

## Machine learning (ML) insights into emergency department (ED) patient admissions from big data analytics; A 'proof-of-concept' partnership between industry, a large public hospital network and academia.

**Dr Kushan De Silva**<sup>1</sup>, Mr Tam Ho<sup>4</sup>, Ms Danielle Ryan<sup>2</sup>, Dr Geoff McDonnell<sup>3</sup>, Dr Christopher Barton<sup>1</sup>, Ms Annette Peart<sup>1</sup>, Professor Andrew Forbes<sup>1</sup>, Mr Mark Aquilina<sup>4</sup>, Ms Julie White<sup>2</sup>, Ms Debra Gascard<sup>2</sup>, Dr Joanne Enticott<sup>1,5</sup>

<sup>1</sup>Monash University, Melbourne, Australia, <sup>2</sup>Monash Health, Melbourne, Australia, <sup>3</sup>University of New South Wales, Sydney, Australia, <sup>4</sup>Klarrio APAC Pty Ltd, Sydney, Australia, <sup>5</sup>Monash Partners Data-Driven Fellow, Monash Partners Academic Health Science Centre, Melbourne, Australia

Parallel Session 2C, Grand Ballroom 1-4, November 20, 2019, 11:00 - 12:30

### Title

**Machine learning (ML) insights into emergency department (ED) patient admissions from big data analytics; A 'proof-of-concept' partnership between industry, a large public hospital network and academia.**

### Authors

**De Silva, K<sup>1</sup>**, Ho, T<sup>4</sup>, Ryan, D<sup>2</sup>, McDonnell, G<sup>3</sup>, Barton, C<sup>1</sup>, Peart, A<sup>1</sup>, Forbes, A<sup>1</sup>, Aquilina, M<sup>4</sup>, White, J<sup>2</sup>, Gascard, D<sup>2</sup>, Enticott, J<sup>1,5</sup>

### Affiliations

<sup>1</sup> Monash University, Melbourne, Australia

<sup>2</sup> Monash Health, Melbourne, Australia

<sup>3</sup>University of New South Wales, Sydney, Australia

<sup>4</sup>Klarrio APAC Pty Ltd, Sydney, Australia

<sup>5</sup>Monash Partners Data-Driven Fellow, Monash Partners Academic Health Science Centre

### Background

Early identification of ED patients requiring admission may optimize hospital resources. Moreover, ED crowding is associated with poorer patient outcomes. Most prior studies predicted these admissions using classical predictive analytics whereas ML may yield more robust predictions.

### Objectives

To predict (1) hospital length of stay (LoS) and (2) cardiovascular disease (CVD) among ED patients

### Method

From 916,146 records of deidentified, retrospective hospital admissions within Monash Health network (January 2013 - February 2017), ED admissions of 357,180 unique patients were extracted. Two light GBM models were trained and tested using 90/10 dataset split. Predictive performance was measured with MAPE, prediction accuracy and AUC. Feature importance were measured via Shapley additive exploration scores.

### Results

Model for LoS had MAPE of 21%, indicating room for improvement. Whilst model for CVD was excellent with predictive accuracy and AUC 93.5% and 94.5%, respectively.

- Longer LoS were associated with: greater duration in ED, age <3 months, lower SEIFA deciles, longer stays in previous 5 admissions, resuscitation/very-urgent/urgent triage, diagnoses of bacterial, mental, cardiovascular, digestive, skin infections and trauma complications, history of diabetes mellitus and renal

failure. Shorter LoS were associated with: being married; admitted midnight to early morning, at start of the week and during autumn.

- CVD was associated with age>54 years, history of renal failure, thyroid problems, coagulation defects, resistance to antimicrobial and antineoplastic drugs, and in Italian, Auslan, Bosnian, Greek speakers.

### **Conclusions**

ML robustly predicted both LoS and CVD, with latter model excelling. Identified were a number of underlying associations and patterns.