

Prehospital factors predicting mortality in patient with non-traumatic shock: state-wide linkage study.

Amminadab L **Eliakundu** MCLinEpi, PhD^{1,3,4}
Jason E **Bloom** BSc, MBBS (Hons), FRACP^{1,2,3,4}
Jocasta **Ball** BBiomedSc (Hons), PhD^{2,3,4}
Emily **Nehme** BSc (Biomedical), MBiosts^{3,4}
Daniel O **Okyere** MBBS, MPH^{3,4}
Stephane **Heritier** PhD, MBA⁴
Aleksandr **Voskoboinik** MBBS(Hons), PhD, FRACP^{1,2}
Luke P **Dawson** MBBS (Hons), MPH, FRACP^{1,3,4}
Shelley **Cox** PhD^{3,4}
David **Anderson** MBChB, DipPallMed, FCICM^{1,3,4}
Aidan **Burrell** MBBS, PhD, FCICM^{1,6}
David **Pilcher** MBBS, MRCP(UK), FCICM, FRACP^{1,6}
Derek P **Chew** MBBS, MPH, PhD, FRACP, FACC, FESC, FCSANZ⁵
David M **Kaye** MBBS, PhD, FRACP, FACC^{1,2}
Ziad **Nehme** BEmergHlth (Paramedic), PhD^{3,4*}
Dion **Stub** MBBS, PhD, FRACP^{1,2,3,4*}

¹ The Alfred Hospital, 55 Commercial Road, Prahran, VIC 3004, Australia.

² Baker Heart and Diabetes Institute, 75 Commercial Road, Melbourne, VIC 3004, Australia.

³ Centre for Research and Evaluation, Ambulance Victoria, 31 Joseph Street, Blackburn, VIC 3130, Australia.

⁴ Faculty of Medicine Nursing and Health Sciences, Monash University, VIC 3800, Australia.

⁵ The Victorian Heart Hospital/Victorian Heart Institute, Monash University, 631 Blackburn Road, Clayton, VIC 3168 Australia

⁶ ANZ Intensive Care Research Centre (ANZIC-RC), Dept. of Epidemiology and Preventive Medicine, Monash University

Corresponding Author:

Professor Dion Stub
The Alfred Hospital & Monash University
55 Commercial Rd, Prahran, Victoria 3004, Australia
Phone +61 9076 2000
Email: d.stub@alfred.org.au

Footnotes:

Dr Ziad Nehme and Prof Dion Stub are Co-Senior Authors

A. Supplementary Methods

I. Dataset linkage processes:

For this study, data linkage was performed to combine electronic patient care record data with key Victorian datasets. These included:

1. Victorian Emergency Minimum Dataset: Victorian Department of Health administrative and clinical data related emergency department (ED) presentations at public hospitals in the state. Data is submitted by individual health services and is then subject to validation checks. For this study, EMS patient identifiers were matched with Department of Health identifiers using Dataflux software with deterministic data linkage and fuzzy matching for variables such as names and dates. ED presentations for matched patients were then linked to ambulance cases as follows:
 - a. Where the patient was transported to hospital by ambulance, the VEMD arrival time was required to be within one hour of the ambulance ED arrival time.
 - b. Where the patient contacted ambulance but was not transported to hospital, the VEMD arrival time was required to be within 48 hours of the emergency call for ambulance. If multiple VEMD records existed within the 48-hour period, the presentation occurring closest in time to the ambulance call was used.
2. Victorian Admitted Episodes Dataset: Victorian Department of Health demographic, clinical and administrative data relating to each admitted episode of care occurring in public and private hospitals, as well as rehabilitation centres, extended care facilities and day procedure centres in the state. For this study, EMS patient identifiers were matched with Department of Health identifiers using Dataflux software with deterministic data linkage and fuzzy matching for variables such as names and dates. For matched patients, individual admitted episodes of care occurring up to 48 hours after the emergency ambulance call were linked to the ambulance patient care record data. Where multiple admitted episodes were recorded within the 48 hours, the episode occurring closest in time to the ambulance call was used.
3. Victorian Death Index: Victorian Department of Health data capturing the date and cause of all deaths in Victoria. For matched patients, death records were then linked to all ambulance contacts occurring in the study period.

II: Study definitions:

Socio-economic status was determined by the Index of Relative Scio-Economic Disadvantage Score (IRSD), a validated measure that ranks individual post-codes into deciles of relative disadvantage. This score is derived from Census data that includes household income, education level, employment status, occupation, housing ownership, and non-English speaking background. For this analysis, we divided the IRSD into quintiles, with the 1st quintile being the most disadvantaged (comprising of ISRD deciles 1 and 2) and the 5th quintile being least disadvantaged (IRSD deciles 9 and 10).

Geographic remoteness was determined through the residential area postcode of each event using The Accessibility and Remoteness Index of Australia (ARIA) – a geographic accessibility index that divides Australia into five classes of remoteness ('Major City', 'Inner Regional', 'Outer Regional', 'Remote', and 'Very Remote') to reflect relative access to services in non-metropolitan Australia. Due to low numbers of patients from 'remote' or 'very remote' regions, these groups were combined with the 'outer regional' group for the purposes of this study.

Aetiology of shock was defined in accordance with the final discharge diagnosis from hospital using the International Classification of Diseases, 10th Revision, Australian Modification (ICD-10 AM codes. The ICD-10 codes used identify patients with cardiogenic shock remains constant across the different ICD-10-AM editions of codes used by hospitals over the study period (i.e. ICD-10-AM: 8th edition in 2014-15; 9th edition in 2015-16 & 2016-17; 10th edition in 2017-18 & 2018-19).

Cardiogenic Shock:

1. Cardiovascular diagnoses: I00-I99
2. ST-elevation myocardial infarction: I210-I213, I220-I229, I256
3. Non-ST elevation myocardial infarction: I214, I219
4. Unstable angina: I200
5. Stable coronary syndromes: I201, I208, I209, I248-I252, I254, I255, I258, I259
6. Atrial fibrillation: I480-I489
7. Supraventricular tachycardia: I471
8. Other arrhythmia: I441, I442, I456, I458- I461, I469, I470, I472, I479, I490-I499
9. Heart failure: I420-I438, I500-I509
10. Myocarditis: I012, I090, I400-I418, I514,
11. Valvular heart disease: I050-I089, I340-I379, I390-I394
12. Other cardiac: I00-I1528 excluding codes categorised above
13. Other vascular: I600-I99 excluding codes categorised above

Septic shock:

1. Respiratory diagnoses: J00-J998
2. Pneumonia: J100, J110, J120-J189, J22
3. Asthma: J450-J46
4. Exacerbation of COPD: J431-J449, J47-J709, J982, J983
5. Other respiratory: J00-J998 excluding codes categorised above
6. Infectious diagnoses: A000-B99
7. Neoplastic diagnoses: C000-D899

Hypovolemic shock:

1. Aortic aneurysm or dissection: I7100-I7103, I711-I719
2. Gastrointestinal diagnoses: K000-K938
3. GORD, gastritis, oesophagitis: K20-K238, K290-K30
4. Peptic ulcer disease: K250-K289
5. Hepatobiliary: K700-K839, K870
6. Pancreatitis: K850-K869, K871
7. Other gastrointestinal: K000-K938 excluding codes categorised above

Other shock:

1. Rheumatological diagnoses: M0000-M99923
2. Mental Health diagnoses: F000-F99
3. Neurological diagnoses: G000-G998
4. Endocrine diagnoses: E000-E899
5. Other medical diagnoses: H000-H959, L00-L998, M0000-M99923, N000-N999, O000-O998, P000-Q999, S001-Z999
6. Pericarditis: I010, I092, I241, I300-I328
7. Non-specific pain: R000-R99
8. Pulmonary embolism: I260, I269
9. Pneumothorax: J930-J939

Procedures in Table 3 were defined according to ICD 10 V9.0 procedural codes as follows:

1. Coronary angiography: 3820300, 3820600, 382500, 3821800-3821802
2. Percutaneous coronary intervention: 3830600-3830605, 3831200, 3831201, 3831800, 3831801
3. Coronary artery bypass graft surgery: 3849700-3849707, 3850000-3850005, 3850300-3850305, 9020100-9020103

B. Consort diagram of cohort derivation