# Causes for 30-day readmissions and accuracy of the LACE index in regional Victoria, Australia

**Dr. Reinhardt Dreyer** FCP(SA); FRACP; MMed; MPH; MSc (Clin.Epid) (1,2)

**Dr. James Gome** FRACP; MBBS (2)

**1 Division of Epidemiology and Biostatistics, University of Stellenbosch, South Africa**

**2 Department of Internal Medicine, South West Healthcare, Victoria, Australia**

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Podcast: https://www.racp.edu.au/podcast

Email: Reinhardt.dreyer@deakin.edu.au

**No conflicts of interest**

# Background

- Thirty-day readmission rates used as a quality metric
- Readmissions are more complex and expensive (1,2,3)
- Clinicians and funders continue to search for ways to reduce costs without sacrificing quality of care

- Focus on developing tools to identify high-risk patients (1,2,3)
  - HOSPITAL score
  - PRA (probability of readmission
  - **LACE index (Score 0 – 19)**
    - **Length of stay**
    - **Acuity of admission**
    - **Charlson Comorbidity Index**
    - **ED admissions in 6 months**
    - **>= 10: high risk of readmission or death**

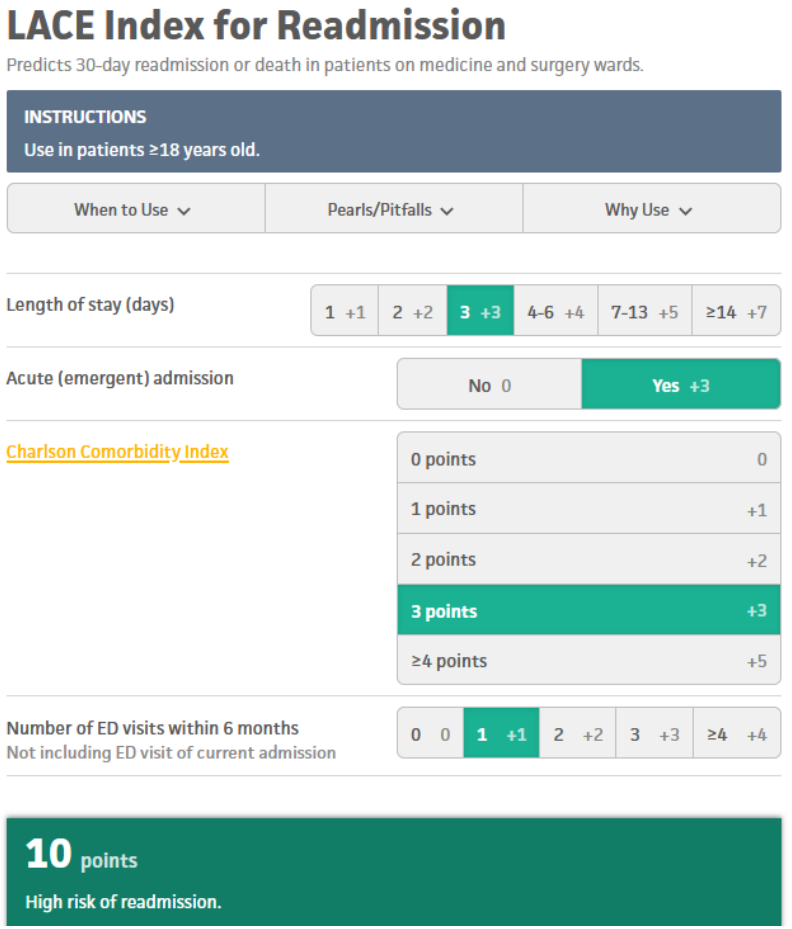
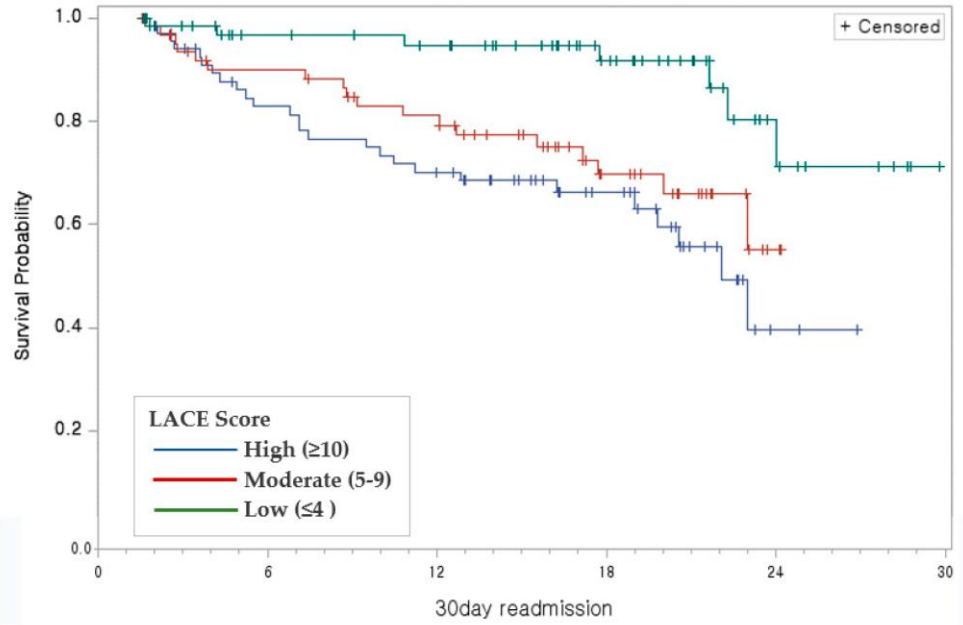


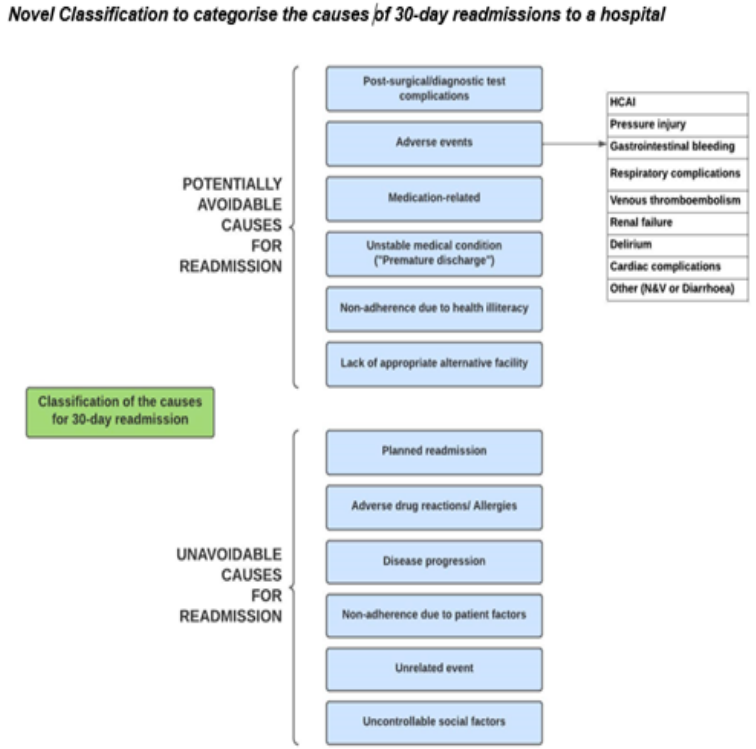

Image: MDCalc.com

# Aims and Objectives

Describe Demographics and Comorbidity
Assess the performance of the LACEi to predict 30-day readmissions (4)




Tested novel clinician-orientated classification for the causes of 30-day readmissions for ease of use and correlation with administrative data



# Methodology and Analysis

**Design**: Used a nested case-control design

**Outcome**: 30-day readmission status

- **Cases**: discharged within 30 days before admission
- **Controls**: No discharge within 30 days before admission

**Date**: 1 July 2020 and 30 June 2022

**Setting**: South West Healthcare (VIC)(Australia)

**Inclusion**: All adult medical patients discharged alive

**Exclusion**: Planned readmissions, surgical admissions, dialysis, transfers and self-discharges

Summary statistics, ANOVA, $\chi^2$, or Wilcoxon rank-sum. Controls were matched with cases based (1:1) on LACEi

Logistic regression evaluated the accuracy of LACEi in predicting readmission. Cox regression for time-to-readmission incidence in the 30-day risk groups was reported as ROC. The covariates were 1) age ≥ 65 and 2) biological sex.

*Analysis done by the University of Stellenbosch using Stata version 18.0 (SE) (StataCorp LLC, College Station, TX, USA).*

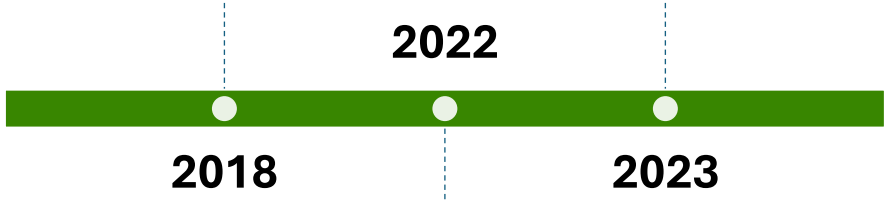
# Development and data collection

**LACEi2018**

- Tertiary LMIC retrospective cohort
- 11 826 total admissions
- LACEi accuracy

**LACEi2023**

- Regional Australia Nested Case-control
- 2157 total admissions
- LACEi: AUC




**LACEi2022**

- Regional Australia retrospective cohort
- 4167 total admissions
- LACEi: C-statistic 0.69 [95% CI: 0.67-0.73]

## Extraction

**From HIS**

**all medical admissions**

**Automated**

## Transformation

**Transform ICD10-AM cross-referenced with ICD10/ICD9 into LACEi**

**Automated**

## Record-review

**Cause for readmission**

**Manual record-review**

# Results: Demographics

| | 30-day readmission (Cases) N = 134 | Non-admissions (Controls) N = 2023 |
|---|---|---|
| **Biological sex*** | | |
| **Male** | 80 (59.7 %) | 975 (48.2 %) |
| **Female** | 54 (40.3 %) | 1048 (51.8 %) |
| **Mean Age in years (+- SD) *** | 71.7 (+- 17.9) | 69.2 (+- 18.1) |
| **18 - 44 years** | 16 (11.9%) | 233 (11.5 %) |
| **45 - 64 years** | 16 (11.9%) | 453 (22.4 %) |
| **65 - 84 years** | 66 (49.3%) | 906 (44.8 %) |
| **85+ years** | 36 (26.9 %) | 431 (21.3%) |
| **Mean LOS (in days) (+- SD)*** | 5.77 (+- 18.4) | 5.12 (+- 8.9) |
| **0 – 3 days** | 52 (38.8%) | 990 (48.9%) |
| **4 – 7 days** | 56 (41.8%) | 691 (34.1%) |
| **8 – 14 days** | 17 (12.7%) | 247 (12.2%) |
| **15 – 30 days** | 9 (6.7%) | 72 (3.6%) |
| **30+ days** | 0 | 23 (1.1%) |

| | 30-day readmission (Cases) N = 134 | Non-admissions (Controls) N = 2023 |
|---|---|---|
| **Number of Comorbid Conditions*** | | |
| **No Comorbidities** | 55 (41.0%) | 995 (49.1%) |
| **1 Comorbidity** | 33 (24.6%) | 593 (29.3%) |
| **2 Comorbidities** | 18 (13.4%) | 213 (10.5%) |
| **3+ Comorbidities** | 28 (20.9%) | 221 (10.9%) |

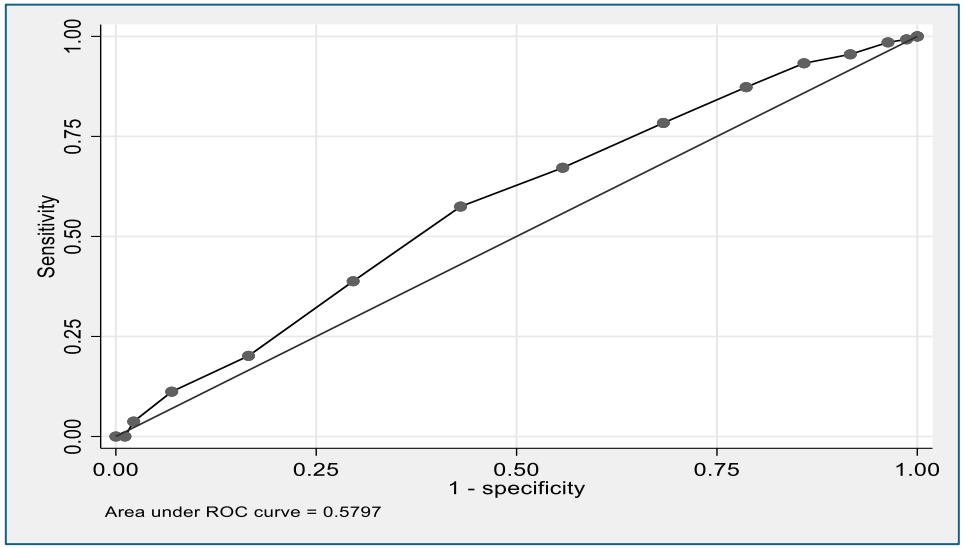
| **LACE index*** | 30-day readmission (Cases) N = 134 | Non-admissions (Controls) N = 2023 |
|---|---|---|
| **Low-risk (LACEi 0 – 4)** | 1 (0.7%) | 27 (1.3%) |
| **Intermediate risk (LACEi 5 – 9)** | 28 (20.9%) | 614 (30.3%) |
| **High-risk (LACEi >= 10)** | 105 (78.4%) | 1382 (68.3%) |

***p < 0.05 (Wilcoxon rank-sum)**

# Readmission Indexes

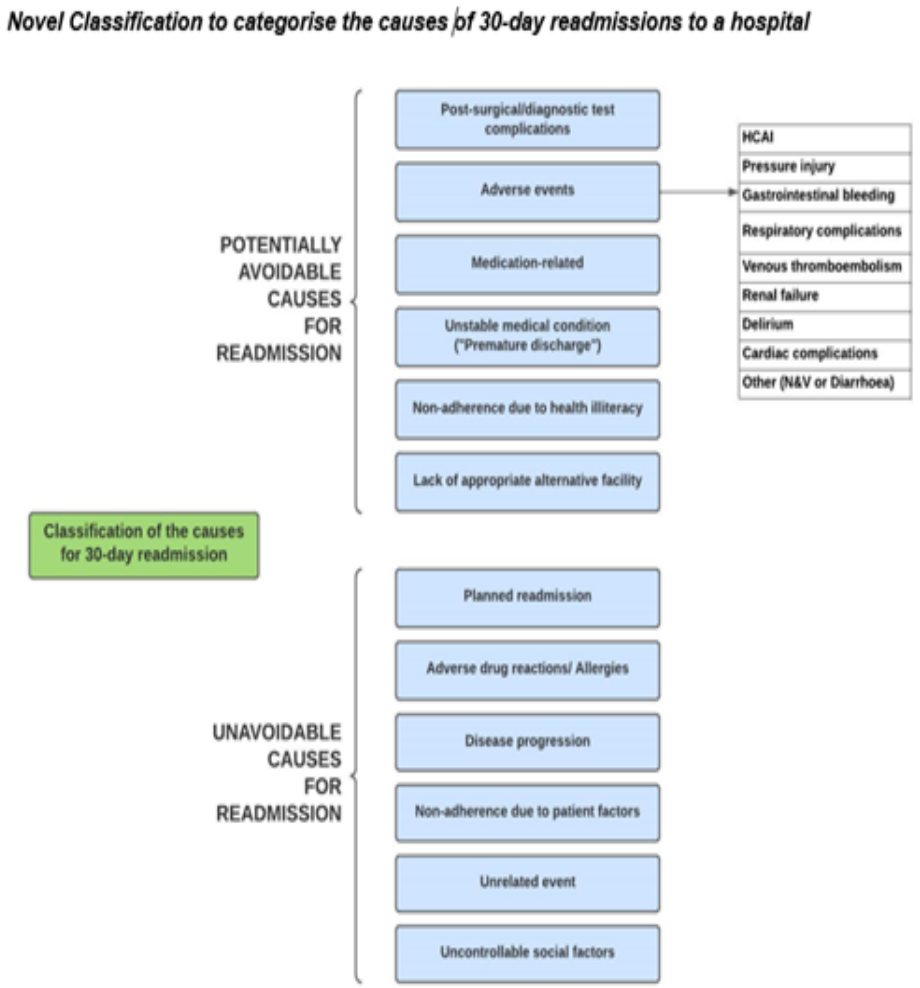
| | 30-day readmission (Cases) N = 134 | Non-admissions (Controls) N = 2023 |
|---|---|---|
| **Length of stay (LOS) score*** | | |
| **LOS score = 1** | 6 (4.5%) | 302 (14.9%) |
| **LOS score = 2** | 18 (13.4%) | 382 (18.9%) |
| **LOS score = 3** | 28 (20.9%) | 303 (15.0%) |
| **LOS score = 4** | 47 (35.1%) | 595 (29.4%) |
| **LOS score = 5** | 23 (17.2%) | 331 (16.4%) |
| **LOS score = 7** | 12 (9.0%) | 110 (5.4%) |
| **Acuity score** | 3 | 3 |
| **Charlson Comorbidity Index (CCI)*** | | |
| **Index = 0** | 12 (9.0%) | 205 (10.1%) |
| **Index = 1** | 8 (6.0%) | 183 (9.0%) |
| **Index = 2** | 10 (7.5%) | 251 (12.4%) |
| **Index = 3** | 23 (17.2%) | 345 (17.1%) |
| **Index = 4** | 0 | 0 |
| **Index = 5** | 81 (60.4%) | 1039 (51.4%) |
| **ED score** | | |
| **ED score = 0** | 46 (34.3%) | 698 (34.5%) |
| **ED score = 1** | 51 (38.1%) | 672 (33.2%) |
| **ED score = 2** | 37 (27.6%) | 653 (32.3%) |

| Interval to readmission | 30-day readmission (Cases) N = 134 |
|---|---|
| **0 – 3 days** | 23 (17.2 %) |
| **4 – 7 days** | 27 (20.1 %) |
| **8 – 14 days** | 34 (25.4 %) |
| **15 – 30 days** | 50 (37.3 %) |




*p < 0.05: Wilcoxon rank-sum

# Readmission Classification




| **Potentially Avoidable readmissions (n = 56) #** | |
|---|---|
| **1. Surgical/Procedural Complications** | # |
| **2. Post-diagnostic procedure complication** | # |
| **3. Medication-related** | 3 (2.2 %) |
| **4. Non-adherence due to health literacy** | 1 (0.7 %) |
| **5. Lack of alternative facility/Systemic factors** | 3 (2.2 %) |
| **6. Avoidable adverse events (n = 48)** | 18 (13.4 %) |
| - **HCAI** | 2 (1.5 %) |
| - **Pressure injuries** | 10 (7.5 %) |
| - **Cardiac Complications** | 8 (6 %) |
| - **Delirium** | 1 (0.7 %) |
| - **VTE** | 7 (5.2 %) |
| - **GIT Bleeding** | 2 (1.5 %) |
| - **Other (Nausea, vomiting, constipation)** | |
| **Unavoidable readmissions (n = 78) #** | |
| **1. Planned readmissions** | # |
| **2. Unplanned ADR/Allergies** | 2 (1.5 %) |
| **3. Disease progression** | 57 (42.5 %) |
| **4. Non-adherence due to patient factors** | 13 (9.7%) |
| **5. Unrelated readmission** | 7 (5.2 %) |
| **6. Uncontrollable social problem** | 0 |

# Conclusion

**Demographic and risk-profile of cases/controls**

- Higher risk of 30-day readmission if biological Male, >= 65 years old, 3+ Comorbidities and high CCI
- Nearly 2/3 of readmissions occurred within the first 14 days

A positive linear correlation between a higher LACEi and readmission risk ($\chi^2 = 5.92$; $df = 1$; $P < 0.05$).

- Each unit increase in LACEi, the odds of readmission increased by 11% (OR 1.11 [95% CI, 1.04–1.19])

**Testing the LACEi accuracy (cutoff ≥10) yielded AUC of 0.58**

- LACEi alone did not adequately predict readmission risk (HR, 1.22 [95% CI, 0.80–1.85]; $P > 0.05$).
- Risk factors: Males > females (HR, 1.60 [95% CI, 1.12–2.25]; $P < 0.05$).
- Incorporating male sex and age ≥ 65 years improved accuracy of the model (AUC = 0.61).

**Classification tool for causes of 30-day Readmission**

- Correctly identified causes of readmission compared to the Australian Administrative Framework#
- Novel classification tool: Over 40% of readmissions were potentially avoidable

# What is next?
# Implementation into practice

Incorporation of LACEi into discharge summaries to identify high-risk groups

Classification tool: multisite validation study

Does early vs. standard follow-up of high-risk patients (using LACEi) reduce readmissions?

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