Big Data research: Artemis, Apollo and Athena

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What is Big Data?
- Big Data is the term applied to large volume, rapidly generated and complex data sets that cannot be processed through traditional applications. Gaining valuable insight from Big Data requires advanced methods of interpretation such as the use of predictive analytics. In critical health care, all different types of data such as heart rate, respiration rate, blood oxygen levels and blood pressure collectively represent an example of Big Data.

What is Artemis?
- Artemis is a Big Data analytics platform capable of analyzing multiple streams of physiological data from multiple patients to provide information for multiple conditions.

What is Artemis Cloud?
- Artemis Cloud is the provision of Artemis as a cloud computing health-analytics-as-a-service.

Sponsors and partners (year joined)
- University of Ontario Institute of Technology (2007)  
- Canada Research Chairs (2007)  
- Canada Foundation for Innovation (2007)  
- Natural Sciences and Engineering Research Council of Canada (2007)  
- IBM (2008)  
- The Hospital for Sick Children (SickKids), Toronto, Ontario, Canada (2009)  
- Women & Infants Hospital, Providence, Rhode Island, USA (Artemis Cloud) (2010)  
- TD Bank (2010)  
- Canadian Institutes for Health Research (2011)  
- Southern Ontario Smart Computing Innovation Platform (2012)  
- Children’s Hospital of Fudan University, Shanghai, China (Artemis Cloud) (2012)  
- IFTech Inventing Future Technology Inc. (2013)  
- Ontario Research and Innovation Optical Network (2014)

Why are the research projects called Artemis, Apollo and Athena?
- They are not acronyms. The Artemis Project is named after the Greek goddess of childbearing. The Apollo Project is named after the Greek god of healing. The Athena Project is named after the Greek goddess of warfare and wisdom.

Staying up-to-date with Artemis developments
- Health Informatics Research at UOIT: hir.uoit.ca, @UOITHIR  
- Follow Dr. McGregor: @CP_McGregor
What has Artemis demonstrated through medical research?
- Combining information from heart and respiration rates with other physiological data reduces false positives in sepsis detection when compared to solely using heart rate information.
- Heart-rate variability improves significantly immediately after babies receive a blood transfusion.
- Artemis can automatically identify what type of neonatal ‘spell’ or apnoea a baby is having with greater than 98 per cent accuracy.
- Artemis can automatically classify sleep and wake states in neonates to help doctors assess the way the baby’s brain is maturing.
- Artemis can provide information on oxygen levels that can be used to help ensure babies don’t receive too much oxygen, which can lead to permanent eye damage.

What have we shown from a computing and IT perspective?
- We have created a Big Data analytics platform, Artemis, for use in critical care. We created Artemis Cloud, which extended Artemis to run in the cloud. We have tested Artemis Cloud between the United States and Canada, and between China and Canada. We created a model to determine the cloud computing resources required on a per-health-care-facility basis to utilize Artemis Cloud.
- We proposed new approaches to mine physiological Big Data to look for patterns in the data that are common before a specific condition is being researched.

What have we shown regarding public opinion of the secondary use of physiological data?
- There is overwhelming public support in Canada and Australia for physiological data generated in critical care to be used for medical research by not-for-profit research organizations.

Can Artemis be used in the kinesiology and chiropractic practices?
- We have shown how Artemis could be used to understand the impact of chiropractic treatment. We have also shown how it can be used to measure drowsiness during transcutaneous muscle stimulation.

On the horizon…

Artemis in space
- We are advancing research that demonstrates how to apply the Artemis platform to monitor astronauts and cosmonauts for use on the International Space Station and NASA’s proposed 2030 Mission to Mars.

The Apollo Project
- We are advancing research to take Artemis out of the hospital and into the home for new approaches to everyday health and wellness. We have shown how we can monitor babies who were previously in neonatal intensive care units but are now living at home.

The Athena Project
- Athena extends Artemis to monitor not just physiological data but also data from a first-person shooter serious game (ArmA3). It also extends to a new haptic (touch) garment called ARAIG created by Oshawa, Ontario tech startup company IFTech Inventing Future Technology Inc.

Artemis by the numbers
- Babies monitored through Artemis: 1,000+
- Partnering Artemis hospitals: 3
- Countries: 3
- Global research impact: An article co-authored by Dr. McGregor and a former PhD student was the third most-cited article in Artificial Intelligence in Medicine (2007-2012)