER 2018.

You do NOT need to apply to the University of Bath at this stage – only those applicants who are successful in obtaining an offer of funding form the DTP will be required to submit an application to study at Bath.