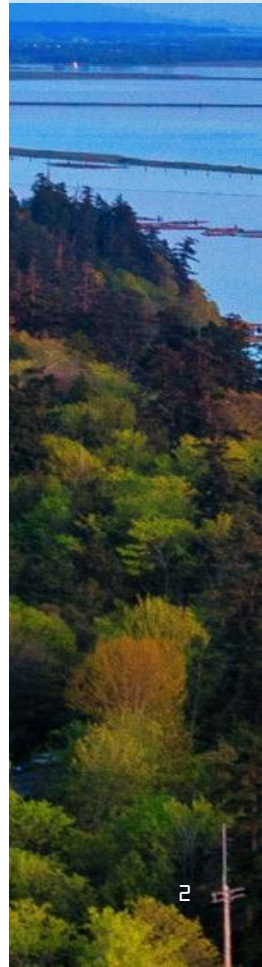
MACHINE LEARNING/ARTIFICIAL INTELLIGENCE IN EMERGENCY MEDICINE

CUHK Centre for Bioethics Webinar Series
"Digital Health & Telemedicine"
September 21st, 2021

KENDALL HO, PROFESSOR OF EMERGENCY MEDICINE
UBC FACULTY OF MEDICINE

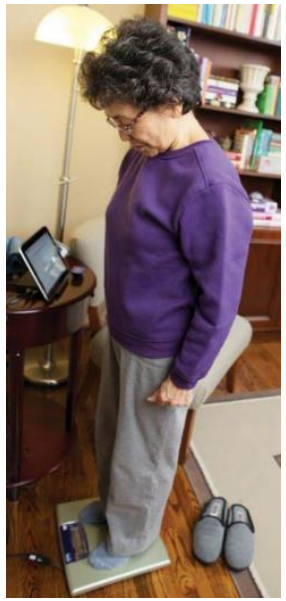
AGENDA: M.L./A.I. IN EMERGENCY MEDICINE

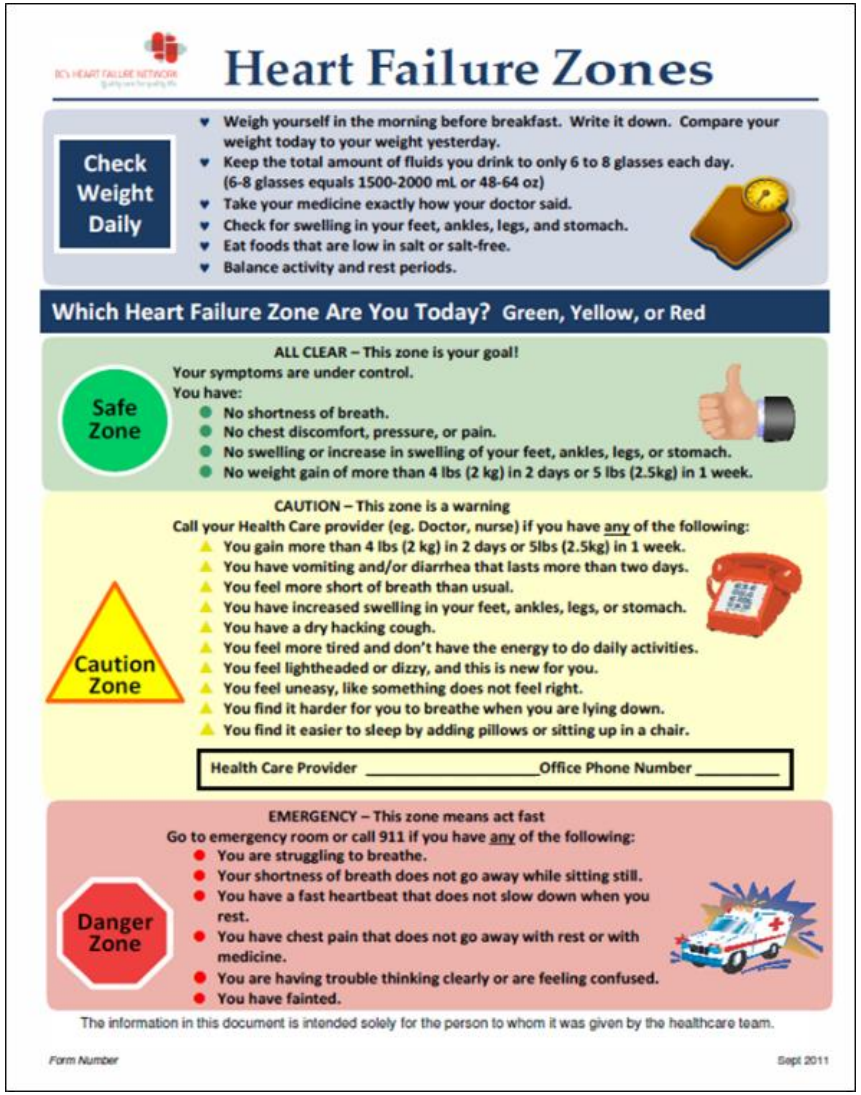
- Sensors, Wearables, & Data Analytics
- Data Science, Machine Learning in Emergency Medicine
- Implications in Clinical Care



TEC4Home

Telehealth for Emergency-Community Continuity of Care Connectivity via Home Tele-monitoring





Heart Failure Zones

Check Weight Daily

- Weigh yourself in the morning before breakfast. Write it down. Compare your weight today to your weight yesterday.
- Keep the total amount of fluids you drink to only 6 to 8 glasses each day. (6-8 glasses equals 1500-2000 mL or 48-64 oz)
- Take your medicine exactly how your doctor said.
- Check for swelling in your feet, ankles, legs, and stomach.
- Eat foods that are low in salt or salt-free.
- Balance activity and rest periods.

Which Heart Failure Zone Are You Today? Green, Yellow, or Red

Safe Zone

ALL CLEAR – This zone is your goal!
Your symptoms are under control.
You have:

- No shortness of breath.
- No chest discomfort, pressure, or pain.
- No swelling or increase in swelling of your feet, ankles, legs, or stomach.
- No weight gain of more than 4 lbs (2 kg) in 2 days or 5 lbs (2.5kg) in 1 week.

Caution Zone

CAUTION – This zone is a warning
Call your Health Care provider (eg. Doctor, nurse) if you have any of the following:

- You gain more than 4 lbs (2 kg) in 2 days or 5lbs (2.5kg) in 1 week.
- You have vomiting and/or diarrhea that lasts more than two days.
- You feel more short of breath than usual.
- You have increased swelling in your feet, ankles, legs, or stomach.
- You have a dry hacking cough.
- You feel more tired and don't have the energy to do daily activities.
- You feel lightheaded or dizzy, and this is new for you.
- You feel uneasy, like something does not feel right.
- You find it harder for you to breathe when you are lying down.
- You find it easier to sleep by adding pillows or sitting up in a chair.

Health Care Provider _____ Office Phone Number _____

Danger Zone

EMERGENCY – This zone means act fast
Go to emergency room or call 911 if you have any of the following:

- You are struggling to breathe.
- Your shortness of breath does not go away while sitting still.
- You have a fast heartbeat that does not slow down when you rest.
- You have chest pain that does not go away with rest or with medicine.
- You are having trouble thinking clearly or are feeling confused.
- You have fainted.

The information in this document is intended solely for the person to whom it was given by the healthcare team.

Form Number Sept 2011

Co-Is:

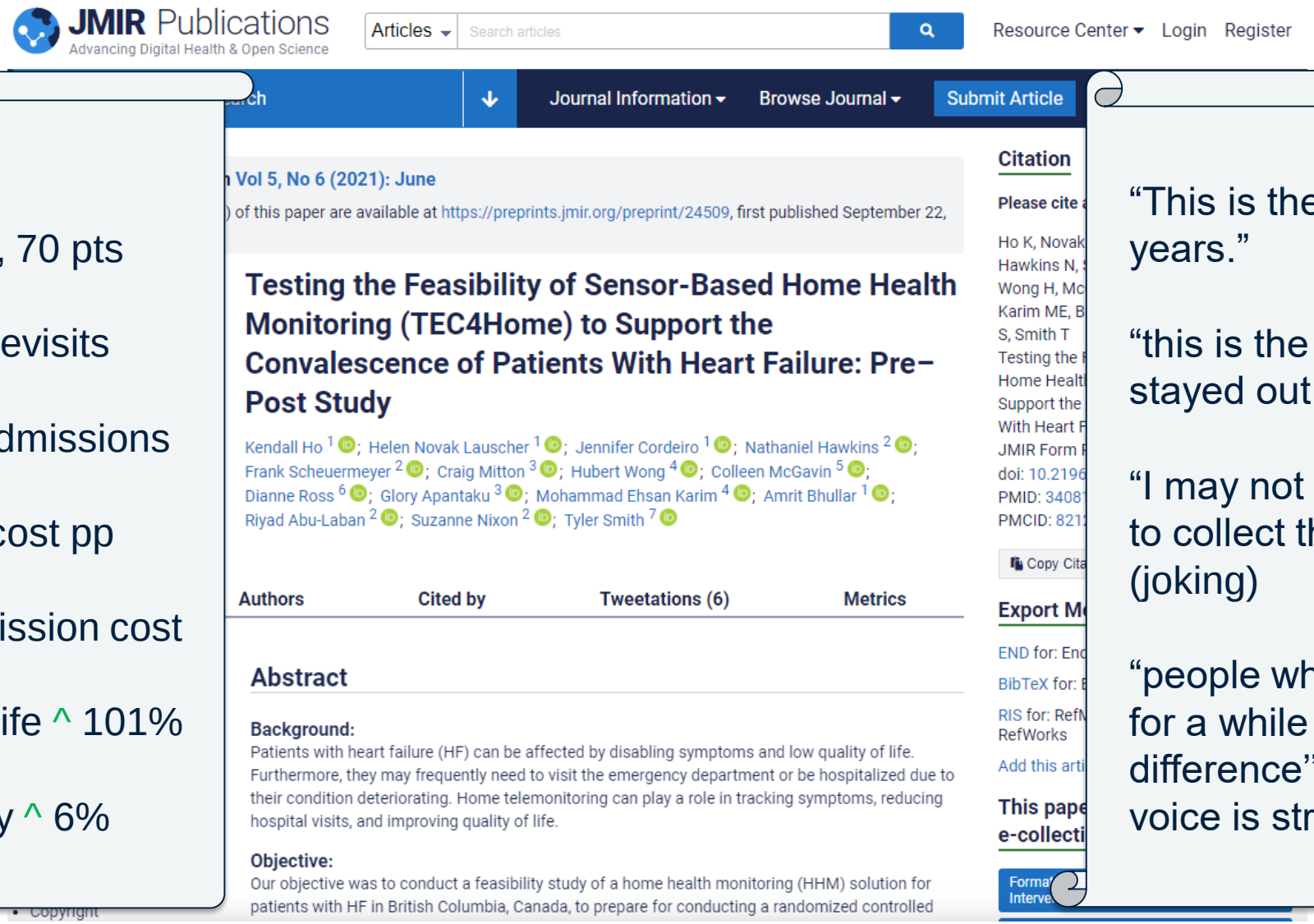
- Riyad Abu-Laban
- Glory Apantaku
- Jennifer Cordeiro
- Suzanne Dixon
- Nat Hawkins
- Ehsan Karim
- Chad Kim Sing
- Colleen McGavin
- Craig Mitton
- Helen Novak Lauscher
- Dianne Ross
- Frank Scheuermeyer
- Tyler Smith
- Lisa Tang
- Hubert Wong
- TEC4Home Research Community

TEC4Home

Telehealth for Emergency-Community Continuity of Care Connectivity via Home Tele-monitoring

Feasibility:

- 3 hospitals, 70 pts
- 79% v ED revisits
- 87% v Readmissions
- 58% v ED cost pp
- 71% v admission cost
- Quality of Life ^ 101%
- Self efficacy ^ 6%



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Vol 5, No 6 (2021): June

) of this paper are available at https://preprints.jmir.org/preprint/24509, first published September 22,

Testing the Feasibility of Sensor-Based Home Health Monitoring (TEC4Home) to Support the Convalescence of Patients With Heart Failure: Pre–Post Study

Kendall Ho [1]; Helen Novak Lauscher [1]; Jennifer Cordeiro [1]; Nathaniel Hawkins [2]; Frank Scheuermeyer [2]; Craig Mitton [3]; Hubert Wong [4]; Colleen McGavin [5]; Dianne Ross [6]; Glory Apantaku [3]; Mohammad Ehsan Karim [4]; Amrit Bhullar [1]; Riyad Abu-Laban [2]; Suzanne Nixon [2]; Tyler Smith [7]

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Abstract

Background:
Patients with heart failure (HF) can be affected by disabling symptoms and low quality of life. Furthermore, they may frequently need to visit the emergency department or be hospitalized due to their condition deteriorating. Home telemonitoring can play a role in tracking symptoms, reducing hospital visits, and improving quality of life.

Objective:
Our objective was to conduct a feasibility study of a home health monitoring (HHM) solution for patients with HF in British Columbia, Canada, to prepare for conducting a randomized controlled

Citation

Please cite

Ho K, Novak
Hawkins N,
Wong H, Mc
Karim ME, B
S, Smith T
Testing the
Home Healt
Support the
With Heart
JMIR Form
doi: 10.2196
PMID: 3408
PMCID: 821

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"This is the best I have felt in 2 years."

"this is the longest I have stayed out of hospital"

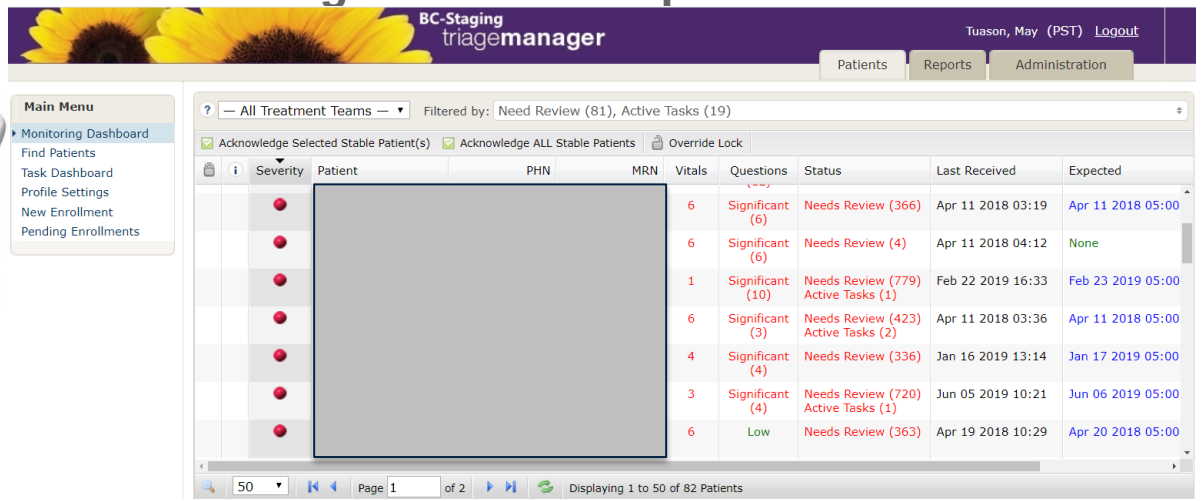
"I may not let Telus in the door to collect the equipment" (joking)

"people who have not seen me for a while tell me 'What a difference'" and "even your voice is stronger"

TEC4HOME: HOME MONITORING OF HEART FAILURE

- **HHM Patient Kit**

- **Monitoring nurse desktop**



DATA ANALYTICS: TEC4HOME

Weight decreased progressively

Systolic blood pressure (SBP)

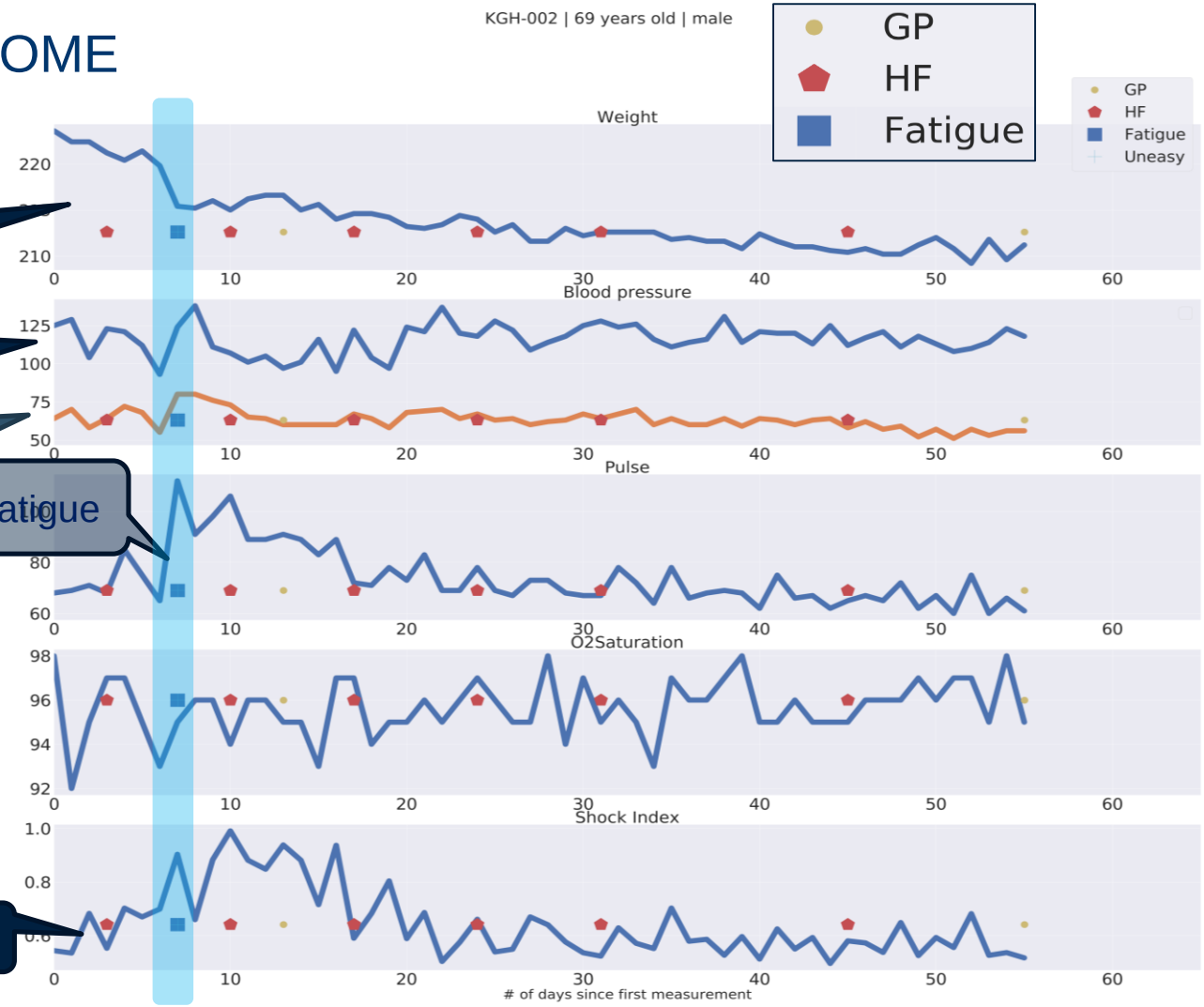
Diastolic blood pressure (DBP)

Fatigue

$$\text{Shock index} = \frac{\text{Pulse}}{\text{SBP}}$$

(normal range: [0.5, 0.7]; above 1 is serious)

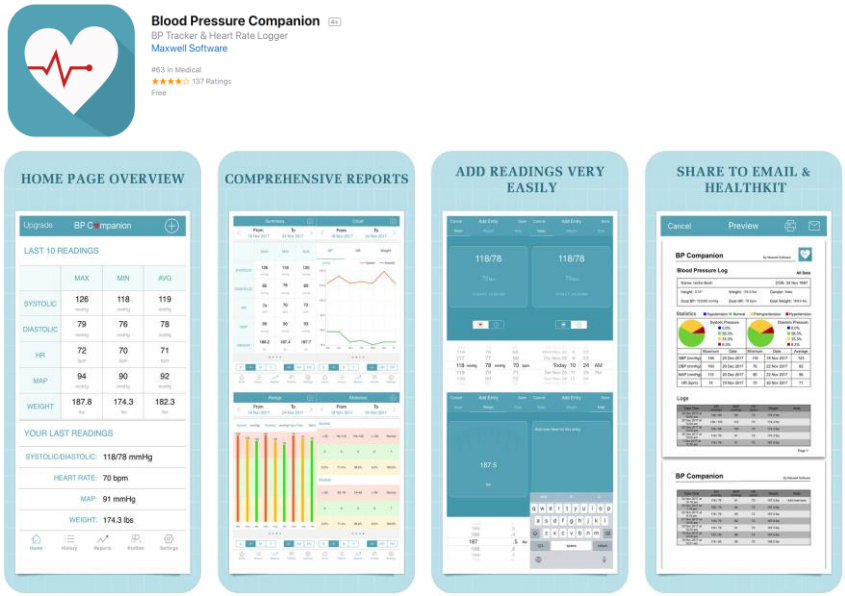
Shock index decreased progressively



TEC4HOME HYPERTENSION: HOME MONITORING OF BLOOD PRESSURE POST ED

Research Questions:

- Hypertension in ED: should we treat?
- How to safely monitor patients: ED to outpatient?



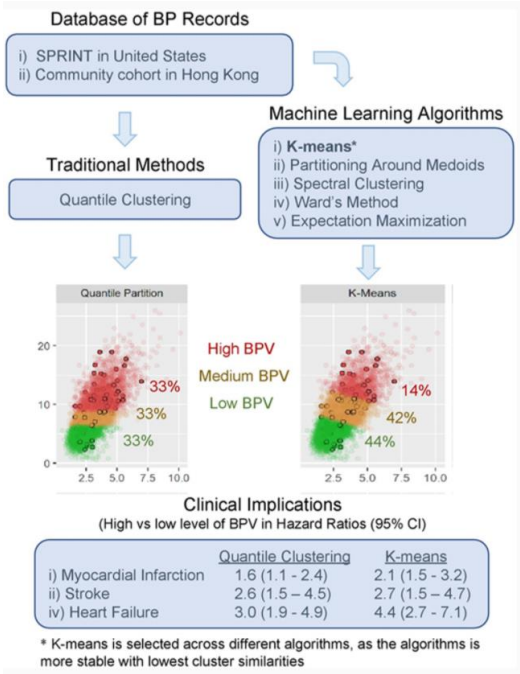
Co-Is:

- Karen Tran
- Nadia Khan
- Laura Kuyper
- Jesse Bittman
- Birinder Mangat
- Chad Kim Sing
- Heather Lindsay
- Martin Dawes
- Hubert Wong
- Jen Cordeiro
- Megan Mak

Machine Learning Clustering for Blood Pressure Variability Applied to Systolic Blood Pressure Intervention Trial (SPRINT) and the Hong Kong Community Cohort

Kelvin K.F. Tsoi ✉, Nicholas B. Chan, Karen K.L. Yiu, Simon K.S. Poon, Bryant Lin, Kendall Ho

Originally published 29 Jun 2020 | https://doi.org/10.1161/HYPERTENSIONAHA.119.14213 | Hypertension. 2020;76:569–576



- SPRINT & Hong Kong Community Cohorts
- Machine learning (ML) better outcome prediction
  - Quantile clustering: 33% high BPV
  - K-means (ML): 14% high BPV
  - ML high BPV: higher stroke & heart failure risk

Co-Is:

- Kevin Tsoi
- Nicholas Chan
- Karen Yiu
- Simon Poon
- Bryant Lin

UBC DATA SCIENCE INSTITUTE PROJECT: ATRIAL FIBRILLATION

Problem:

- Atrial fibrillation: most common arrhythmia
- Serious complications if not treated: stroke
- Ablation: 50% to 70% success rate
- How to predict success?

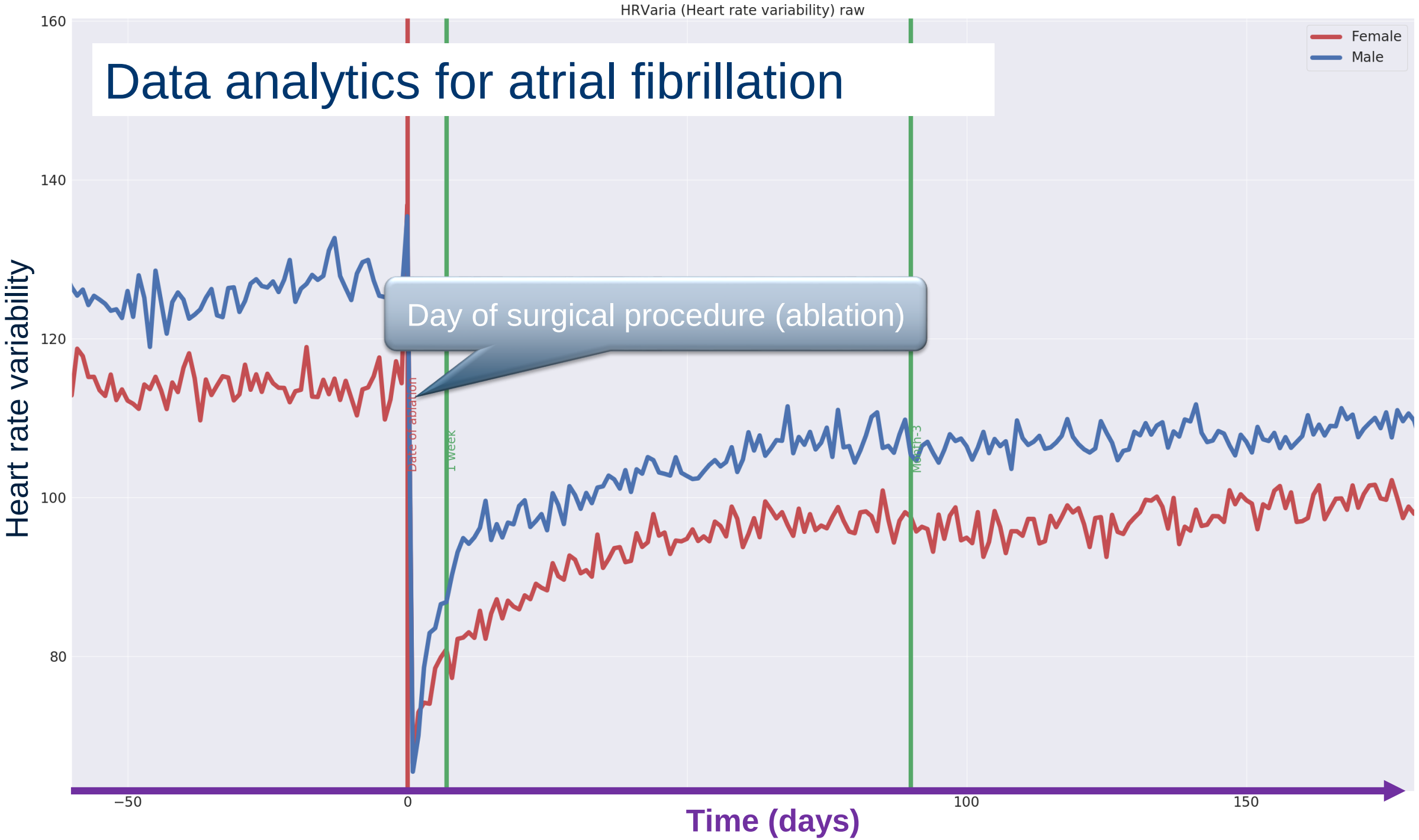
CIRCA-DOSE Project:

- 300 patients with detailed pre- and post-treatment data
- Can data analytics demonstrate treatment success?

Co-Is:

- Nat Hawkins
- Jason Andrade
- Marc Deyell
- Roger Tam
- Lisa Tang
- Michael Lim

Data analytics for atrial fibrillation



JAHA
Journal of the American Heart Association

OPEN ACCESS
RESEARCH ARTICLE

Autonomic Alterations After Pulmonary Vein Isolation in the CIRCA-DOSE (Cryoballoon vs Irrigated Radiofrequency Catheter Ablation) Study

Lisa Y. W. Tang, Nathaniel M. Hawkins, Kendall Ho, Roger Tam, Marc W. Deyell, Laurent Macle, Atul Verma, Paul Khairy, Robert Sheldon, Jason G. Andrade, On behalf of and CIRCA-DOSE Study Investigators

Originally published 26 Feb 2021 | https://doi.org/10.1161/JAHA.120.018610 | Journal of the American Heart Association. 2021;10:e018610

PDF/EPUB

Tools | Share

Jump to

Abstract

Background

The natural history of autonomic alterations following catheter ablation of drug-refractory paroxysmal atrial fibrillation is poorly defined, largely because of the historical reliance on non-invasive intermittent rhythm monitoring for outcome ascertainment.

Methods and Results

The study included 346 patients with drug-refractory paroxysmal atrial fibrillation undergoing pulmonary vein isolation using contemporary advanced-generation ablation technologies. All patients underwent insertion of a Reveal LINQ (Medtronic) implantable cardiac monitor before ablation. The implantable cardiac monitor continuously recorded physical activity, heart rate variability (measured as the SD of the average normal-to-normal), daytime heart rate, and nighttime heart rate. Longitudinal autonomic data in the 2-month period leading up to the date of ablation were compared with the period from 91 to 365 days following ablation. Following ablation there was a significant decrease in SD of the average normal-to-normal (mean difference versus baseline of 19.3 ms; range, 12.9–25.7; $P<0.0001$), and significant increases

March 2, 2021
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Article Information

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Government of Canada announces funding for research and development to address COVID-19 gaps and challenges

From: Innovation, Science and Economic Development Canada

News release

October 30, 2020 – Ottawa, Ontario

The Government of Canada is committed to protecting the health and safety of all Canadians while ensuring economic resilience and contributing to the international response to COVID-19. Since the outbreak of COVID-19, the government has been working closely with industry to understand which areas require urgent investment while building domestic capabilities to fight future pandemics.

Today, the Honourable Navdeep Bains, Minister of Innovation, Science and Industry, announced $796,000 in funding from the National Research Council of Canada (NRC) through the Pandemic Response Challenge program, as well as challenge winners and new contracts under the Innovative Solutions Canada (ISC) Testing Stream.

The NRC, under the Pandemic Response Challenge program that is aimed at specific COVID-19 gaps and challenges identified by Canadian health experts, is providing research and development funding to the following six collaborative projects:

- $147,000 to the University of British Columbia for a project to facilitate clinical adoption of contactless sensors for COVID-19 patients;
- $150,000 to OCAD University to develop guidelines and functionalities for the design of virtual care software for vulnerable populations;
- $199,000 to the Centre for Addiction and Mental Health for the development and validation of mobile application modules to attenuate mental health symptoms related to the COVID-19 pandemic;
- $100,000 to the University of Toronto to develop latex agglutination tests for rapid, instrument-free COVID-19

National Research Council:

Contactless sensing:

Co-Is:

- Di Jiang
- David Rivest-Henault
- Linda Pecora
- Michelle Lavasseur
- Michael Lim
- Nooshin Jafari

CANADA'S DIGITAL TECHNOLOGY SUPERCLUSTER

Digital Telework for Remote Physical Work

Remote-operated robots to help protect long-term care home staff, residents.

Project Budget* - $5.7M

Partner Co-investment - $1.7M

Supercluster Co-investment - $4.0M

+ Partners receiving Supercluster funds

Project Partners

AiN3C expeto Microsoft THE UNIVERSITY OF BRITISH COLUMBIA

Co-Is:

- Roger Tam
- Lisa Tang
- James Wells
- Brad Bycraft
- Michael Lim
- Nooshin Jafari

ED Laboratory for Innovation, Validation and Evaluation

Vancouver General Hospital
ED LIVE
MEDTEQ BEACHHEAD™

Vancouver CoastalHealth | one VCH

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Key Domains

- Artificial Intelligence
- Virtual Health
- Digital Medicine

Areas Of Focus

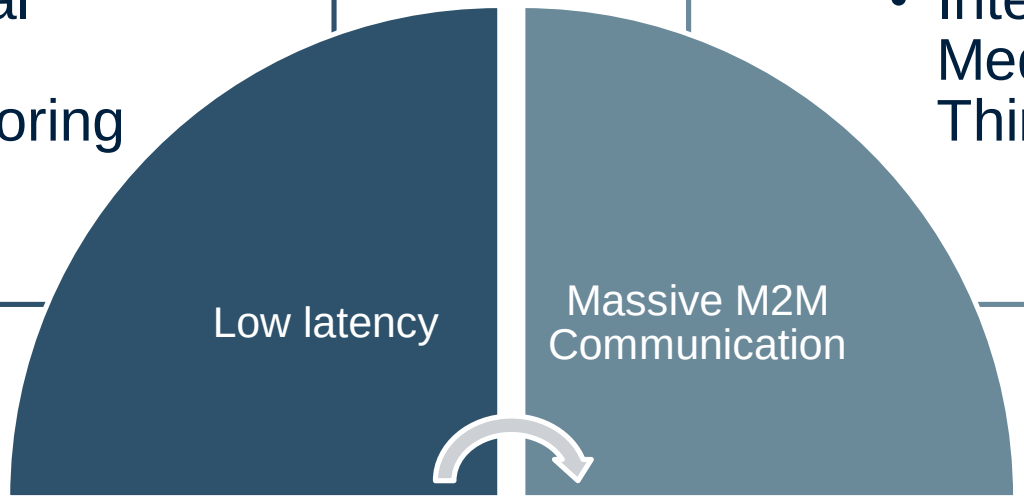
- ED operations
  - Quality patient care
  - Clinical innovation
- Patient flow (efficiency)
- Patient & HCP experience

5G Network in Emergency Medicine

Vancouver General Hospital
ED LIVE
MEDTEQ BEACHHEAD™

- Critical care monitoring

- Internet of Medical Things

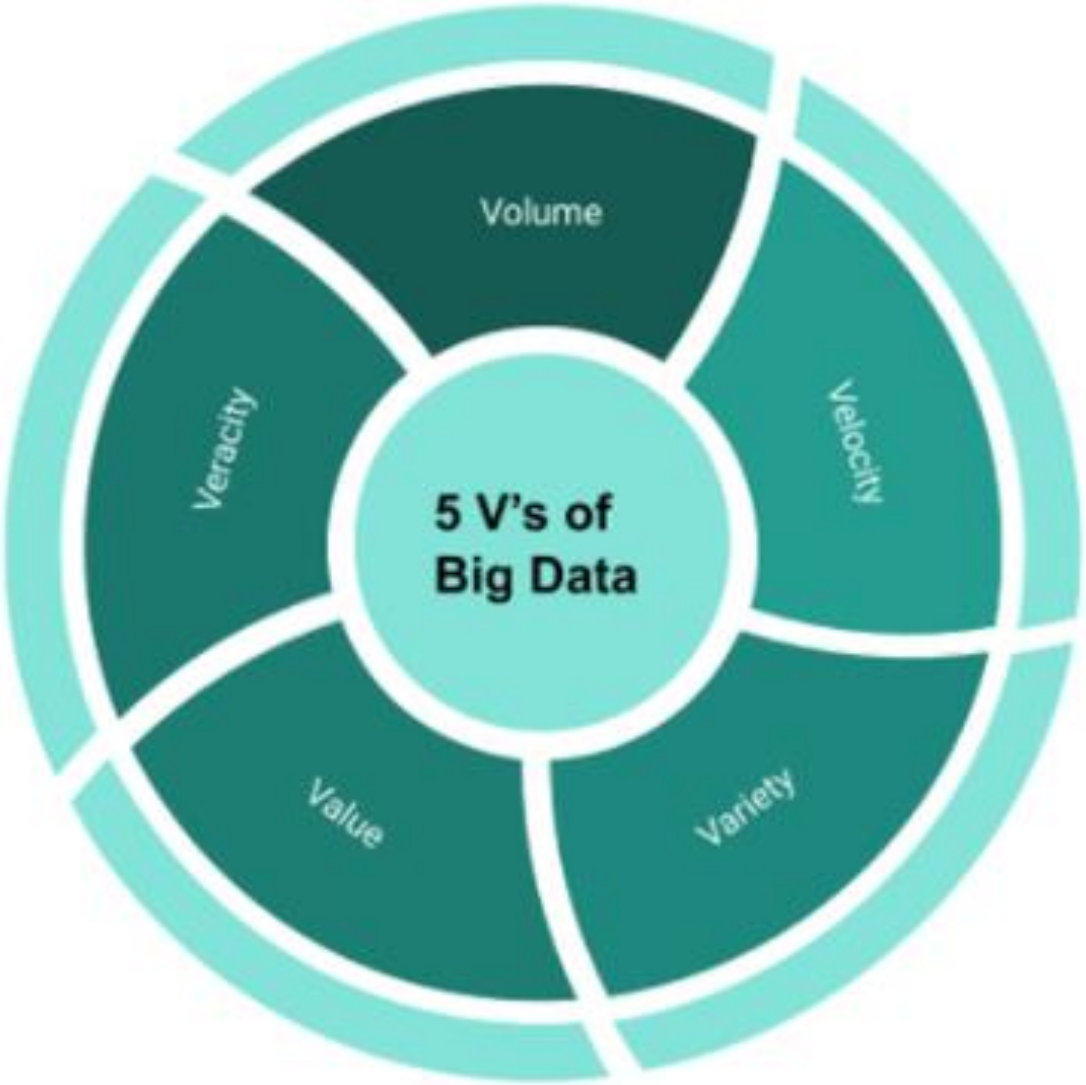


- Data analytics dashboard

- Dedicated channels

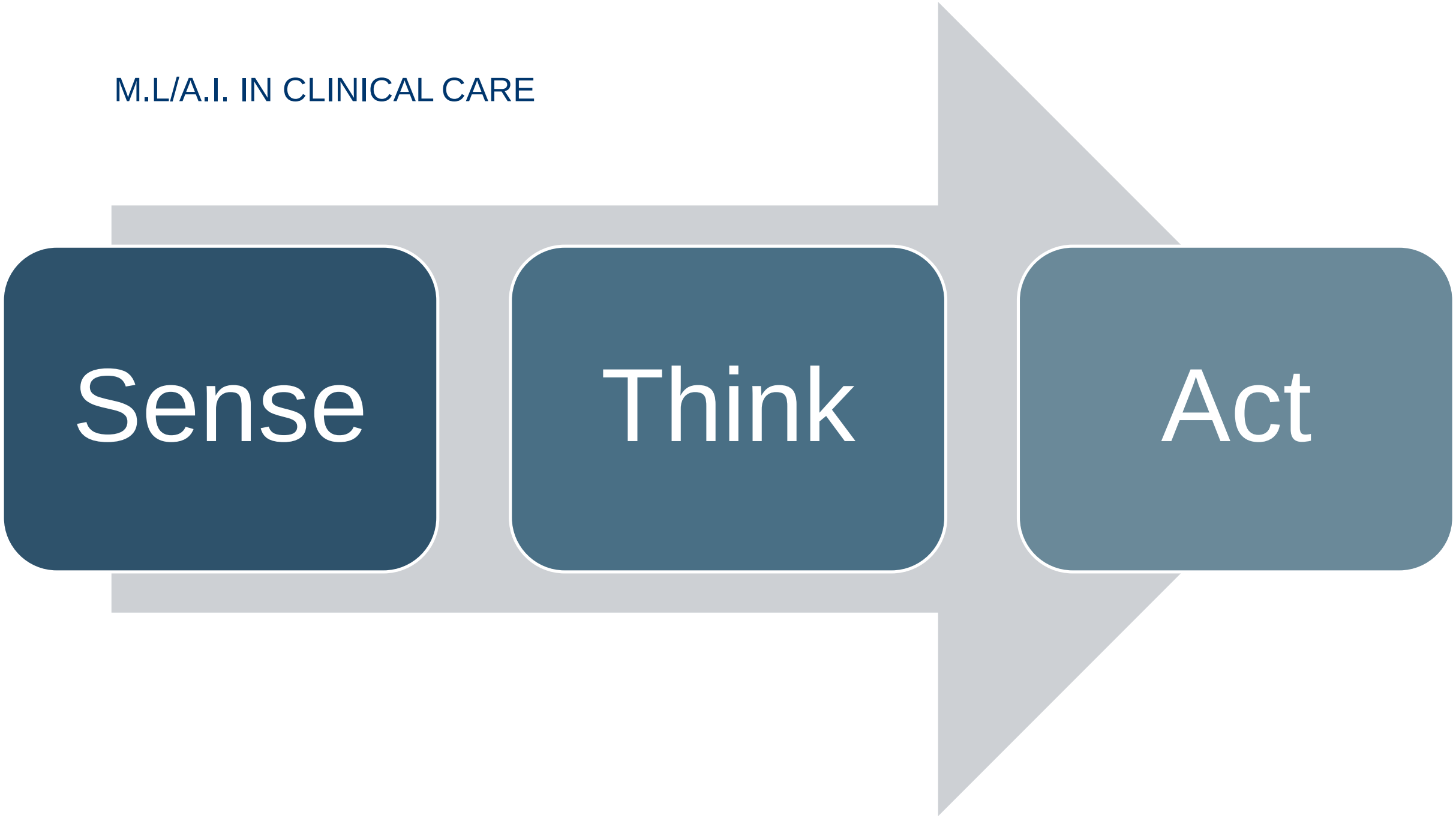
Vancouver CoastalHealth | one VCH

ISSUES & CONSIDERATIONS: M.L./A.I. IN CLINICAL CARE



- Applicability
- Equity, diversity & inclusion
- Explanability
- Security
- Human learning
- …

M.L/A.I. IN CLINICAL CARE



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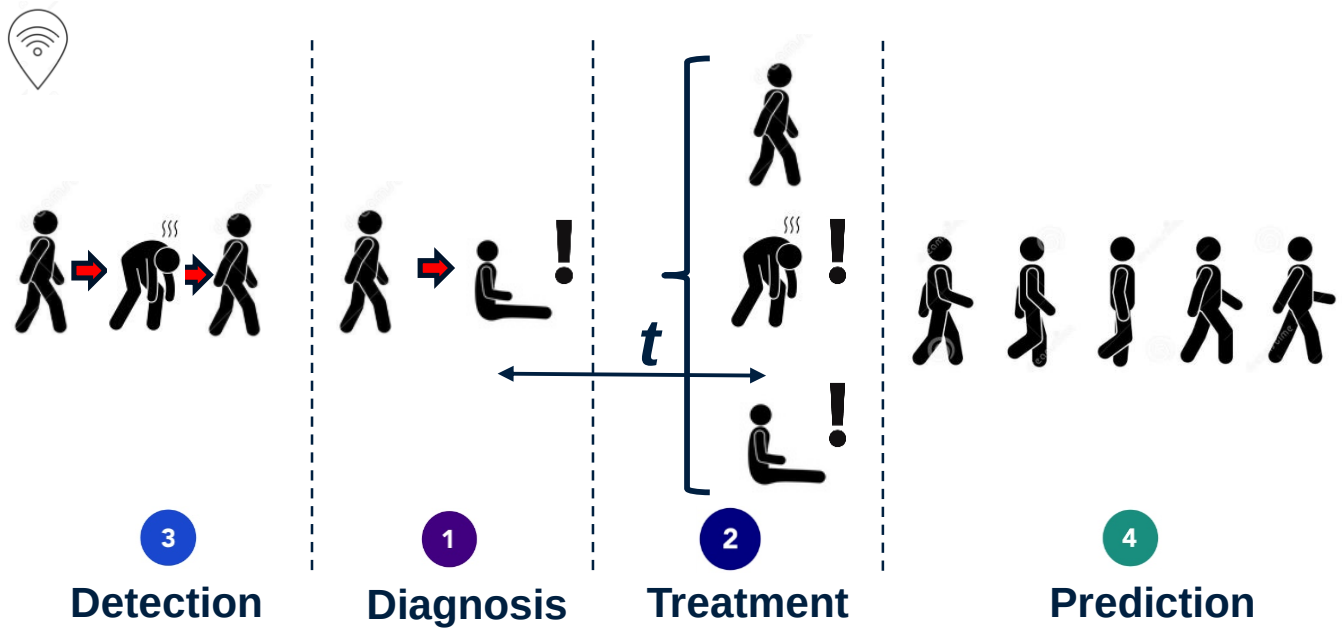
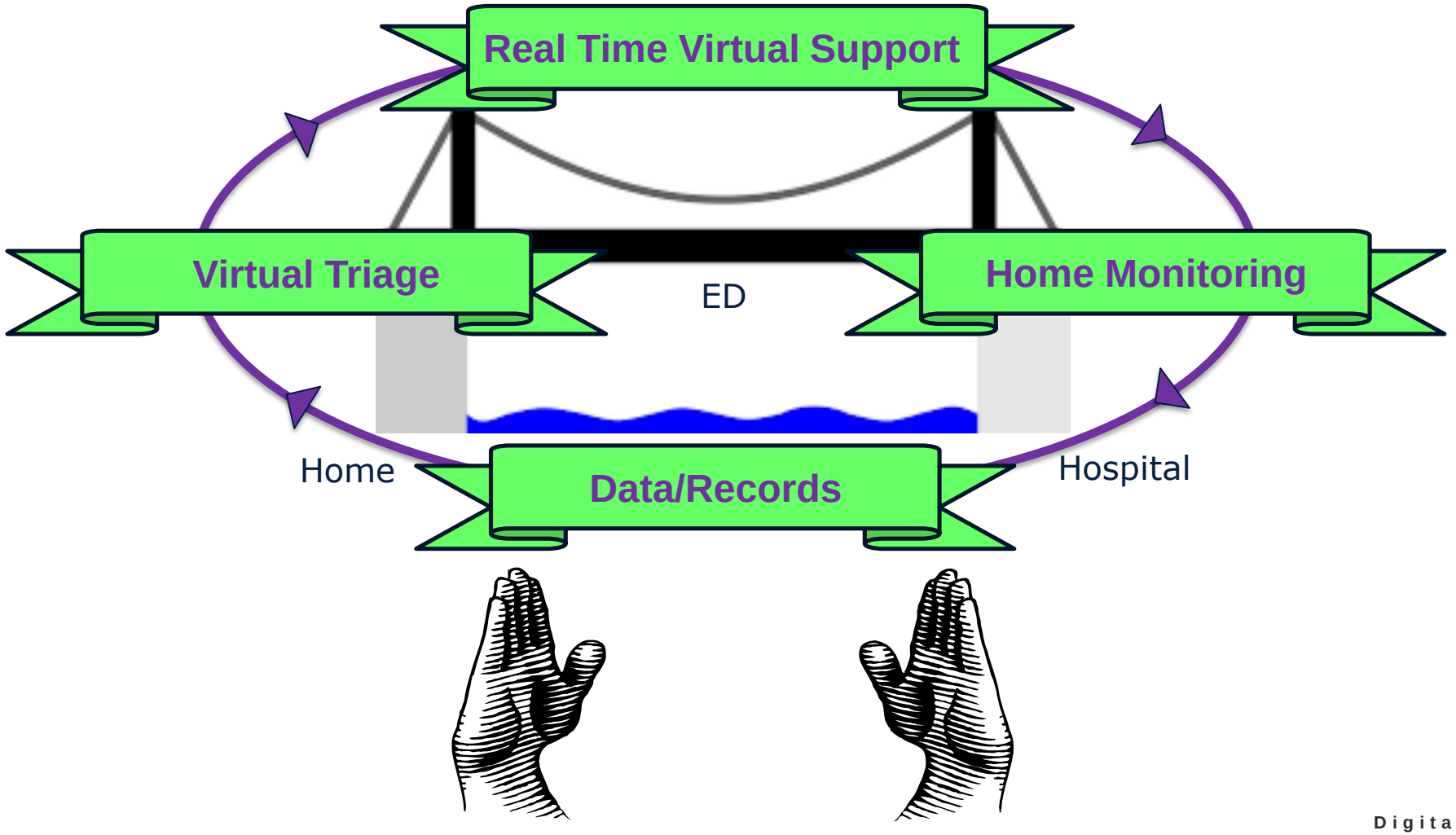


Digital Emergency Medicine: Partnership

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