Discoveries City's biomedical engineers are at the forefront of new developments in healthcare, with sensors that transform life opportunities. Elsewhere, academic staff are changing how we think about smell and touch, deepening our understanding of a complex continent and challenging the fundamentals of criminal procedure.

Engineers at the forefront of healthcare

From left, Dr Justin Phillips, Senior Lecturer in Biomedical Engineering and Professor Panicos Kyriacou, Professor of Biomedical Engineering

BIOMEDICAL ENGINEERING

City's Biomedical Engineering Research Group (BERG), established in 2004, is leading the way in a discipline that is transforming developments in medicine and healthcare delivery. Under the leadership of Professor Panicos Kyriacou, the Group has as its mission the extension of the frontiers of science and technology by developing new tools and techniques to solve challenging medical problems.

More specifically, BERG's focus is on the use of engineering principles to advance understanding of how biological or physiological systems operate. The ultimate goals? The development of effective medical-based technologies for application across societal needs including breakthroughs in the diagnosis, treatment and prevention of disease and the design of novel devices, sensors and processes.

Reflecting BERG's twin emphases on advances in basic bioscience and applied biomedical engineering, Professor Kyriacou says the Group's work can be summed up succinctly as "creating biomedical technologies from design to the patient." The Group's principal areas of expertise are in medical sensors and instrumentation; biosignal and imaging analysis; biomedical optics; electrical impedance; physiological measurement; and physiological modelling.

Transformative sensors

Developments in optical technologies mean that some sensors are no larger than a hair and in the words of Professor Kyriacou, can "go into places in the body that people have never gone before." The startling potential of ever-smarter and smaller sensors created by his team includes non-invasive monitoring of blood oxygen levels in specific organs and tissues to ascertain their condition and tracking the progress of critically ill patients during surgery and in intensive care. This research challenges the status quo in monitoring blood components such as glucose, haemoglobin and cholesterol by innovating new non-invasive sensors that have the potential to make such measurements possible, without the invasive extraction of blood. Such technologies will enable patients with chronic diseases such as diabetes to monitor their wellbeing and remain in control of their condition.

BERG has recently been awarded a major research grant by the National Institute of Health Research to develop a personal lithium blood analyser for patients with bipolar disorder. This will revolutionise the monitoring of psychiatric disorders given that there is currently an absence of non-invasive medical devices for monitoring or assessing bipolar disorder.

The mood of patients with bipolar disorder frequently changes, featuring episodes of depression (with feelings of being lethargic and 'low') and mania (with feelings of being 'high' and overactive). These patients are dependent on lithium to maintain their mental equilibrium. Too much lithium causes toxicity and too little causes patients to have uncontrollable mood swings.

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The personal lithium blood analyser will assist in providing more information on lithium blood levels to psychiatrists, clinicians and patients, allowing for more effective management of bipolar disorder with lithium therapy. A low cost, portable healthcare technology which makes use of smart medical sensors allows bipolar patients to have more control of the earliest signs of health problems with medications that can be detected and corrected.

Preliminary studies will involve the spectrophotometric evaluation of lithium in blood to determine the optimum parameters for the sensor. The ultimate goal is to provide a handheld technology to monitor lithium levels non-invasively at home and to provide a personal monitor to assist, support and inform both the patient and clinician.

Funding future breakthroughs

While members of BERG are revolutionising the care of patients in critical condition, colleagues elsewhere in the School of Mathematics, Computer Science & Engineering, led by its Dean, are set to transform the life opportunities of babies born with congenital heart disease.

To find out how alumni can help fund their groundbreaking research, please turn to page 15.

Transformative telehealth

HEALTHCARE REVOLUTION

Telehealth, which is the management or delivery of health-related services through telecommunications technologies, has the potential to transform healthcare in the United Kingdom and around the world. It offers healthcare providers the means of tackling the twin challenges of an ageing population and limited resources, while for patients and their families, telehealth could help avoid admissions to and lengthy stays in hospital, as it can facilitate care in the home or the local community.

Professor Stanton Newman, Dean of the School of Health Sciences and a leading expert in telehealth, has undertaken research into how telehealth technologies should be integrated in the healthcare pathway for different chronic conditions and individuals with different levels of severity. He notes that "while telehealth holds huge promise, it's important for us to recognise that we have a long way to go before we can easily and successfully implement such a programme throughout the country.

"We need research to demonstrate the best techniques to integrate telehealth into a sustainable and effective model that could not only save many lives, but also help the NHS save millions of pounds annually," adds Professor Newman. "Key to the sustainability of a telehealth pathway for chronic conditions is ensuring that patients are able to utilise the additional information that telehealth can provide and change their behaviour to manage their condition."

To help bridge the gap between traditional and technology-based healthcare, Professor Newman has been involved in launching the Advancing Care Coordination and Telehealth Deployment (ACT) programme, a pan-European study that will uncover some of the barriers to implementation of telehealth services and establish best practice in the sector.

The Development & Alumni Relations Office are supporting Professor Newman with this important research. If you believe you can help, please contact David Street (david.street.1@city.ac.uk)