

## **CGH and SUTD co-create and receive US patent for warning sensor in early detection of wound bleeding**

*Innovation complements monitoring efforts of patients at risk of wound bleeding for enhanced patient safety.*

**Singapore, 29 April 2021** - Changi General Hospital (CGH) and the Singapore University of Technology and Design (SUTD) have developed the **Blood Warning Technology with Continuous Haemoglobin (BWATCH) sensor**, a lightweight monitoring device placed over a patient's bandage that detects real-time bleeding from wound sites following invasive medical procedures.

BWATCH was tested and validated in an observational clinical trial involving 250 patients at CGH with a dialysis catheter inserted or removed. The device was securely placed over their dressing for at least six hours. During the trial, 36 episodes of bleeding occurred and the sensor detected all instances of early bleeding. The blood loss detected in the bleeding episodes was minimal and the bandages were only partially stained. The nursing staff were alerted to the bleeding when the alarm was triggered and took the necessary actions to prevent an escalation of the bleeding. The findings from the clinical trial have been published in *Scientific Reports, A device for surveillance of vascular access sites for bleeding: results from a clinical evaluation trial* by Chionh, C.Y., Soh, D.Y., Tan, C.H. et al.

CGH and SUTD have patented BWATCH in Singapore and the United States (US), with future plans of commercialisation with suitable industry partners. BWATCH is the first joint patent between CGH and SUTD under a partnership to develop innovative patient care solutions to address evolving healthcare challenges.

### **Enhancing Patient Safety with Continuous Real-Time Monitoring**

In developed countries like Singapore, the incidence of acute dialysis is estimated to be at 200-300 per million population each year. Patients with acute dialysis have acute illnesses, which can lead to a sudden deterioration of their kidney functions, such that the kidney is not able to sustain life. When this occurs, the patient will require haemodialysis, a life-saving therapy to filter out waste products from the blood.

BWATCH is developed with haemodialysis patients in mind to meet a clinical need, as there is a risk of bleeding occurring after a catheter is inserted during vascular access procedures. The wound sites for these patients are usually heavily bandaged and covered under blankets as they rest. To ensure that patients are recovering well, the care team conducts regular inspections, as many as four times in an hour, to check for any potential bleeding.

Designed to complement patient care and enhance patient safety, BWATCH's ability to detect

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bleeding early will reduce the risk of a potential major bleeding episode. The device is also useful in the care of patients who are incapacitated and unable to call for assistance. As more confidence is gained from wider use of this device, the frequency of inspections and resource requirements may be reduced with no compromise to safety.

“Heavy bleeding following medical procedures is rare but when it occurs, it can be life-threatening. Monitoring at short intervals is highly manpower intensive but necessary. However, despite close monitoring, bleeding may still occur between these inspections. BWATCH offers continuous monitoring, allowing the care team to focus on other patient-centric tasks,” said **Associate Professor Chionh Chang Yin, Chief and Senior Consultant, Department of Renal Medicine at CGH.**

### **Using Light Absorption Properties to Detect Blood**

Unlike other blood-detection devices, BWATCH's main underlying detection principle is based on the light absorption properties of haemoglobin. The innovation also includes a moisture-detecting sensor that does not require direct contact with the liquid. With these two properties, the device is able to differentiate blood from other types of fluids such as sweat and urine, accurately detecting the bleeding episode and triggering the alarm without requiring direct contact with the patient or patient's bodily fluids. (*refer to Annex for more details*)

“While there are other commercial systems and products that are available for fluid detection, they are only able to detect the presence of fluids by changes in physical properties such as electrical resistance, capacitance or opacity to light. None of the detection methods were specific for blood, making BWATCH a precise non-invasive sterile monitoring device for early detection of bleeding,” said **Associate Professor Foong Shaohui, Department of Engineering Product Development at SUTD.**

### **Potential Future Applications**

Besides haemodialysis patients, BWATCH is applicable to other patient types within the hospital. It can be used on other wound types or locations that are prone to external bleeding, for example in post-cardiac catheterisation. Cardiac catheterisation is a procedure used to diagnose and treat certain cardiovascular conditions. During the procedure, a catheter is inserted into an artery and threaded through the blood vessels, which leads to the heart. The wound site is a potential area of bleeding.

The device can also be tested in other clinical situations beyond the hospital setting, such as on-site monitoring of traumatic wounds. The shape of the device would have to be adapted for different wound types.

In addition, there is potential for the device to be integrated into hospital systems, such as linking it directly to the nurses' call system. “Bringing BWATCH to market will offer many possibilities in the early detection of bleeding,” said A/Prof Chionh.

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### **About CGH and SUTD joint collaboration**

The CGH and SUTD partnership aims to develop innovative patient care solutions to current healthcare challenges. It also aims to nurture future generations of engineers and cultivate healthcare innovation.

### **About Changi General Hospital**

Changi General Hospital (CGH) is an academic medical institution caring for more than 1 million people in Singapore. A tertiary referral centre with over 1,000 beds, CGH is committed to medical research and education, clinical innovation and care for patients through a comprehensive range of medical specialties and services. Helmed by a multi-disciplinary, dedicated team of healthcare professionals, CGH consistently delivers positive health outcomes for patients. For more information, visit [www.cgh.com.sg](http://www.cgh.com.sg)

### **About Singapore University of Technology and Design (SUTD)**

The Singapore University of Technology and Design (SUTD) is one of the first universities in the world to incorporate the art and science of design and technology into a truly holistic interdisciplinary education and research experience that culminates in real-world design innovations. SUTD seeks to advance knowledge and nurture technically-grounded leaders and innovators to serve societal needs. SUTD also topped a list of emerging engineering schools in the world in a study commissioned by MIT.

A research-intensive university, SUTD is distinguished by its unique East and West academic programmes that incorporate design thinking, human-centred innovation, entrepreneurship, coupled with local and international industry collaborations. SUTD's key focus areas are Healthcare, Cities and Aviation, with Artificial Intelligence/Data Science and Digital Manufacturing capabilities across all of them. Multiple post-graduate opportunities are available. Skill-based professional education and training courses are also available at SUTD Academy.

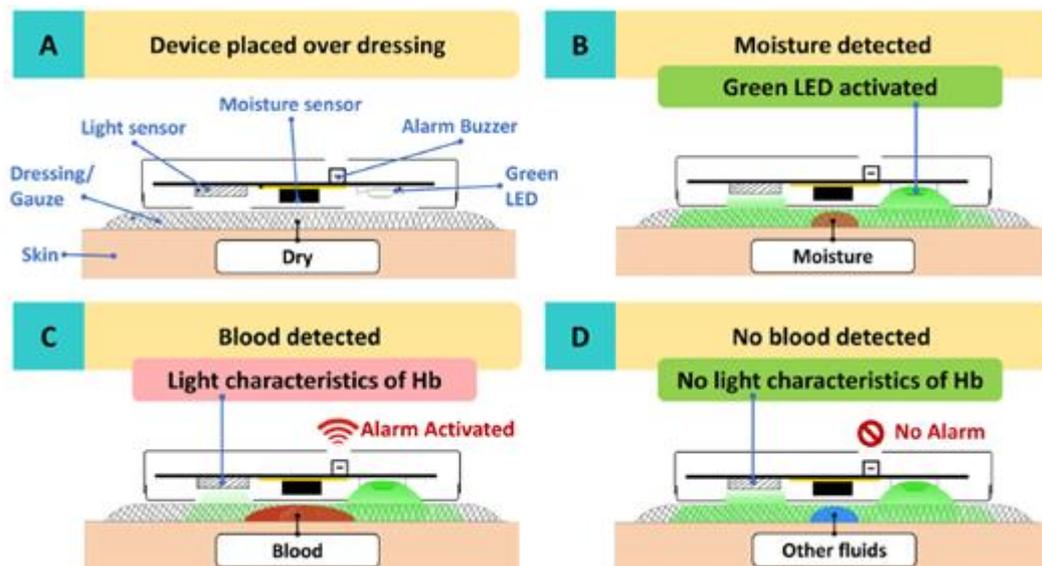
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## Annex

BWATCH is a stand-alone, disc-shaped device (43 mm in diameter, 12 mm in thickness, and 11.5 g in weight). The device is powered by an in-built rechargeable battery, which provides a runtime range between 7 to 9 hours with each charge. The device is small, lightweight and wireless. It meets infection control requirements, as it will not be in direct contact with the patient's skin and can be sheathed in a transparent, disposable sleeve. This prevents cross contamination.

The device's sensor employs two techniques. The first is a sensor fusion technique that exploits the unique light absorption spectra of the haemoglobin to differentiate blood from other fluids. The underlying detection principle is based on the light absorption properties of haemoglobin, which is most significant at the 525nm wavelength. Blood absorbs the 525nm wavelength, while other moisture does not. Thus, when the sensor detects the absence of 525nm wavelength light, it signals the presence of blood. The second property of the device is a moisture-sensitive electric circuit that is able to detect the presence of liquids in the dressing.

With these two properties, the device is able to detect that the moisture on the bandage is blood and not other fluids, accurately detecting bleeding episodes. The device will then trigger a loud alarm, alerting medical staff to the patient, allowing timely and appropriate action to be taken for the patient.



*Illustration of the technical process of monitoring and detection of blood by the BWATCH device. (A) Device placed over a dressing. (B) When moisture is present in the dressing, a change in capacitance is detected and the green light emitting diode (LED) is activated. (C) Haemoglobin (Hb) in the blood absorbs 525nm wavelength light. When the light sensor does not detect 525nm light, the alarm is triggered. (D) With other fluids (non-blood), the light sensor detects 525nm and no alarm is triggered.*



*BWATCH is designed to be small and lightweight to ensure the patient's comfort. It has a disposable transparent sleeve which meets infection control requirements.*



Changi  
General Hospital  
SingHealth



*BWATCH continuously monitors the wound site to detect bleeding (patient model featured in photos).*

**Watch the BWATCH demonstration video at: <https://youtu.be/AarQaDnTrzQ>**