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## Online supplement

### Predicting risk of unplanned hospital readmission in survivors of critical illness: a population-level cohort study

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## Supplementary methods

### Setting

The Scottish National Health Service provides comprehensive community and hospital based health care funded through general taxation and free at the point of delivery. Private health care providers comprise a small number of total activity and are not involved in delivery of emergency care. Scotland does not provide Long Term Acute Care facilities such as those found in the USA, nor has there been widespread adoption of post-ICU clinics.

### Variables

Predictors: Factors were classified into three groups: demographics; indices of pre-existing patient health; and indices of critical illness severity. See Supplement for additional information relating to variables. Demographic variables comprised: sex, age at ICU admission, socioeconomic status (measured using Scottish Index of Multiple Deprivation(1)) and remoteness of residence.(2) Indices of pre-existing patient health comprised: admissions/attendances in year prior to index hospital stay (unplanned inpatient, elective/day case, new outpatient attendances, acute psychiatric admissions) and comorbidities (represented as a count and as individual comorbidities). Indices of critical illness severity comprised: ICU admission type (elective surgery, unplanned surgery, non-operative), diagnosis on ICU admission (28 categories(3)), acute physiology score (APS) at admission to ICU, Acute Physiology and Chronic Health Evaluation (APACHE) II score, organ support (mechanical ventilation, renal replacement therapy, circulatory support, maximum number of organs supported on any day during ICU stay), and length of stay variables (length of stay before, during and after ICU stay, total length of index hospital stay).

Measures of comorbidity were derived from three registries: a list of comorbidities derived from previous hospital admissions recorded in SMR01; previous cancer diagnosis from the Scottish Cancer Registry; and the comorbidities recorded in the Scottish Intensive Care Society Audit Group registry as part of severity of illness scoring. The comorbidities identified by Charlson were derived from a five year 'look-back' period from the date of the hospital admission during which the index ICU admission occurred using published International Classification of Disease version 10 coding algorithms.(4) This list was supplemented by codes relating to previous alcohol misuse and drug misuse. The comorbidities extracted from the SICSAG database were derived from those recorded at the time of ICU admission by health care staff as part of the APACHE II and the SAPS II comorbidities. This resulted in six comorbidity categories derived from the SICSSAG database: severe cardiovascular disease, severe respiratory disease, severe liver disease, end stage renal disease, immunosuppression and metastatic cancer. In order to maximise use of the two separate measures of comorbidity and reduce duplication of these measures, we combined the sources of comorbidity ascertainment to produce 19 comorbid categories. The 19 comorbidities were entered as a count of comorbidities (0, 1, 2, 3, 4,  $\geq 5$ ) in analyses.

The Scottish Index of Multiple Deprivation is an area-based ranking measure of relative deprivation across Scotland which combines seven domains of indicators of deprivation: income, employment, education, health,

access to services, crime, and housing.(1) It was used in analyses as quintiles. Remoteness of residence defined by the Scottish Office of National Statistics and were used in analyses as a four level variable.(2) An urban settlement is defined as one with greater than 10,000 people. A remote settlement is defined as one with a drive time of greater than 30 minutes to the nearest settlement with 10,000 or more people in it. A very remote settlement is defined as one with a drive time of greater than 60 minutes to the nearest settlement with 10,000 or more people in it.

All quantitative variables were analysed as categorical variables, with categories determined by frequencies.

Variable selection in the multivariable regression models differed depending on the modelling strategy. For models identifying independent predictors of readmission, variables that were closely related from a conceptual (rather than statistical) viewpoint were only entered in one form (e.g. pre-ICU, ICU and post-ICU length of stay rather than hospital length of stay). For organ support variables, individual organ support variables were entered as binary variables rather than number of days of organ support (which was related to ICU length of stay) or total number of organs supported. Count of comorbidities was entered in models rather than individual comorbidities in the primary analysis. In a sensitivity analysis, count of comorbidities was replaced by individual comorbidities. For risk prediction modelling, we allowed conceptually related variables to be candidate variables for selection e.g. count of comorbidities and individual comorbidities were eligible for selection.

## References

1. Scottish Government. SIMD Scottish Index of Multiple Deprivation 2009 General Report. 2009 [cited 04/05/2017] Available from: <http://www.gov.scot/resource/doc/289599/0088642.pdf>
2. Scottish Government. Scottish Government Urban Rural Classification 2013-2014. 2014 [cited 04/04/2017] Available from: <http://www.gov.scot/Publications/2014/11/2763/0>
3. Lone NI, Gillies MA, Haddow C, et al. Five-Year Mortality and Hospital Costs Associated with Surviving Intensive Care. *Am J Respir Crit Care Med* 2016;194(2):198-208.
4. Quan H, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Medical care* 2005;43(11):1130-1139.

**eTable 1 Baseline characteristics**

| Characteristic  |                                    | N or Median | % or Quartiles | Missing N (%) |
|---|------------------------------------|-------------|----------------|---------------|
| <b>Demographics</b>   |                                    |             |                |               |
| Sex   | Female                             | 24,466      | 43.7           | 0             |
| Age at admission to ICU (years)                             | Median and Quartiles               | 60          | 45, 71         | 0             |
| Scottish Index of Multiple Deprivation                      | First quintile (Most deprived)     | 14,809      | 26.5           | 31 (0.1)      |
|   | Second quintile                    | 12,907      | 23.1           |               |
|   | Third quintile                     | 11,269      | 20.1           |               |
|   | Fourth quintile                    | 9,631       | 17.2           |               |
|   | Fifth quintile (Least deprived)    | 7,328       | 13.1           |               |
| Remoteness of residence                                     | Urban area                         | 37,469      | 68.1           | 941 (1.7)     |
|   | Accessible                         | 13,271      | 24.1           |               |
|   | Remote                             | 2,483       | 4.5            |               |
|   | Very remote                        | 1,811       | 3.3            |               |
| <b>Indices of pre-existing patient health</b>               |                                    |             |                |               |
| Admissions/attendances in year prior to index hospital stay |                                    |             |                | 0             |
| Number of unplanned inpatient admissions                    | 0                                  | 38,429      | 68.7           |               |
|   | 1                                  | 10,582      | 18.9           |               |
|   | 2 or more                          | 6,964       | 12.5           |               |
| Number of elective inpatient & daycase admissions           | 0                                  | 37,770      | 67.5           |               |
|   | 1                                  | 4,286       | 7.7            |               |
|   | 2 or more                          | 13,919      | 24.9           |               |
| Number of new outpatient attendances                        | 0                                  | 27,134      | 48.5           |               |
|   | 1                                  | 15,428      | 27.6           |               |
|   | 2 or more                          | 13,413      | 23.9           |               |
| Number of acute psychiatric admissions                      | 0                                  | 54,703      | 97.7           |               |
|   | 1                                  | 845         | 1.5            |               |
|   | 2 or more                          | 427         | 0.8            |               |
| <b>Comorbidities</b>  |                                    |             |                |               |
| Number of comorbidities present                             | 0                                  | 24,420      | 43.6           | 0             |
|   | 1                                  | 17,490      | 31.2           |               |
|   | 2                                  | 8,338       | 14.9           |               |
|   | 3 or more                          | 5,727       | 10.2           |               |
| Myocardial infarction                                       | Yes                                | 3,232       | 5.8            |               |
| Cardiovascular disease                                      | Yes                                | 3,780       | 6.8            |               |
| Peripheral vascular disease                                 | Yes                                | 2,763       | 4.9            |               |
| Cerebrovascular disease                                     | Yes                                | 2,149       | 3.8            |               |
| Dementia  | Yes                                | 177         | 0.3            |               |
| Respiratory disease   | Yes                                | 6,663       | 11.9           |               |
| Rheumatic disease   | Yes                                | 910         | 1.6            |               |
| Peptic ulcer disease  | Yes                                | 1,094       | 2.0            |               |
| Liver disease   | No                                 | 53,401      | 95.4           |               |
|   | Mild                               | 966         | 1.7            |               |
|   | Moderate or severe                 | 1,608       | 2.9            |               |
| Diabetes mellitus   | No                                 | 51,175      | 91.4           |               |
|   | Yes - without chronic complication | 4,122       | 7.4            |               |
|   | Yes - with chronic complication    | 678         | 1.2            |               |
| Hemiplegia or paraplegia                                    | Yes                                | 390         | 0.7            |               |
| Renal disease   | Yes                                | 2,256       | 4.0            |               |
| Cancer  | No                                 | 43,763      | 78.2           |               |
|   | Yes - without metastases           | 10,324      | 18.4           |               |
|   | Yes - with metastases              | 1,888       | 3.4            |               |
| Immunosuppression   | Yes                                | 1,401       | 2.5            |               |

| Characteristic  |   | N or Median | % or Quartiles | Missing N (%) |
|---|---|-------------|----------------|---------------|
| Alcohol misuse  | Yes   | 6,065       | 10.8           |               |
| Drug misuse   | Yes   | 3,927       | 7.0            |               |
| <b>Indices of critical illness severity</b>                   |   |             |                |               |
| Type of admission to ICU                                      | Elective surgery                              | 15,553      | 28.0           | 402 (0.7)     |
|   | Emergency surgery                             | 13,222      | 23.8           |               |
|   | Non-operative                                 | 26,798      | 48.2           |               |
| Diagnosis at admission to ICU                                 | Trauma including head injury                  | 1,231       | 2.2            | 0             |
|   | Cardiovascular                                |             |                |               |
|   | Aortic aneurysm rupture                       | 597         | 1.1            |               |
|   | Cardiogenic shock                             | 211         | 0.4            |               |
|   | Post cardiac arrest                           | 1,200       | 2.1            |               |
|   | Septic shock                                  | 2,805       | 5.0            |               |
|   | Vascular surgery                              | 1,946       | 3.5            |               |
|   | Other CVS                                     | 5,136       | 9.2            |               |
|   | Respiratory                                   |             |                |               |
|   | ARDS  | 265         | 0.5            |               |
|   | Asthma  | 649         | 1.2            |               |
|   | COPD  | 390         | 0.7            |               |
|   | Pneumonia                                     | 4,696       | 8.4            |               |
|   | Other respiratory                             | 4,546       | 8.1            |               |
|   | Gastrointestinal/Liver                        |             |                |               |
|   | GI bleed                                      | 1,026       | 1.8            |               |
|   | GI neoplasm                                   | 2,956       | 5.3            |               |
|   | GI obstruction                                | 2,007       | 3.6            |               |
|   | GI perforation/ischaemia/ peritonitis/abscess | 3,931       | 7.0            |               |
|   | Other GI                                      | 3,000       | 5.4            |               |
|   | Liver failure                                 | 219         | 0.4            |               |
|   | Oesophageal variceal bleed                    | 465         | 0.8            |               |
|   | Pancreatitis                                  | 597         | 1.1            |               |
|   | Nervous system                                |             |                |               |
|   | Intracranial bleed                            | 1,410       | 2.5            |               |
|   | Seizures                                      | 1,321       | 2.4            |               |
|   | Other CNS                                     | 2,017       | 3.6            |               |
|   | Other   |             |                |               |
|   | Diabetic ketoacidosis                         | 531         | 0.9            |               |
|   | Renal   | 1,578       | 2.8            |               |
|   | Self poisoning                                | 2,863       | 5.1            |               |
|   | Trauma excluding head injury                  | 2,576       | 4.6            |               |
|   | Miscellaneous                                 | 5,806       | 10.4           |               |
| CPR prior to admission to ICU                                 | Yes   | 1,834       | 3.3            | 0             |
| APACHE II score at admission to ICU                           | Median and Quartiles                          | 15          | 11, 20         | 7157 (12.8)   |
| Acute physiology score at admission to ICU                    | Median and Quartiles                          | 11          | 8, 16          | 7182 (12.8)   |
| Mechanical ventilation during ICU stay                        | Yes   | 33,447      | 60.2           | 445 (0.8)     |
| Renal replacement therapy during ICU stay                     | Yes   | 3,925       | 7.1            | 445 (0.8)     |
| Cardiovascular system support during ICU stay                 | Yes   | 20,101      | 36.2           | 445 (0.8)     |
| Maximum number of organs supported on any day during ICU stay | 0   | 17,877      | 32.2           | 445 (0.8)     |
|   | 1   | 20,969      | 37.8           |               |
|   | 2   | 14,277      | 25.7           |               |
|   | 3   | 2,407       | 4.3            |               |
| Tracheostomy during ICU stay                                  | Yes   | 5,304       | 9.6            |               |
| Length of stay prior to ICU stay (days)                       | Median and Quartiles                          | 1           | 0, 2           | 445 (0.8)     |
| Length of ICU stay (days)                                     | Median and Quartiles                          | 2           | 1, 4           | 0             |
| Length of stay post ICU stay (days)                           | Median and Quartiles                          | 9           | 4, 22          | 0             |
| Length of index hospital stay (days)                          | Median and Quartiles                          | 15          | 8, 31          | 0             |

**eTable 2 Risk factors for unplanned hospital admission and unplanned hospital admission or death within 90 days of discharge from index hospital stay: univariable analyses**

| Risk factor   |                                 | N      | 90d readmission<br>N (%) | 90d death without readmission<br>N (%) | Odds ratio for 90d readmission<br>(95% CI) | c-index | p-value | Odds ratio for 90 day readmission or death<br>(95% CI) | c-index | p-value |
|---|---------------------------------|--------|--------------------------|--|--|---------|---------|--|---------|---------|
| <b>Demographics</b>   |                                 |        |                          |  |  |         |         |  |         |         |
| Sex   | Male                            | 31,509 | 7519 (23.9)              | 409 (1.3)                              | 1.00 (reference)                           | 0.50    | 0.20    | 1.00 (reference)                                       | 0.50    | 0.27    |
|   | Female                          | 24,466 | 5952 (24.3)              | 303 (1.2)                              | 1.03 (0.99 to 1.07)                        |         |         | 1.02 (0.98 to 1.06)                                    |         |         |
| Age at admission to ICU (years)                             | 16 - 25                         | 3,739  | 636 (17.0)               | 16 (0.4)                               | 1.00 (reference)                           | 0.52    | <0.0001 | 1.00 (reference)                                       | 0.53    | <0.0001 |
|   | 26 - 35                         | 4,310  | 898 (20.8)               | 16 (0.4)                               | 1.28 (1.15 to 1.44)                        |         |         | 1.27 (1.14 to 1.42)                                    |         |         |
|   | 36 - 45                         | 6,364  | 1565 (24.6)              | 41 (0.6)                               | 1.59 (1.44 to 1.76)                        |         |         | 1.60 (1.44 to 1.77)                                    |         |         |
|   | 46 - 55                         | 8,479  | 2161 (25.5)              | 69 (0.8)                               | 1.67 (1.51 to 1.84)                        |         |         | 1.69 (1.53 to 1.86)                                    |         |         |
|   | 56 - 65                         | 11,550 | 2847 (24.6)              | 143 (1.2)                              | 1.60 (1.45 to 1.76)                        |         |         | 1.65 (1.51 to 1.82)                                    |         |         |
|   | 66 - 75                         | 12,917 | 3232 (25.0)              | 216 (1.7)                              | 1.63 (1.48 to 1.79)                        |         |         | 1.72 (1.57 to 1.89)                                    |         |         |
|   | 76 - 85                         | 7,572  | 1854 (24.5)              | 153 (2.0)                              | 1.58 (1.43 to 1.75)                        |         |         | 1.71 (1.55 to 1.88)                                    |         |         |
|   | 86 or older                     | 1,044  | 278 (26.6)               | 58 (5.6)                               | 1.77 (1.51 to 2.08)                        |         |         | 2.25 (1.92 to 2.62)                                    |         |         |
| Scottish Index of Multiple Deprivation                      | First quintile (Most deprived)  | 14,809 | 3810 (25.7)              | 195 (1.3)                              | 1.00 (reference)                           | 0.52    | <0.0001 | 1.00 (reference)                                       | 0.52    | <0.0001 |
|   | Second quintile                 | 12,907 | 3182 (24.7)              | 149 (1.2)                              | 0.94 (0.89 to 1.00)                        |         |         | 0.94 (0.89 to 0.99)                                    |         |         |
|   | Third quintile                  | 11,269 | 2645 (23.5)              | 155 (1.4)                              | 0.89 (0.84 to 0.94)                        |         |         | 0.89 (0.84 to 0.94)                                    |         |         |
|   | Fourth quintile                 | 9,631  | 2129 (22.1)              | 119 (1.2)                              | 0.82 (0.77 to 0.87)                        |         |         | 0.82 (0.77 to 0.87)                                    |         |         |
|   | Fifth quintile (Least deprived) | 7,328  | 1699 (23.2)              | 92 (1.3)                               | 0.87 (0.82 to 0.93)                        |         |         | 0.87 (0.82 to 0.93)                                    |         |         |
| Remoteness of residence                                     | Urban area                      | 37,469 | 9321 (24.9)              | 458 (1.2)                              | 1.00 (reference)                           | 0.52    | <0.0001 | 1.00 (reference)                                       | 0.51    | <0.0001 |
|   | Accessible                      | 13,271 | 2974 (22.4)              | 185 (1.4)                              | 0.87 (0.83 to 0.91)                        |         |         | 0.88 (0.84 to 0.93)                                    |         |         |
|   | Remote                          | 2,483  | 516 (20.8)               | 35 (1.4)                               | 0.79 (0.72 to 0.88)                        |         |         | 0.81 (0.73 to 0.89)                                    |         |         |
|   | Very remote                     | 1,811  | 449 (24.8)               | 27 (1.5)                               | 1.00 (0.89 to 1.11)                        |         |         | 1.01 (0.91 to 1.12)                                    |         |         |
| <b>Indices of pre-existing patient health</b>               |                                 |        |                          |  |  |         |         |  |         |         |
| Admissions/attendances in year prior to index hospital stay |                                 |        |                          |  |  |         |         |  |         |         |
| Number of unplanned inpatient admissions                    | 0                               | 38,429 | 7494 (19.5)              | 418 (1.1)                              | 1.00 (reference)                           | 0.60    | <0.0001 | 1.00 (reference)                                       | 0.60    | <0.0001 |
|   | 1                               | 10,582 | 2968 (28.0)              | 162 (1.5)                              | 1.61 (1.53 to 1.69)                        |         |         | 1.62 (1.54 to 1.70)                                    |         |         |
|   | 2                               | 3,624  | 1296 (35.8)              | 65 (1.8)                               | 2.30 (2.14 to 2.47)                        |         |         | 2.32 (2.16 to 2.49)                                    |         |         |
|   | 3                               | 1,570  | 681 (43.4)               | 35 (2.2)                               | 3.16 (2.85 to 3.51)                        |         |         | 3.23 (2.92 to 3.58)                                    |         |         |

| Risk factor                                       |           | N      | 90d          | 90d death | Odds ratio for 90d   |  | c-index | p-value | Odds ratio for 90 day |  | c-index | p-value |
|---|-----------|--------|--------------|-----------|----------------------|--|---------|---------|-----------------------|--|---------|---------|
|   |           |        | readmission  | without   | readmission          |  |         |         | readmission or death  |  |         |         |
|   |           |        | N (%)        | N (%)     | (95% CI)             |  |         |         | (95% CI)              |  |         |         |
|   | 4         | 754    | 376 (49.9)   | 14 (1.9)  | 4.11 (3.55 to 4.75)  |  |         |         | 4.13 (3.57 to 4.78)   |  |         |         |
|   | 5         | 368    | 201 (54.6)   | 3 (0.8)   | 4.97 (4.04 to 6.11)  |  |         |         | 4.80 (3.90 to 5.90)   |  |         |         |
|   | 6 or more | 648    | 455 (70.2)   | 15 (2.3)  | 9.72 (8.20 to 11.52) |  |         |         | 10.18 (8.55 to 12.11) |  |         |         |
| Number of elective inpatient & daycase admissions | 0         | 37,770 | 8395 (22.2)  | 459 (1.2) | 1.00 (reference)     |  | 0.54    | <0.0001 | 1.00 (reference)      |  | 0.54    | <0.0001 |
|   | 1         | 4,286  | 1203 (28.1)  | 68 (1.6)  | 1.37 (1.27 to 1.47)  |  |         |         | 1.38 (1.28 to 1.48)   |  |         |         |
|   | 2         | 7,320  | 1841 (25.2)  | 82 (1.1)  | 1.18 (1.11 to 1.25)  |  |         |         | 1.16 (1.10 to 1.23)   |  |         |         |
|   | 3         | 1,877  | 540 (28.8)   | 27 (1.4)  | 1.41 (1.28 to 1.57)  |  |         |         | 1.41 (1.28 to 1.56)   |  |         |         |
|   | 4         | 1,963  | 557 (28.4)   | 20 (1.0)  | 1.39 (1.25 to 1.53)  |  |         |         | 1.36 (1.23 to 1.50)   |  |         |         |
|   | 5         | 651    | 211 (32.4)   | 8 (1.2)   | 1.68 (1.42 to 1.98)  |  |         |         | 1.66 (1.41 to 1.95)   |  |         |         |
|   | 6         | 596    | 202 (33.9)   | 9 (1.5)   | 1.79 (1.51 to 2.13)  |  |         |         | 1.79 (1.51 to 2.12)   |  |         |         |
|   | 7 or more | 1,512  | 522 (34.5)   | 39 (2.6)  | 1.85 (1.66 to 2.06)  |  |         |         | 1.93 (1.73 to 2.15)   |  |         |         |
| Number of new outpatient attendances              | 0         | 27,134 | 5889 (21.7)  | 374 (1.4) | 1.00 (reference)     |  | 0.54    | <0.0001 | 1.00 (reference)      |  | 0.53    | <0.0001 |
|   | 1         | 15,428 | 3904 (25.3)  | 197 (1.3) | 1.22 (1.17 to 1.28)  |  |         |         | 1.21 (1.15 to 1.26)   |  |         |         |
|   | 2         | 8,244  | 2219 (26.9)  | 91 (1.1)  | 1.33 (1.26 to 1.41)  |  |         |         | 1.30 (1.23 to 1.37)   |  |         |         |
|   | 3         | 3,365  | 909 (27.0)   | 32 (1.0)  | 1.34 (1.23 to 1.45)  |  |         |         | 1.29 (1.19 to 1.40)   |  |         |         |
|   | 4         | 1,139  | 350 (30.7)   | 13 (1.1)  | 1.60 (1.41 to 1.82)  |  |         |         | 1.56 (1.37 to 1.77)   |  |         |         |
|   | 5 or more | 665    | 200 (30.1)   | 5 (0.8)   | 1.55 (1.31 to 1.84)  |  |         |         | 1.49 (1.26 to 1.76)   |  |         |         |
| Number of acute psychiatric admissions            | 0         | 54,703 | 13079 (23.9) | 686 (1.3) | 1.00 (reference)     |  | 0.50    | <0.0001 | 1.00 (reference)      |  | 0.50    | <0.0001 |
|   | 1         | 845    | 251 (29.7)   | 16 (1.9)  | 1.34 (1.16 to 1.56)  |  |         |         | 1.37 (1.19 to 1.59)   |  |         |         |
|   | 2 or more | 427    | 141 (33.0)   | 10 (2.3)  | 1.57 (1.28 to 1.92)  |  |         |         | 1.63 (1.33 to 1.99)   |  |         |         |
| Comorbidities                                     |           |        |              |           |                      |  |         |         |                       |  |         |         |
| Number of comorbidities present                   | 0         | 24,420 | 4214 (17.3)  | 165 (0.7) | 1.00 (reference)     |  | 0.60    | <0.0001 | 1.00 (reference)      |  | 0.61    | <0.0001 |
|   | 1         | 17,490 | 4419 (25.3)  | 277 (1.6) | 1.62 (1.55 to 1.70)  |  |         |         | 1.68 (1.60 to 1.76)   |  |         |         |
|   | 2         | 8,338  | 2582 (31.0)  | 144 (1.7) | 2.15 (2.03 to 2.28)  |  |         |         | 2.22 (2.10 to 2.35)   |  |         |         |
|   | 3         | 3,621  | 1342 (37.1)  | 74 (2.0)  | 2.82 (2.62 to 3.04)  |  |         |         | 2.94 (2.73 to 3.17)   |  |         |         |
|   | 4         | 1,428  | 583 (40.8)   | 30 (2.1)  | 3.31 (2.96 to 3.70)  |  |         |         | 3.44 (3.08 to 3.84)   |  |         |         |
|   | 5 or more | 678    | 331 (48.8)   | 22 (3.2)  | 4.57 (3.92 to 5.34)  |  |         |         | 4.97 (4.26 to 5.80)   |  |         |         |
| Myocardial infarction                             | No        | 52,743 | 12463 (23.6) | 657 (1.2) | 1.00 (reference)     |  | 0.51    | <0.0001 | 1.00 (reference)      |  | 0.51    | <0.0001 |
|   | Yes       | 3,232  | 1008 (31.2)  | 55 (1.7)  | 1.47 (1.36 to 1.58)  |  |         |         | 1.48 (1.37 to 1.60)   |  |         |         |
| Cardiovascular disease                            | No        | 52,195 | 12222 (23.4) | 627 (1.2) | 1.00 (reference)     |  | 0.52    | <0.0001 | 1.00 (reference)      |  | 0.52    | <0.0001 |
|   | Yes       | 3,780  | 1249 (33.0)  | 85 (2.2)  | 1.61 (1.50 to 1.73)  |  |         |         | 1.67 (1.56 to 1.79)   |  |         |         |
|   | No        | 53,212 | 12648 (23.8) | 675 (1.3) | 1.00 (reference)     |  | 0.51    | <0.0001 | 1.00 (reference)      |  | 0.51    | <0.0001 |



| Risk factor                                 |                                 | N      | 90d          | 90d death | Odds ratio for 90d  | c-index | p-value | Odds ratio for 90 day | c-index | p-value |
|---|---------------------------------|--------|--------------|-----------|---------------------|---------|---------|-----------------------|---------|---------|
|   |                                 |        | readmission  | without   |                     |         |         |                       |         |         |
|   |                                 |        | N (%)        | N (%)     | (95% CI)            |         |         | (95% CI)              |         |         |
| Peripheral vascular disease                 | Yes                             | 2,763  | 823 (29.8)   | 37 (1.3)  | 1.36 (1.25 to 1.48) |         |         | 1.35 (1.25 to 1.47)   |         |         |
| Cerebrovascular disease                     | No                              | 53,826 | 12799 (23.8) | 667 (1.2) | 1.00 (reference)    | 0.51    | <0.0001 | 1.00 (reference)      | 0.51    | <0.0001 |
|   | Yes                             | 2,149  | 672 (31.3)   | 45 (2.1)  | 1.46 (1.33 to 1.60) |         |         | 1.50 (1.37 to 1.65)   |         |         |
| Dementia                                    | No                              | 55,798 | 13411 (24.0) | 697 (1.2) | 1.00 (reference)    | 0.50    | 0.002   | 1.00 (reference)      | 0.50    | <0.0001 |
|   | Yes                             | 177    | 60 (33.9)    | 15 (8.5)  | 1.62 (1.19 to 2.21) |         |         | 2.17 (1.61 to 2.93)   |         |         |
| Respiratory disease                         | No                              | 49,312 | 11260 (22.8) | 586 (1.2) | 1.00 (reference)    | 0.53    | <0.0001 | 1.00 (reference)      | 0.53    | <0.0001 |
|   | Yes                             | 6,663  | 2211 (33.2)  | 126 (1.9) | 1.68 (1.59 to 1.77) |         |         | 1.71 (1.62 to 1.80)   |         |         |
| Rheumatic disease                           | No                              | 55,065 | 13190 (24.0) | 699 (1.3) | 1.00 (reference)    | 0.50    | <0.0001 | 1.00 (reference)      | 0.50    | <0.0001 |
|   | Yes                             | 910    | 281 (30.9)   | 13 (1.4)  | 1.42 (1.23 to 1.63) |         |         | 1.42 (1.23 to 1.63)   |         |         |
| Peptic ulcer disease                        | No                              | 54,881 | 13104 (23.9) | 691 (1.3) | 1.00 (reference)    | 0.51    | <0.0001 | 1.00 (reference)      | 0.51    | <0.0001 |
|   | Yes                             | 1,094  | 367 (33.5)   | 21 (1.9)  | 1.61 (1.42 to 1.83) |         |         | 1.64 (1.44 to 1.86)   |         |         |
| Liver disease                               | No                              | 53,401 | 12393 (23.2) | 670 (1.3) | 1.00 (reference)    | 0.52    | <0.0001 | 1.00 (reference)      | 0.52    | <0.0001 |
|   | Mild                            | 966    | 372 (38.5)   | 20 (2.1)  | 2.07 (1.82 to 2.36) |         |         | 2.11 (1.85 to 2.40)   |         |         |
|   | Moderate or severe              | 1,608  | 706 (43.9)   | 22 (1.4)  | 2.59 (2.34 to 2.86) |         |         | 2.56 (2.31 to 2.83)   |         |         |
| Diabetes mellitus                           | No                              | 51,175 | 11806 (23.1) | 621 (1.2) | 1.00 (reference)    | 0.53    | <0.0001 | 1.00 (reference)      | 0.53    | <0.0001 |
|   | Yes without complication        | 4,122  | 1334 (32.4)  | 76 (1.8)  | 1.60 (1.49 to 1.71) |         |         | 1.62 (1.52 to 1.73)   |         |         |
|   | Yes - with chronic complication | 678    | 331 (48.8)   | 15 (2.2)  | 3.18 (2.73 to 3.70) |         |         | 3.25 (2.79 to 3.78)   |         |         |
| Hemiplegia or paraplegia                    | No                              | 55,585 | 13337 (24.0) | 705 (1.3) | 1.00 (reference)    | 0.50    | <0.0001 | 1.00 (reference)      | 0.50    | <0.0001 |
|   | Yes                             | 390    | 134 (34.4)   | 7 (1.8)   | 1.66 (1.34 to 2.05) |         |         | 1.68 (1.36 to 2.06)   |         |         |
| Renal disease                               | No                              | 53,719 | 12531 (23.3) | 658 (1.2) | 1.00 (reference)    | 0.52    | <0.0001 | 1.00 (reference)      | 0.52    | <0.0001 |
|   | Yes                             | 2,256  | 940 (41.7)   | 54 (2.4)  | 2.35 (2.15 to 2.56) |         |         | 2.42 (2.22 to 2.64)   |         |         |
| Cancer                                      | No                              | 43,763 | 9960 (22.8)  | 426 (1.0) | 1.00 (reference)    | 0.53    | <0.0001 | 1.00 (reference)      | 0.53    | <0.0001 |
|   | Yes - without metastases        | 10,324 | 2892 (28.0)  | 188 (1.8) | 1.32 (1.26 to 1.39) |         |         | 1.37 (1.30 to 1.43)   |         |         |
|   | Yes - with metastases           | 1,888  | 619 (32.8)   | 98 (5.2)  | 1.66 (1.50 to 1.83) |         |         | 1.97 (1.79 to 2.17)   |         |         |
| Immunosuppression                           | No                              | 54,574 | 12960 (23.7) | 687 (1.3) | 1.00 (reference)    | 0.51    | <0.0001 | 1.00 (reference)      | 0.51    | <0.0001 |
|   | Yes                             | 1,401  | 511 (36.5)   | 25 (1.8)  | 1.85 (1.65 to 2.06) |         |         | 1.86 (1.67 to 2.07)   |         |         |
| Alcohol misuse                              | No                              | 49,910 | 11515 (23.1) | 639 (1.3) | 1.00 (reference)    | 0.52    | <0.0001 | 1.00 (reference)      | 0.52    | <0.0001 |
|   | Yes                             | 6,065  | 1956 (32.3)  | 73 (1.2)  | 1.59 (1.50 to 1.68) |         |         | 1.56 (1.48 to 1.65)   |         |         |
| Drug misuse                                 | No                              | 52,048 | 12203 (23.4) | 661 (1.3) | 1.00 (reference)    | 0.52    | <0.0001 | 1.00 (reference)      | 0.52    | <0.0001 |
|   | Yes                             | 3,927  | 1268 (32.3)  | 51 (1.3)  | 1.56 (1.45 to 1.67) |         |         | 1.54 (1.44 to 1.65)   |         |         |
| <b>Indices of critical illness severity</b> |                                 |        |              |           |                     |         |         |                       |         |         |

| Risk factor                   |  | N      | 90d readmission N (%) | 90d death without readmission N (%) | Odds ratio for 90d readmission (95% CI) | c-index             | p-value | Odds ratio for 90 day readmission or death (95% CI) | c-index             | p-value |
|-------------------------------|--|--------|-----------------------|-------------------------------------|---|---------------------|---------|---|---------------------|---------|
| Type of admission to ICU      | Elective surgery                             | 15,553 | 3480 (22.4)           | 113 (0.7)                           | 1.00 (reference)                        | 0.51                | <0.0001 | 1.00 (reference)                                    | 0.52                | <0.0001 |
|                               | Emergency surgery                            | 13,222 | 3323 (25.1)           | 201 (1.5)                           | 1.16 (1.10 to 1.23)                     |                     |         | 1.21 (1.15 to 1.28)                                 |                     |         |
|                               | Non-operative                                | 26,798 | 6576 (24.5)           | 388 (1.4)                           | 1.13 (1.08 to 1.18)                     |                     |         | 1.17 (1.12 to 1.22)                                 |                     |         |
| Diagnosis at admission to ICU | Trauma including head injury                 | 1,231  | 176 (14.3)            | 4 (0.3)                             | 1.00 (reference)                        | 0.57                | <0.0001 | 1.00 (reference)                                    | 0.57                | <0.0001 |
| Cardiovascular                | Aortic aneurysm rupture                      | 597    | 113 (18.9)            | 5 (0.8)                             | 1.40 (1.08 to 1.81)                     |                     |         | 1.44 (1.11 to 1.86)                                 |                     |         |
|                               | Cardiogenic shock                            | 211    | 64 (30.3)             | 6 (2.8)                             | 2.61 (1.87 to 3.65)                     |                     |         | 2.90 (2.09 to 4.02)                                 |                     |         |
|                               | Post cardiac arrest                          | 1,200  | 261 (21.8)            | 40 (3.3)                            | 1.67 (1.35 to 2.06)                     |                     |         | 1.95 (1.59 to 2.40)                                 |                     |         |
|                               | Septic shock                                 | 2,805  | 739 (26.3)            | 38 (1.4)                            | 2.14 (1.79 to 2.57)                     |                     |         | 2.24 (1.87 to 2.67)                                 |                     |         |
|                               | Vascular surgery                             | 1,946  | 384 (19.7)            | 16 (0.8)                            | 1.47 (1.21 to 1.79)                     |                     |         | 1.51 (1.25 to 1.83)                                 |                     |         |
|                               | Other CVS                                    | 5,136  | 1267 (24.7)           | 36 (0.7)                            | 1.96 (1.65 to 2.33)                     |                     |         | 1.98 (1.67 to 2.35)                                 |                     |         |
|                               | Respiratory                                  | ARDS   | 265                   | 80 (30.2)                           | 3 (1.1)                                 | 2.59 (1.91 to 3.52) |         |   | 2.66 (1.96 to 3.61) |         |
| Asthma                        |  | 649    | 171 (26.3)            | 1 (0.2)                             | 2.14 (1.69 to 2.72)                     |                     |         | 2.11 (1.66 to 2.66)                                 |                     |         |
| COPD                          |  | 390    | 117 (30.0)            | 8 (2.1)                             | 2.57 (1.96 to 3.36)                     |                     |         | 2.75 (2.11 to 3.59)                                 |                     |         |
| Pneumonia                     |  | 4,696  | 1066 (22.7)           | 62 (1.3)                            | 1.76 (1.48 to 2.09)                     |                     |         | 1.85 (1.55 to 2.19)                                 |                     |         |
| Other respiratory             |  | 4,546  | 1110 (24.4)           | 75 (1.6)                            | 1.94 (1.63 to 2.30)                     |                     |         | 2.06 (1.73 to 2.44)                                 |                     |         |
| Gastrointestinal/Liver        | GI bleed                                     | 1,026  | 275 (26.8)            | 15 (1.5)                            | 2.19 (1.78 to 2.71)                     |                     |         | 2.30 (1.87 to 2.83)                                 |                     |         |
|                               | GI neoplasm                                  | 2,956  | 781 (26.4)            | 41 (1.4)                            | 2.15 (1.80 to 2.58)                     |                     |         | 2.25 (1.88 to 2.69)                                 |                     |         |
|                               | GI obstruction                               | 2,007  | 529 (26.4)            | 51 (2.5)                            | 2.15 (1.78 to 2.59)                     |                     |         | 2.37 (1.97 to 2.86)                                 |                     |         |
|                               | GI perforation/ischaemia/peritonitis/abscess | 3,931  | 1093 (27.8)           | 64 (1.6)                            | 2.31 (1.94 to 2.75)                     |                     |         | 2.44 (2.05 to 2.89)                                 |                     |         |
|                               | Other GI                                     | 3,000  | 839 (28.0)            | 28 (0.9)                            | 2.33 (1.95 to 2.78)                     |                     |         | 2.37 (1.99 to 2.83)                                 |                     |         |
|                               | Liver failure                                | 219    | 78 (35.6)             | 1 (0.5)                             | 3.32 (2.41 to 4.56)                     |                     |         | 3.29 (2.40 to 4.53)                                 |                     |         |
|                               | Oesophageal variceal bleed                   | 465    | 213 (45.8)            | 12 (2.6)                            | 5.07 (3.98 to 6.46)                     |                     |         | 5.47 (4.30 to 6.97)                                 |                     |         |
|                               | Pancreatitis                                 | 597    | 239 (40.0)            | 3 (0.5)                             | 4.00 (3.18 to 5.03)                     |                     |         | 3.98 (3.17 to 5.00)                                 |                     |         |
| Nervous system                | Intracranial bleed                           | 1,410  | 312 (22.1)            | 19 (1.3)                            | 1.70 (1.39 to 2.09)                     |                     |         | 1.79 (1.47 to 2.19)                                 |                     |         |
|                               | Seizures                                     | 1,321  | 406 (30.7)            | 12 (0.9)                            | 2.66 (2.18 to 3.24)                     |                     |         | 2.70 (2.22 to 3.29)                                 |                     |         |
|                               | Other CNS                                    | 2,017  | 437 (21.7)            | 39 (1.9)                            | 1.66 (1.37 to 2.01)                     |                     |         | 1.80 (1.49 to 2.18)                                 |                     |         |
| Other                         | Diabetic ketoacidosis                        | 531    | 165 (31.1)            | 9 (1.7)                             | 2.70 (2.12 to 3.45)                     |                     |         | 2.85 (2.24 to 3.62)                                 |                     |         |
|                               | Renal  | 1,578  | 503 (31.9)            | 21 (1.3)                            | 2.80 (2.32 to 3.40)                     |                     |         | 2.90 (2.40 to 3.51)                                 |                     |         |
|                               | Self poisoning                               | 2,863  | 516 (18.0)            | 26 (0.9)                            | 1.32 (1.09 to 1.59)                     |                     |         | 1.36 (1.13 to 1.64)                                 |                     |         |
|                               | Trauma excluding head injury                 | 2,576  | 462 (17.9)            | 33 (1.3)                            | 1.31 (1.08 to 1.58)                     |                     |         | 1.39 (1.15 to 1.67)                                 |                     |         |

| Risk factor                                |               | N      | 90d          | 90d death | Odds ratio for 90d  | c-index | p-value | Odds ratio for 90 day | c-index | p-value |
|--|---------------|--------|--------------|-----------|---------------------|---------|---------|-----------------------|---------|---------|
|  |               |        | readmission  | without   |                     |         |         |                       |         |         |
|  |               |        | N (%)        | N (%)     | (95% CI)            |         |         | (95% CI)              |         |         |
|  | Miscellaneous | 5,806  | 1075 (18.5)  | 44 (0.8)  | 1.36 (1.15 to 1.62) |         |         | 1.39 (1.17 to 1.65)   |         |         |
| CPR prior to admission to ICU              | No            | 54,141 | 13027 (24.1) | 665 (1.2) | 1.00 (reference)    | 0.50    | 0.88    | 1.00 (reference)      | 0.50    | 0.15    |
|  | Yes           | 1,834  | 444 (24.2)   | 47 (2.6)  | 1.01 (0.90 to 1.12) |         |         | 1.08 (0.97 to 1.20)   |         |         |
| APACHE II score at admission to ICU        | 1 - 7         | 4,439  | 801 (18.0)   | 11 (0.2)  | 1.00 (reference)    | 0.55    | <0.0001 | 1.00 (reference)      | 0.56    | <0.0001 |
|  | 8 - 10        | 6,394  | 1330 (20.8)  | 35 (0.5)  | 1.19 (1.08 to 1.31) |         |         | 1.21 (1.10 to 1.34)   |         |         |
|  | 11 - 12       | 5,427  | 1233 (22.7)  | 28 (0.5)  | 1.33 (1.21 to 1.47) |         |         | 1.35 (1.22 to 1.49)   |         |         |
|  | 13 - 14       | 5,977  | 1435 (24.0)  | 54 (0.9)  | 1.43 (1.30 to 1.58) |         |         | 1.48 (1.35 to 1.63)   |         |         |
|  | 15 - 16       | 5,824  | 1447 (24.8)  | 75 (1.3)  | 1.50 (1.36 to 1.65) |         |         | 1.58 (1.44 to 1.74)   |         |         |
|  | 17 - 18       | 5,202  | 1318 (25.3)  | 84 (1.6)  | 1.54 (1.40 to 1.70) |         |         | 1.65 (1.49 to 1.82)   |         |         |
|  | 19 - 21       | 6,048  | 1649 (27.3)  | 114 (1.9) | 1.70 (1.55 to 1.87) |         |         | 1.84 (1.67 to 2.02)   |         |         |
|  | 22 - 25       | 5,032  | 1375 (27.3)  | 98 (1.9)  | 1.71 (1.55 to 1.88) |         |         | 1.85 (1.68 to 2.04)   |         |         |
|  | 26 or more    | 4,475  | 1309 (29.3)  | 114 (2.5) | 1.88 (1.70 to 2.07) |         |         | 2.08 (1.89 to 2.30)   |         |         |
| Acute physiology score at admission to ICU | 0 - 5         | 5,427  | 1096 (20.2)  | 33 (0.6)  | 1.00 (reference)    | 0.53    | <0.0001 | 1.00 (reference)      | 0.53    | <0.0001 |
|  | 6 - 7         | 5,946  | 1330 (22.4)  | 42 (0.7)  | 1.14 (1.04 to 1.25) |         |         | 1.14 (1.04 to 1.25)   |         |         |
|  | 8 - 9         | 6,919  | 1647 (23.8)  | 79 (1.1)  | 1.23 (1.13 to 1.35) |         |         | 1.27 (1.16 to 1.38)   |         |         |
|  | 10 - 11       | 6,754  | 1650 (24.4)  | 82 (1.2)  | 1.28 (1.17 to 1.39) |         |         | 1.31 (1.21 to 1.43)   |         |         |
|  | 12 - 13       | 5,715  | 1467 (25.7)  | 87 (1.5)  | 1.36 (1.25 to 1.49) |         |         | 1.42 (1.30 to 1.55)   |         |         |
|  | 14 - 15       | 5,219  | 1327 (25.4)  | 86 (1.6)  | 1.35 (1.23 to 1.48) |         |         | 1.41 (1.29 to 1.55)   |         |         |
|  | 16 - 18       | 5,239  | 1392 (26.6)  | 66 (1.3)  | 1.43 (1.31 to 1.56) |         |         | 1.47 (1.34 to 1.60)   |         |         |
|  | 19 - 22       | 4,143  | 1034 (25.0)  | 82 (2.0)  | 1.31 (1.19 to 1.45) |         |         | 1.40 (1.28 to 1.54)   |         |         |
|  | 23 or more    | 3,431  | 945 (27.5)   | 55 (1.6)  | 1.50 (1.36 to 1.66) |         |         | 1.57 (1.42 to 1.73)   |         |         |
| Mechanical ventilation during ICU stay     |               |        |              |           |                     |         |         |                       |         |         |
| Any day                                    | No            | 22,083 | 5273 (23.9)  | 264 (1.2) | 1.00 (reference)    | 0.50    | 0.30    | 1.00 (reference)      | 0.50    | 0.17    |
|  | Yes           | 33,447 | 8116 (24.3)  | 443 (1.3) | 1.02 (0.98 to 1.06) |         |         | 1.03 (0.99 to 1.07)   |         |         |
| Number of days                             | 0             | 22,083 | 5273 (23.9)  | 264 (1.2) | 1.00 (reference)    | 0.51    | 0.051   | 1.00 (reference)      | 0.51    | 0.013   |
|  | 1             | 11,615 | 2712 (23.3)  | 127 (1.1) | 0.97 (0.92 to 1.02) |         |         | 0.97 (0.92 to 1.02)   |         |         |
|  | 2             | 9,093  | 2261 (24.9)  | 130 (1.4) | 1.06 (1.00 to 1.12) |         |         | 1.07 (1.01 to 1.13)   |         |         |
|  | 3             | 2,874  | 747 (26.0)   | 42 (1.5)  | 1.12 (1.02 to 1.22) |         |         | 1.13 (1.04 to 1.23)   |         |         |
|  | 4             | 1,674  | 425 (25.4)   | 30 (1.8)  | 1.08 (0.97 to 1.22) |         |         | 1.12 (1.00 to 1.25)   |         |         |
|  | 5             | 1,123  | 259 (23.1)   | 16 (1.4)  | 0.96 (0.83 to 1.10) |         |         | 0.97 (0.84 to 1.11)   |         |         |
|  | 6             | 952    | 223 (23.4)   | 14 (1.5)  | 0.98 (0.84 to 1.14) |         |         | 0.99 (0.85 to 1.15)   |         |         |
|  | 7             | 825    | 206 (25.0)   | 12 (1.5)  | 1.06 (0.90 to 1.25) |         |         | 1.07 (0.92 to 1.26)   |         |         |

| Risk factor   |            | N      | 90d readmission N (%) | 90d death without readmission N (%) | Odds ratio for 90d readmission (95% CI) | c-index | p-value | Odds ratio for 90 day readmission or death (95% CI) | c-index | p-value |
|---|------------|--------|-----------------------|-------------------------------------|---|---------|---------|---|---------|---------|
|   | 8          | 693    | 187 (27.0)            | 7 (1.0)                             | 1.18 (0.99 to 1.40)                     |         |         | 1.16 (0.98 to 1.38)                                 |         |         |
|   | 9          | 542    | 123 (22.7)            | 9 (1.7)                             | 0.94 (0.76 to 1.15)                     |         |         | 0.96 (0.79 to 1.17)                                 |         |         |
|   | 10         | 504    | 115 (22.8)            | 8 (1.6)                             | 0.94 (0.76 to 1.16)                     |         |         | 0.96 (0.79 to 1.18)                                 |         |         |
|   | 11 or more | 3,552  | 858 (24.2)            | 48 (1.4)                            | 1.02 (0.93 to 1.10)                     |         |         | 1.02 (0.94 to 1.11)                                 |         |         |
| Renal replacement therapy during ICU stay                     |            |        |                       |                                     |   |         |         |   |         |         |
| Any day   | No         | 51,605 | 12219 (23.7)          | 656 (1.3)                           | 1.00 (reference)                        | 0.51    | <0.0001 | 1.00 (reference)                                    | 0.51    | <0.0001 |
|   | Yes        | 3,925  | 1170 (29.8)           | 51 (1.3)                            | 1.37 (1.27 to 1.47)                     |         |         | 1.36 (1.27 to 1.46)                                 |         |         |
| Number of days  | 0          | 51,605 | 12219 (23.7)          | 656 (1.3)                           | 1.00 (reference)                        | 0.51    | <0.0001 | 1.00 (reference)                                    | 0.51    | <0.0001 |
|   | 1          | 597    | 198 (33.2)            | 6 (1.0)                             | 1.60 (1.35 to 1.90)                     |         |         | 1.56 (1.32 to 1.85)                                 |         |         |
|   | 2          | 680    | 220 (32.4)            | 11 (1.6)                            | 1.54 (1.31 to 1.81)                     |         |         | 1.55 (1.32 to 1.82)                                 |         |         |
|   | 3          | 588    | 193 (32.8)            | 10 (1.7)                            | 1.58 (1.32 to 1.87)                     |         |         | 1.59 (1.34 to 1.88)                                 |         |         |
|   | 4 or more  | 2,060  | 559 (27.1)            | 24 (1.2)                            | 1.20 (1.09 to 1.33)                     |         |         | 1.19 (1.08 to 1.31)                                 |         |         |
| Cardiovascular system support during ICU stay                 |            |        |                       |                                     |   |         |         |   |         |         |
| Any day   | No         | 35,429 | 8215 (23.2)           | 455 (1.3)                           | 1.00 (reference)                        | 0.52    | <0.0001 | 1.00 (reference)                                    | 0.52    | <0.0001 |
|   | Yes        | 20,101 | 5174 (25.7)           | 252 (1.3)                           | 1.15 (1.10 to 1.20)                     |         |         | 1.14 (1.10 to 1.19)                                 |         |         |
| Number of days  | 0          | 35,429 | 8215 (23.2)           | 455 (1.3)                           | 1.00 (reference)                        | 0.52    | <0.0001 | 1.00 (reference)                                    | 0.52    | <0.0001 |
|   | 1          | 5,562  | 1390 (25.0)           | 50 (0.9)                            | 1.10 (1.03 to 1.18)                     |         |         | 1.08 (1.01 to 1.15)                                 |         |         |
|   | 2          | 5,759  | 1531 (26.6)           | 77 (1.3)                            | 1.20 (1.13 to 1.28)                     |         |         | 1.20 (1.12 to 1.27)                                 |         |         |
|   | 3          | 3,471  | 913 (26.3)            | 42 (1.2)                            | 1.18 (1.09 to 1.28)                     |         |         | 1.17 (1.08 to 1.27)                                 |         |         |
|   | 4          | 1,945  | 485 (24.9)            | 29 (1.5)                            | 1.10 (0.99 to 1.22)                     |         |         | 1.11 (1.00 to 1.23)                                 |         |         |
|   | 5          | 1,131  | 287 (25.4)            | 16 (1.4)                            | 1.13 (0.98 to 1.29)                     |         |         | 1.13 (0.99 to 1.29)                                 |         |         |
|   | 6          | 683    | 163 (23.9)            | 13 (1.9)                            | 1.04 (0.87 to 1.24)                     |         |         | 1.07 (0.90 to 1.27)                                 |         |         |
|   | 7 or more  | 1,550  | 405 (26.1)            | 25 (1.6)                            | 1.17 (1.04 to 1.32)                     |         |         | 1.18 (1.06 to 1.33)                                 |         |         |
| Maximum number of organs supported on any day during ICU stay | 0          | 17,877 | 4070 (22.8)           | 202 (1.1)                           | 1.00 (reference)                        | 0.52    | <0.0001 | 1.00 (reference)                                    | 0.52    | <0.0001 |
|   | 1          | 20,969 | 5032 (24.0)           | 297 (1.4)                           | 1.07 (1.02 to 1.12)                     |         |         | 1.09 (1.04 to 1.14)                                 |         |         |
|   | 2          | 14,277 | 3638 (25.5)           | 183 (1.3)                           | 1.16 (1.10 to 1.22)                     |         |         | 1.16 (1.11 to 1.22)                                 |         |         |
|   | 3          | 2,407  | 649 (27.0)            | 25 (1.0)                            | 1.25 (1.14 to 1.38)                     |         |         | 1.24 (1.13 to 1.36)                                 |         |         |
| Tracheostomy during ICU stay                                  | No         | 50,226 | 12155 (24.2)          | 622 (1.2)                           | 1.00 (reference)                        | 0.50    | 0.13    | 1.00 (reference)                                    | 0.50    | 0.37    |
|   | Yes        | 5,304  | 1234 (23.3)           | 85 (1.6)                            | 0.95 (0.89 to 1.02)                     |         |         | 0.97 (0.91 to 1.04)                                 |         |         |
| Length of stay prior to ICU stay (days)                       | 0          | 23,322 | 5042 (21.6)           | 265 (1.1)                           | 1.00 (reference)                        | 0.54    | <0.0001 | 1.00 (reference)                                    | 0.55    | <0.0001 |
|   | 1          | 16,684 | 3857 (23.1)           | 142 (0.9)                           | 1.09 (1.04 to 1.14)                     |         |         | 1.07 (1.02 to 1.12)                                 |         |         |
|   | 2 - 3      | 6,839  | 1785 (26.1)           | 91 (1.3)                            | 1.28 (1.20 to 1.36)                     |         |         | 1.28 (1.21 to 1.36)                                 |         |         |

| Risk factor                          |            | N           | 90d         | 90d death | Odds ratio for 90d |                | c-index | p-value | Odds ratio for 90 day |                | c-index | p-value |
|--------------------------------------|------------|-------------|-------------|-----------|--------------------|----------------|---------|---------|-----------------------|----------------|---------|---------|
|                                      |            |             | readmission | without   | readmission        |                |         |         | readmission or death  |                |         |         |
|                                      |            |             | N (%)       | N (%)     | (95% CI)           |                |         |         | (95% CI)              |                |         |         |
| Length of ICU stay (days)            | 4 - 7      | 4,123       | 1120 (27.2) | 63 (1.5)  | 1.35               | (1.25 to 1.46) |         |         | 1.37                  | (1.27 to 1.47) |         |         |
|                                      | 8 or more  | 5,007       | 1667 (33.3) | 151 (3.0) | 1.81               | (1.69 to 1.93) |         |         | 1.94                  | (1.81 to 2.07) |         |         |
|                                      | 0          | 4,730       | 1043 (22.1) | 52 (1.1)  | 1.00               | (reference)    | 0.52    | <0.0001 | 1.00                  | (reference)    | 0.52    | <0.0001 |
|                                      | 1          | 17,685      | 4031 (22.8) | 207 (1.2) | 1.04               | (0.97 to 1.13) |         |         | 1.05                  | (0.97 to 1.13) |         |         |
|                                      | 2          | 10,409      | 2544 (24.4) | 122 (1.2) | 1.14               | (1.05 to 1.24) |         |         | 1.14                  | (1.05 to 1.24) |         |         |
|                                      | 3          | 5,888       | 1519 (25.8) | 90 (1.5)  | 1.23               | (1.12 to 1.35) |         |         | 1.25                  | (1.14 to 1.36) |         |         |
|                                      | 4 - 5      | 6,113       | 1553 (25.4) | 89 (1.5)  | 1.20               | (1.10 to 1.32) |         |         | 1.22                  | (1.12 to 1.33) |         |         |
|                                      | 6 - 10     | 5,930       | 1487 (25.1) | 78 (1.3)  | 1.18               | (1.08 to 1.30) |         |         | 1.19                  | (1.09 to 1.30) |         |         |
| 11 or more                           | 5,220      | 1294 (24.8) | 74 (1.4)    | 1.17      | (1.06 to 1.28)     |                |         | 1.18    | (1.08 to 1.29)        |                |         |         |
| Length of stay post ICU stay (days)  | 0 - 1      | 5,468       | 890 (16.3)  | 52 (1.0)  | 1.00               | (reference)    | 0.56    | <0.0001 | 1.00                  | (reference)    | 0.57    | <0.0001 |
|                                      | 2 - 3      | 5,538       | 1060 (19.1) | 34 (0.6)  | 1.22               | (1.10 to 1.34) |         |         | 1.18                  | (1.07 to 1.30) |         |         |
|                                      | 4 - 5      | 7,035       | 1488 (21.2) | 40 (0.6)  | 1.38               | (1.26 to 1.51) |         |         | 1.33                  | (1.22 to 1.46) |         |         |
|                                      | 6 - 7      | 5,822       | 1313 (22.6) | 46 (0.8)  | 1.50               | (1.36 to 1.65) |         |         | 1.46                  | (1.33 to 1.61) |         |         |
|                                      | 8 - 9      | 4,257       | 1011 (23.7) | 43 (1.0)  | 1.60               | (1.45 to 1.77) |         |         | 1.58                  | (1.43 to 1.75) |         |         |
|                                      | 10 - 13    | 6,597       | 1750 (26.5) | 64 (1.0)  | 1.86               | (1.70 to 2.03) |         |         | 1.82                  | (1.67 to 1.99) |         |         |
|                                      | 14 - 18    | 5,073       | 1406 (27.7) | 73 (1.4)  | 1.97               | (1.79 to 2.17) |         |         | 1.98                  | (1.80 to 2.17) |         |         |
|                                      | 19 - 28    | 5,545       | 1621 (29.2) | 90 (1.6)  | 2.12               | (1.94 to 2.33) |         |         | 2.14                  | (1.96 to 2.35) |         |         |
|                                      | 29 - 52    | 5,307       | 1549 (29.2) | 104 (2.0) | 2.12               | (1.93 to 2.33) |         |         | 2.17                  | (1.98 to 2.38) |         |         |
|                                      | 53 or more | 5,333       | 1383 (25.9) | 166 (3.1) | 1.80               | (1.64 to 1.98) |         |         | 1.97                  | (1.79 to 2.16) |         |         |
| Length of index hospital stay (days) | 0 - 3      | 5,785       | 949 (16.4)  | 41 (0.7)  | 1.00               | (reference)    | 0.56    | <0.0001 | 1.00                  | (reference)    | 0.57    | <0.0001 |
|                                      | 4 - 6      | 5,436       | 1050 (19.3) | 36 (0.7)  | 1.22               | (1.11 to 1.34) |         |         | 1.21                  | (1.10 to 1.33) |         |         |
|                                      | 7 - 9      | 7,487       | 1570 (21.0) | 40 (0.5)  | 1.35               | (1.24 to 1.48) |         |         | 1.33                  | (1.22 to 1.45) |         |         |
|                                      | 10 - 12    | 5,694       | 1312 (23.0) | 44 (0.8)  | 1.53               | (1.39 to 1.67) |         |         | 1.51                  | (1.38 to 1.66) |         |         |
|                                      | 13 - 15    | 4,691       | 1200 (25.6) | 44 (0.9)  | 1.75               | (1.59 to 1.93) |         |         | 1.75                  | (1.59 to 1.92) |         |         |
|                                      | 16 - 20    | 5,585       | 1417 (25.4) | 60 (1.1)  | 1.73               | (1.58 to 1.90) |         |         | 1.74                  | (1.59 to 1.91) |         |         |
|                                      | 21 - 27    | 5,268       | 1443 (27.4) | 69 (1.3)  | 1.92               | (1.75 to 2.11) |         |         | 1.95                  | (1.78 to 2.14) |         |         |
|                                      | 28 - 39    | 5,233       | 1529 (29.2) | 105 (2.0) | 2.10               | (1.92 to 2.31) |         |         | 2.20                  | (2.01 to 2.41) |         |         |
|                                      | 40 - 67    | 5,488       | 1589 (29.0) | 107 (1.9) | 2.08               | (1.90 to 2.27) |         |         | 2.17                  | (1.98 to 2.37) |         |         |
|                                      | 68 or more | 5,308       | 1412 (26.6) | 166 (3.1) | 1.85               | (1.68 to 2.03) |         |         | 2.05                  | (1.87 to 2.24) |         |         |

**eTable 3a Comparison of predictive ability of groups of patient characteristics using c-index and reclassification of outcome.** Characteristics are grouped into patient demographics, indices of pre-existing patient health, and indices of critical illness severity. The reclassification of outcome is illustrated at a threshold of  $\geq 20\%$  predicted probability of 90 day unplanned hospital readmission defining those predicted to have an event. The underlying classification table which has been used to calculate improved classification is provided in eTable 3b stratified by outcome.

| Groups of variables in model being compared     | Comparison of c-indices | Change in c-index | Improved classification of events: 90d readmissions | Improved classification of non-events: no 90d readmission |
|---|-------------------------|-------------------|---|---|
| Critical illness indices vs demographics        | 0.603 vs 0.542          | 0.061             | -12.1%  | 20.8%   |
| Pre-existing health indices vs demographics     | 0.634 vs 0.542          | 0.092             | -18.2%  | 31.5%   |
| Pre-existing health vs critical illness indices | 0.634 vs 0.603          | 0.031             | -6.1%   | 10.7%   |

**eTable 3b Classification tables stratified by outcome comparing groups of patient characteristics.**

|                          |                | Patients readmitted         |                |        | Patients not readmitted |                |        |
|--------------------------|----------------|-----------------------------|----------------|--------|-------------------------|----------------|--------|
|                          |                | Critical illness indices    |                |        |                         |                |        |
|                          |                | Readmission                 | No readmission | Total  | Readmission             | No readmission | Total  |
| Demographics             | Readmission    | 9,024                       | 1,852          | 10,876 | 23,730                  | 8,795          | 32,525 |
|                          | No readmission | 447                         | 290            | 737    | 1,326                   | 2,103          | 3,429  |
|                          | Total          | 9,471                       | 2,142          | 11,613 | 25,056                  | 10,898         | 35,954 |
|                          |                | Pre-existing health indices |                |        |                         |                |        |
| Demographics             | Readmission    | 8,326                       | 2,550          | 10,876 | 20,065                  | 12,460         | 32,525 |
|                          | No readmission | 433                         | 304            | 737    | 1,130                   | 2,299          | 3,429  |
|                          | Total          | 8,759                       | 2,854          | 11,613 | 21,195                  | 14,759         | 35,954 |
|                          |                | Pre-existing health indices |                |        |                         |                |        |
| Critical illness indices | Readmission    | 7,372                       | 2,099          | 9,471  | 16,362                  | 8,694          | 25,056 |
|                          | No readmission | 1,387                       | 755            | 2,142  | 4,833                   | 6,065          | 10,898 |
|                          | Total          | 8,759                       | 2,854          | 11,613 | 21,195                  | 14,759         | 35,954 |

Classification tables allow the reader to see how many persons are classified into those predicted to have a readmission and not to have a readmission using each group of variables. For example, the comparison of critical illness indices vs demographics (first three rows of data) demonstrates that of 11,613 patients who were readmitted, critical illness indices correctly classified 9,471 (81.6%) compared with 10,876 (93.7%) classified by demographics, which is a 12.1% decrease in correct classification. Similarly, of 35,954 patients who were not readmitted, critical illness indices correctly classified 10,898 (30.3%) compared with 3,429 (9.5%) classified by demographics, which is a 20.8% improvement in correct classification. The reclassification of outcome in these tables is illustrated at a threshold of  $\geq 20\%$  predicted probability of 90 day unplanned hospital readmission defining those predicted to have an event. The proportions of improved classification would change if this threshold varied.

**eTable 4 Independent risk factors for unplanned hospital admission within 90 days, unplanned hospital admission or death within 90 days, and time to first unplanned hospital admission: multivariable analysis logistic and Fine and Gray competing risks regression.**

| Risk factor   |                                 | Predicted % with event | Adjusted odds ratio for 90d readmission (95% CI) | P value | Predicted % with event | Adjusted odds ratio for 90d readmission or death (95% CI) | P value | Adjusted hazard ratio (95% CI) | P value |
|---|---------------------------------|------------------------|--|---------|------------------------|---|---------|--------------------------------|---------|
| <b>Demographics</b>   |                                 |                        |  |         |                        |   |         |                                |         |
| Sex   | Male                            | 22.9                   | 1.00 (reference)                                 | 0.74    | 24.2                   | 1.00 (reference)  | 0.95    | 1.00 (reference)               | 0.77    |
|   | Female                          | 23.1                   | 1.01 (0.96 to 1.05)                              |         | 24.2                   | 1.00 (0.96 to 1.04)                                       |         | 1.01 (0.97 to 1.04)            |         |
| Age at admission to ICU (years)                             | 16 - 25                         | 21.4                   | 1.00 (reference)                                 | <0.001  | 21.8                   | 1.00 (reference)  | <0.001  | 1.00 (reference)               | 0.001   |
|   | 26 - 35                         | 23.1                   | 1.10 (0.97 to 1.25)                              |         | 23.5                   | 1.10 (0.97 to 1.25)                                       |         | 1.09 (0.98 to 1.21)            |         |
|   | 36 - 45                         | 24.8                   | 1.21 (1.08 to 1.36)                              |         | 25.3                   | 1.21 (1.08 to 1.36)                                       |         | 1.17 (1.06 to 1.29)            |         |
|   | 46 - 55                         | 24.0                   | 1.16 (1.03 to 1.30)                              |         | 24.7                   | 1.18 (1.05 to 1.32)                                       |         | 1.12 (1.02 to 1.23)            |         |
|   | 56 - 65                         | 22.9                   | 1.09 (0.97 to 1.22)                              |         | 24.1                   | 1.14 (1.02 to 1.27)                                       |         | 1.07 (0.97 to 1.17)            |         |
|   | 66 - 75                         | 22.5                   | 1.06 (0.95 to 1.19)                              |         | 24.1                   | 1.14 (1.02 to 1.27)                                       |         | 1.05 (0.95 to 1.15)            |         |
|   | 76 - 85                         | 21.9                   | 1.03 (0.91 to 1.16)                              |         | 23.9                   | 1.12 (1.00 to 1.27)                                       |         | 1.01 (0.91 to 1.12)            |         |
|   | 86 or older                     | 25.3                   | 1.24 (1.03 to 1.50)                              |         | 30.4                   | 1.56 (1.30 to 1.87)                                       |         | 1.18 (1.00 to 1.38)            |         |
| Scottish Index of Multiple Deprivation                      | First quintile (Most deprived)  | 23.7                   | 1.00 (reference)                                 | 0.058   | 25.1                   | 1.00 (reference)  | 0.024   | 1.00 (reference)               | 0.053   |
|   | Second quintile                 | 23.3                   | 0.98 (0.92 to 1.04)                              |         | 24.4                   | 0.96 (0.91 to 1.02)                                       |         | 0.99 (0.94 to 1.04)            |         |
|   | Third quintile                  | 22.7                   | 0.95 (0.88 to 1.01)                              |         | 24.0                   | 0.95 (0.88 to 1.01)                                       |         | 0.96 (0.91 to 1.02)            |         |
|   | Fourth quintile                 | 21.8                   | 0.90 (0.84 to 0.97)                              |         | 22.9                   | 0.89 (0.83 to 0.95)                                       |         | 0.91 (0.86 to 0.97)            |         |
|   | Fifth quintile (Least deprived) | 22.9                   | 0.96 (0.89 to 1.03)                              |         | 24.1                   | 0.95 (0.88 to 1.02)                                       |         | 0.96 (0.91 to 1.03)            |         |
| Remoteness of residence                                     | Urban area                      | 23.5                   | 1.00 (reference)                                 | <0.001  | 24.7                   | 1.00 (reference)  | 0.002   | 1.00 (reference)               | <0.001  |
|   | Accessible                      | 22.0                   | 0.92 (0.87 to 0.97)                              |         | 23.4                   | 0.93 (0.88 to 0.98)                                       |         | 0.93 (0.89 to 0.98)            |         |
|   | Remote                          | 20.2                   | 0.82 (0.73 to 0.92)                              |         | 21.4                   | 0.83 (0.75 to 0.93)                                       |         | 0.84 (0.76 to 0.92)            |         |
|   | Very remote                     | 23.0                   | 0.97 (0.86 to 1.09)                              |         | 24.2                   | 0.97 (0.87 to 1.10)                                       |         | 0.98 (0.88 to 1.08)            |         |
| <b>Indices of pre-existing patient health</b>               |                                 |                        |  |         |                        |   |         |                                |         |
| Admissions/attendances in year prior to index hospital stay |                                 |                        |  |         |                        |   |         |                                |         |
| Number of unplanned inpatient admissions                    | 0                               | 20.4                   | 1.00 (reference)                                 | <0.001  | 21.5                   | 1.00 (reference)  | <0.001  | 1.00 (reference)               | <0.001  |
|   | 1                               | 25.4                   | 1.33 (1.26 to 1.41)                              |         | 26.7                   | 1.33 (1.26 to 1.41)                                       |         | 1.28 (1.22 to 1.35)            |         |
|   | 2                               | 30.2                   | 1.69 (1.56 to 1.84)                              |         | 31.6                   | 1.69 (1.56 to 1.83)                                       |         | 1.54 (1.44 to 1.64)            |         |
|   | 3                               | 36.1                   | 2.21 (1.97 to 2.49)                              |         | 37.9                   | 2.23 (1.99 to 2.50)                                       |         | 1.88 (1.73 to 2.06)            |         |
|   | 4                               | 41.5                   | 2.77 (2.36 to 3.26)                              |         | 43.0                   | 2.76 (2.35 to 3.24)                                       |         | 2.20 (1.96 to 2.46)            |         |
|   | 5                               | 46.0                   | 3.33 (2.64 to 4.20)                              |         | 46.7                   | 3.21 (2.55 to 4.05)                                       |         | 2.33 (2.01 to 2.70)            |         |
|   | 6 or more                       | 61.3                   | 6.19 (5.12 to 7.49)                              |         | 63.7                   | 6.43 (5.29 to 7.80)                                       |         | 3.47 (3.12 to 3.87)            |         |
| Number of elective inpatient & daycase admissions           | 0                               | 22.5                   | 1.00 (reference)                                 | 0.006   | 23.6                   | 1.00 (reference)  | <0.001  | 1.00 (reference)               | 0.007   |
|   | 1                               | 24.7                   | 1.13 (1.04 to 1.23)                              |         | 26.2                   | 1.15 (1.06 to 1.25)                                       |         | 1.11 (1.03 to 1.18)            |         |
|   | 2                               | 23.3                   | 1.04 (0.97 to 1.12)                              |         | 24.5                   | 1.05 (0.98 to 1.12)                                       |         | 1.04 (0.98 to 1.11)            |         |
|   | 3                               | 24.1                   | 1.09 (0.97 to 1.24)                              |         | 25.5                   | 1.10 (0.98 to 1.25)                                       |         | 1.07 (0.97 to 1.18)            |         |
|   | 4                               | 23.9                   | 1.08 (0.96 to 1.22)                              |         | 24.9                   | 1.07 (0.95 to 1.21)                                       |         | 1.07 (0.97 to 1.18)            |         |
|   | 5                               | 25.4                   | 1.17 (0.97 to 1.42)                              |         | 26.7                   | 1.17 (0.97 to 1.42)                                       |         | 1.10 (0.95 to 1.28)            |         |

| Risk factor                            |                              | Predicted % with event | Adjusted odds ratio for 90d readmission (95% CI) |                | p value | Predicted % with event | Adjusted odds ratio for 90d readmission or death (95% CI) |                | p value | Adjusted hazard ratio (95% CI) |                | P value |
|--|------------------------------|------------------------|--|----------------|---------|------------------------|---|----------------|---------|--------------------------------|----------------|---------|
|  |                              |                        |  |                |         |                        |   |                |         |                                |                |         |
|  | 6                            | 28.1                   | 1.35   | (1.11 to 1.64) |         | 29.2                   | 1.33  | (1.10 to 1.61) |         | 1.27                           | (1.10 to 1.48) |         |
|  | 7 or more                    | 25.0                   | 1.15   | (1.01 to 1.30) |         | 27.6                   | 1.23  | (1.08 to 1.40) |         | 1.11                           | (1.00 to 1.23) |         |
| Number of new outpatient attendances   | 0                            | 21.8                   | 1.00   | (reference)    | <0.001  | 23.1                   | 1.00  | (reference)    | <0.001  | 1.00                           | (reference)    | <0.001  |
|  | 1                            | 24.0                   | 1.14   | (1.08 to 1.20) |         | 25.3                   | 1.13  | (1.07 to 1.19) |         | 1.11                           | (1.06 to 1.16) |         |
|  | 2                            | 24.4                   | 1.16   | (1.08 to 1.25) |         | 25.4                   | 1.14  | (1.06 to 1.22) |         | 1.13                           | (1.07 to 1.20) |         |
|  | 3                            | 24.5                   | 1.17   | (1.06 to 1.29) |         | 25.2                   | 1.12  | (1.02 to 1.24) |         | 1.14                           | (1.05 to 1.23) |         |
|  | 4                            | 25.7                   | 1.24   | (1.07 to 1.45) |         | 26.6                   | 1.21  | (1.04 to 1.40) |         | 1.19                           | (1.06 to 1.35) |         |
|  | 5 or more                    | 24.8                   | 1.19   | (0.98 to 1.44) |         | 25.1                   | 1.12  | (0.92 to 1.35) |         | 1.15                           | (0.98 to 1.35) |         |
| Number of acute psychiatric admissions | 0                            | 22.9                   | 1.00   | (reference)    | 0.053   | 24.1                   | 1.00  | (reference)    | 0.007   | 1.00                           | (reference)    | 0.081   |
|  | 1                            | 24.0                   | 1.06   | (0.89 to 1.26) |         | 26.1                   | 1.11  | (0.94 to 1.31) |         | 1.04                           | (0.91 to 1.19) |         |
|  | 2 or more                    | 28.3                   | 1.33   | (1.05 to 1.68) |         | 31.1                   | 1.42  | (1.13 to 1.79) |         | 1.22                           | (1.02 to 1.46) |         |
| Comorbidities                          |                              |                        |  |                |         |                        |   |                |         |                                |                |         |
| Number of comorbidities present        | 0                            | 19.5                   | 1.00   | (reference)    | <0.001  | 20.2                   | 1.00  | (reference)    | <0.001  | 1.00                           | (reference)    | <0.001  |
|  | 1                            | 24.3                   | 1.33   | (1.26 to 1.41) |         | 25.8                   | 1.37  | (1.30 to 1.45) |         | 1.28                           | (1.22 to 1.35) |         |
|  | 2                            | 26.6                   | 1.50   | (1.40 to 1.60) |         | 28.1                   | 1.54  | (1.44 to 1.65) |         | 1.42                           | (1.34 to 1.50) |         |
|  | 3                            | 29.9                   | 1.77   | (1.61 to 1.93) |         | 31.6                   | 1.82  | (1.66 to 1.99) |         | 1.60                           | (1.49 to 1.72) |         |
|  | 4                            | 29.7                   | 1.75   | (1.53 to 1.99) |         | 31.5                   | 1.81  | (1.59 to 2.06) |         | 1.58                           | (1.43 to 1.74) |         |
|  | 5 or more                    | 34.5                   | 2.18   | (1.82 to 2.62) |         | 37.7                   | 2.39  | (1.99 to 2.86) |         | 1.82                           | (1.60 to 2.07) |         |
| Indices of critical illness severity   |                              |                        |  |                |         |                        |   |                |         |                                |                |         |
| Type of admission to ICU               | Elective surgery             | 20.4                   | 1.00   | (reference)    | <0.001  | 21.2                   | 1.00  | (reference)    | <0.001  | 1.00                           | (reference)    | <0.001  |
|  | Emergency surgery            | 23.5                   | 1.20   | (1.10 to 1.30) |         | 24.7                   | 1.23  | (1.13 to 1.33) |         | 1.15                           | (1.08 to 1.24) |         |
|  | Non-operative                | 24.0                   | 1.23   | (1.14 to 1.34) |         | 25.5                   | 1.28  | (1.18 to 1.38) |         | 1.19                           | (1.12 to 1.28) |         |
| Diagnosis at admission to ICU          | Trauma including head injury | 17.2                   | 1.00   | (reference)    | <0.001  | 17.5                   | 1.00  | (reference)    | <0.001  | 1.00                           | (reference)    | <0.001  |
| Cardiovascular                         | Aortic aneurysm rupture      | 21.6                   | 1.33   | (1.00 to 1.77) |         | 22.2                   | 1.34  | (1.01 to 1.77) |         | 1.29                           | (0.99 to 1.67) |         |
|  | Cardiogenic shock            | 26.7                   | 1.76   | (1.22 to 2.53) |         | 28.8                   | 1.90  | (1.33 to 2.71) |         | 1.66                           | (1.22 to 2.26) |         |
|  | Post cardiac arrest          | 19.0                   | 1.13   | (0.86 to 1.49) |         | 21.8                   | 1.31  | (1.00 to 1.71) |         | 1.12                           | (0.88 to 1.44) |         |
|  | Septic shock                 | 21.8                   | 1.34   | (1.10 to 1.64) |         | 22.8                   | 1.39  | (1.14 to 1.69) |         | 1.31                           | (1.09 to 1.57) |         |
|  | Vascular surgery             | 21.1                   | 1.29   | (1.03 to 1.62) |         | 22.0                   | 1.33  | (1.06 to 1.66) |         | 1.25                           | (1.02 to 1.52) |         |
|  | Other CVS                    | 24.2                   | 1.54   | (1.25 to 1.89) |         | 25.3                   | 1.59  | (1.30 to 1.95) |         | 1.47                           | (1.22 to 1.76) |         |
| Respiratory                            | ARDS                         | 25.0                   | 1.61   | (1.15 to 2.24) |         | 26.0                   | 1.65  | (1.19 to 2.30) |         | 1.48                           | (1.12 to 1.95) |         |
|  | Asthma                       | 25.2                   | 1.62   | (1.25 to 2.10) |         | 25.7                   | 1.62  | (1.25 to 2.10) |         | 1.48                           | (1.19 to 1.84) |         |
|  | COPD                         | 26.4                   | 1.72   | (1.28 to 2.31) |         | 28.1                   | 1.83  | (1.37 to 2.45) |         | 1.64                           | (1.28 to 2.10) |         |
|  | Pneumonia                    | 20.5                   | 1.24   | (1.02 to 1.50) |         | 21.6                   | 1.29  | (1.07 to 1.56) |         | 1.21                           | (1.02 to 1.44) |         |
|  | Other respiratory            | 23.1                   | 1.45   | (1.19 to 1.76) |         | 24.7                   | 1.54  | (1.27 to 1.87) |         | 1.36                           | (1.14 to 1.63) |         |
| Gastrointestinal/Liver                 | GI bleed                     | 25.2                   | 1.62   | (1.28 to 2.05) |         | 26.0                   | 1.65  | (1.31 to 2.09) |         | 1.53                           | (1.24 to 1.88) |         |
|  | GI neoplasm                  | 25.3                   | 1.63   | (1.32 to 2.02) |         | 26.9                   | 1.73  | (1.41 to 2.14) |         | 1.53                           | (1.27 to 1.86) |         |



| Risk factor                                     |                              | Predicted % with event | Adjusted odds ratio for 90d readmission (95% CI) | p value | Predicted % with event | Adjusted odds ratio for 90d readmission or death (95% CI) | p value             | Adjusted hazard ratio (95% CI) | P value |
|---|------------------------------|------------------------|--|---------|------------------------|---|---------------------|--------------------------------|---------|
|   | GI obstruction               | 24.3                   | 1.55 (1.24 to 1.92)                              |         | 26.2                   | 1.67 (1.34 to 2.07)                                       |                     | 1.44 (1.18 to 1.75)            |         |
|   | Acute GI pathology*          | 25.2                   | 1.62 (1.33 to 1.98)                              |         | 26.5                   | 1.69 (1.39 to 2.06)                                       |                     | 1.54 (1.28 to 1.84)            |         |
|   | Other GI                     | 24.2                   | 1.54 (1.25 to 1.89)                              |         | 25.0                   | 1.57 (1.28 to 1.92)                                       |                     | 1.45 (1.21 to 1.75)            |         |
|   | Liver failure                | 28.4                   | 1.91 (1.35 to 2.71)                              |         | 29.1                   | 1.93 (1.36 to 2.73)                                       |                     | 1.73 (1.31 to 2.27)            |         |
|   | Oesophageal variceal bleed   | 33.5                   | 2.42 (1.84 to 3.18)                              |         | 36.0                   | 2.64 (2.02 to 3.47)                                       |                     | 1.95 (1.57 to 2.44)            |         |
|   | Pancreatitis                 | 38.4                   | 3.00 (2.32 to 3.86)                              |         | 38.6                   | 2.95 (2.29 to 3.80)                                       |                     | 2.41 (1.94 to 2.99)            |         |
| Nervous system                                  | Intracranial bleed           | 23.3                   | 1.47 (1.17 to 1.83)                              |         | 24.6                   | 1.53 (1.23 to 1.91)                                       |                     | 1.43 (1.17 to 1.75)            |         |
|   | Seizures                     | 28.1                   | 1.88 (1.51 to 2.34)                              |         | 28.7                   | 1.89 (1.52 to 2.34)                                       |                     | 1.66 (1.38 to 2.01)            |         |
|   | Other CNS                    | 22.1                   | 1.37 (1.11 to 1.69)                              |         | 24.0                   | 1.49 (1.21 to 1.83)                                       |                     | 1.33 (1.10 to 1.61)            |         |
| Other   | Diabetic ketoacidosis        | 25.2                   | 1.63 (1.24 to 2.13)                              |         | 26.4                   | 1.68 (1.29 to 2.20)                                       |                     | 1.57 (1.25 to 1.97)            |         |
|   | Renal                        | 27.7                   | 1.84 (1.48 to 2.29)                              |         | 28.8                   | 1.90 (1.53 to 2.36)                                       |                     | 1.71 (1.41 to 2.07)            |         |
|   | Self poisoning               | 21.2                   | 1.30 (1.05 to 1.60)                              |         | 22.2                   | 1.34 (1.09 to 1.65)                                       |                     | 1.27 (1.05 to 1.53)            |         |
|   | Trauma excluding head injury | 20.4                   | 1.24 (1.00 to 1.52)                              |         | 21.8                   | 1.31 (1.07 to 1.61)                                       |                     | 1.20 (1.00 to 1.45)            |         |
|   | Miscellaneous                | 20.9                   | 1.27 (1.04 to 1.54)                              |         | 21.8                   | 1.31 (1.08 to 1.60)                                       |                     | 1.23 (1.03 to 1.48)            |         |
| CPR prior to admission to ICU                   | No                           | 22.9                   | 1.00 (reference)                                 | 0.24    | 24.1                   | 1.00 (reference)  | 0.23                | 1.00 (reference)               | 0.25    |
|   | Yes                          | 24.8                   | 1.11 (0.94 to 1.31)                              |         | 26.1                   | 1.11 (0.94 to 1.31)                                       |                     | 1.09 (0.94 to 1.26)            |         |
| Acute physiology score at admission to ICU      | 0 - 5                        | 21.7                   | 1.00 (reference)                                 | 0.17    | 22.3                   | 1.00 (reference)  | 0.035               | 1.00 (reference)               | 0.23    |
|   | 6 - 7                        | 22.3                   | 1.04 (0.95 to 1.14)                              |         | 23.0                   | 1.04 (0.95 to 1.14)                                       |                     | 1.05 (0.96 to 1.13)            |         |
|   | 8 - 9                        | 23.0                   | 1.08 (0.98 to 1.18)                              |         | 24.0                   | 1.10 (1.01 to 1.21)                                       |                     | 1.06 (0.98 to 1.15)            |         |
|   | 10 - 11                      | 23.1                   | 1.09 (0.99 to 1.19)                              |         | 24.3                   | 1.11 (1.02 to 1.22)                                       |                     | 1.08 (1.00 to 1.17)            |         |
|   | 12 - 13                      | 23.5                   | 1.11 (1.01 to 1.22)                              |         | 24.9                   | 1.15 (1.05 to 1.27)                                       |                     | 1.09 (1.01 to 1.19)            |         |
|   | 14 - 15                      | 23.1                   | 1.09 (0.98 to 1.20)                              |         | 24.7                   | 1.14 (1.03 to 1.26)                                       |                     | 1.08 (0.99 to 1.17)            |         |
|   | 16 - 18                      | 24.2                   | 1.15 (1.04 to 1.28)                              |         | 25.4                   | 1.18 (1.07 to 1.31)                                       |                     | 1.13 (1.04 to 1.23)            |         |
|   | 19 - 22                      | 22.5                   | 1.05 (0.94 to 1.17)                              |         | 24.5                   | 1.13 (1.01 to 1.26)                                       |                     | 1.05 (0.95 to 1.15)            |         |
| 23 or more                                      | 24.2                         | 1.16 (1.03 to 1.31)    |  | 25.8    | 1.21 (1.07 to 1.37)    |   | 1.12 (1.01 to 1.24) |                                |         |
| Mechanical ventilation on any day in ICU        | No                           | 23.5                   | 1.00 (reference)                                 | 0.11    | 24.7                   | 1.00 (reference)  | 0.15                | 1.00 (reference)               | 0.18    |
|   | Yes                          | 22.7                   | 0.96 (0.91 to 1.01)                              |         | 23.9                   | 0.96 (0.91 to 1.01)                                       |                     | 0.97 (0.93 to 1.01)            |         |
| Renal replacement therapy on any day in ICU     | No                           | 22.8                   | 1.00 (reference)                                 | 0.005   | 24.1                   | 1.00 (reference)  | 0.028               | 1.00 (reference)               | 0.006   |
|   | Yes                          | 25.2                   | 1.14 (1.04 to 1.24)                              |         | 25.9                   | 1.10 (1.01 to 1.21)                                       |                     | 1.11 (1.03 to 1.19)            |         |
| Cardiovascular system support on any day in ICU | No                           | 22.8                   | 1.00 (reference)                                 | 0.35    | 24.2                   | 1.00 (reference)  | 0.98                | 1.00 (reference)               | 0.38    |
|   | Yes                          | 23.3                   | 1.03 (0.97 to 1.08)                              |         | 24.2                   | 1.00 (0.95 to 1.05)                                       |                     | 1.02 (0.97 to 1.07)            |         |
| Tracheostomy during ICU stay                    | No                           | 23.2                   | 1.00 (reference)                                 | 0.006   | 24.4                   | 1.00 (reference)  | 0.010               | 1.00 (reference)               | 0.002   |
|   | Yes                          | 21.1                   | 0.88 (0.81 to 0.96)                              |         | 22.4                   | 0.89 (0.82 to 0.97)                                       |                     | 0.89 (0.82 to 0.96)            |         |
| Length of stay prior to ICU stay (days)         | 0                            | 22.3                   | 1.00 (reference)                                 | <0.001  | 23.4                   | 1.00 (reference)  | <0.001              | 1.00 (reference)               | <0.001  |
|   | 1                            | 22.7                   | 1.02 (0.96 to 1.09)                              |         | 23.7                   | 1.02 (0.96 to 1.08)                                       |                     | 1.03 (0.98 to 1.08)            |         |
|   | 2 - 3                        | 23.3                   | 1.06 (0.98 to 1.14)                              |         | 24.3                   | 1.05 (0.97 to 1.13)                                       |                     | 1.06 (1.00 to 1.13)            |         |
|   | 4 - 7                        | 23.4                   | 1.06 (0.97 to 1.16)                              |         | 24.5                   | 1.06 (0.97 to 1.16)                                       |                     | 1.07 (0.99 to 1.15)            |         |
|   | 8 or more                    | 27.7                   | 1.34 (1.23 to 1.45)                              |         | 30.1                   | 1.41 (1.30 to 1.52)                                       |                     | 1.27 (1.19 to 1.36)            |         |

| Risk factor                         |            | Predicted % with event | Adjusted odds ratio for 90d readmission (95% CI) | p value | Predicted % with event | Adjusted odds ratio for 90d readmission or death (95% CI) | p value             | Adjusted hazard ratio (95% CI) | P value |
|-------------------------------------|------------|------------------------|--|---------|------------------------|---|---------------------|--------------------------------|---------|
| Length of ICU stay (days)           | 0          | 22.8                   | 1.00 (reference)                                 | 0.93    | 23.8                   | 1.00 (reference)  | 0.83                | 1.00 (reference)               | 0.93    |
|                                     | 1          | 22.9                   | 1.01 (0.91 to 1.11)                              |         | 24.2                   | 1.02 (0.93 to 1.12)                                       |                     | 1.01 (0.93 to 1.09)            |         |
|                                     | 2          | 23.2                   | 1.02 (0.92 to 1.13)                              |         | 24.4                   | 1.03 (0.93 to 1.14)                                       |                     | 1.01 (0.93 to 1.11)            |         |
|                                     | 3          | 23.7                   | 1.05 (0.94 to 1.17)                              |         | 25.0                   | 1.07 (0.95 to 1.19)                                       |                     | 1.04 (0.94 to 1.14)            |         |
|                                     | 4 - 5      | 23.1                   | 1.02 (0.91 to 1.14)                              |         | 24.3                   | 1.03 (0.92 to 1.15)                                       |                     | 1.00 (0.91 to 1.10)            |         |
|                                     | 6 - 10     | 22.7                   | 0.99 (0.88 to 1.11)                              |         | 23.7                   | 0.99 (0.89 to 1.11)                                       |                     | 0.99 (0.90 to 1.09)            |         |
|                                     | 11 or more | 22.8                   | 1.00 (0.88 to 1.14)                              |         | 24.0                   | 1.01 (0.89 to 1.15)                                       |                     | 1.01 (0.90 to 1.13)            |         |
| Length of stay post ICU stay (days) | 0 - 1      | 17.2                   | 1.00 (reference)                                 | <0.001  | 18.5                   | 1.00 (reference)  | <0.001              | 1.00 (reference)               | <0.001  |
|                                     | 2 - 3      | 19.5                   | 1.16 (1.04 to 1.30)                              |         | 20.4                   | 1.13 (1.01 to 1.26)                                       |                     | 1.15 (1.04 to 1.27)            |         |
|                                     | 4 - 5      | 20.7                   | 1.25 (1.12 to 1.40)                              |         | 21.6                   | 1.21 (1.08 to 1.35)                                       |                     | 1.22 (1.11 to 1.34)            |         |
|                                     | 6 - 7      | 22.3                   | 1.38 (1.23 to 1.55)                              |         | 23.1                   | 1.32 (1.18 to 1.48)                                       |                     | 1.32 (1.19 to 1.45)            |         |
|                                     | 8 - 9      | 22.7                   | 1.41 (1.25 to 1.60)                              |         | 23.7                   | 1.36 (1.21 to 1.54)                                       |                     | 1.35 (1.22 to 1.50)            |         |
|                                     | 10 - 13    | 24.7                   | 1.58 (1.41 to 1.76)                              |         | 25.5                   | 1.50 (1.35 to 1.68)                                       |                     | 1.47 (1.34 to 1.62)            |         |
|                                     | 14 - 18    | 25.9                   | 1.68 (1.49 to 1.88)                              |         | 26.9                   | 1.62 (1.44 to 1.81)                                       |                     | 1.54 (1.39 to 1.70)            |         |
|                                     | 19 - 28    | 27.0                   | 1.78 (1.58 to 2.00)                              |         | 28.2                   | 1.73 (1.54 to 1.94)                                       |                     | 1.61 (1.46 to 1.77)            |         |
|                                     | 29 - 52    | 26.8                   | 1.76 (1.56 to 1.98)                              |         | 28.2                   | 1.72 (1.54 to 1.94)                                       |                     | 1.61 (1.45 to 1.78)            |         |
| 53 or more                          | 24.7       | 1.57 (1.40 to 1.78)    |  | 27.3    | 1.65 (1.46 to 1.85)    |   | 1.44 (1.30 to 1.60) |                                |         |

\*Acute GI pathology comprises gastrointestinal perforation/ischaemia/ peritonitis/abscess

**eTable 5 Characteristics of patients in development and validation cohorts**

| Characteristic  |                                 | Development cohort (N=33,294) |                | Validation cohort (N=14,273) |                |
|---|---------------------------------|-------------------------------|----------------|------------------------------|----------------|
|   |                                 | n or median                   | % or quartiles | n or median                  | % or quartiles |
| <b>Demographics</b>   |                                 |                               |                |                              |                |
| Sex   | Female                          | 14,652                        | 44.0           | 6,176                        | 43.3           |
| Age at admission to ICU (years)                             | Median and Quartiles            | 59                            | 43, 71         | 62                           | 48, 72         |
| Scottish Index of Multiple Deprivation                      | First quintile (Most deprived)  | 9,111                         | 27.4           | 3,837                        | 26.9           |
|   | Second quintile                 | 7,780                         | 23.4           | 3,253                        | 22.8           |
|   | Third quintile                  | 6,597                         | 19.8           | 2,817                        | 19.7           |
|   | Fourth quintile                 | 5,541                         | 16.6           | 2,428                        | 17.0           |
|   | Fifth quintile (Least deprived) | 4,265                         | 12.8           | 1,938                        | 13.6           |
| Remoteness of residence                                     | Urban area                      | 22,771                        | 68.4           | 9,917                        | 69.5           |
|   | Accessible                      | 7,855                         | 23.6           | 3,226                        | 22.6           |
|   | Remote                          | 1,558                         | 4.7            | 602                          | 4.2            |
|   | Very remote                     | 1,110                         | 3.3            | 528                          | 3.7            |
| <b>Indices of pre-existing patient health</b>               |                                 |                               |                |                              |                |
| Admissions/attendances in year prior to index hospital stay |                                 |                               |                |                              |                |
| Number of unplanned inpatient admissions                    | 0                               | 22,934                        | 68.9           | 9,603                        | 67.3           |
|   | 1                               | 6,087                         | 18.3           | 2,864                        | 20.1           |
|   | 2                               | 2,204                         | 6.6            | 934                          | 6.5            |
|   | 3 or more                       | 2,069                         | 6.2            | 872                          | 6.1            |
| Number of elective inpatient & daycase admissions           | 0                               | 23,803                        | 71.5           | 8,987                        | 63.0           |
|   | 1                               | 2,595                         | 7.8            | 1,034                        | 7.2            |
|   | 2                               | 3,389                         | 10.2           | 2,325                        | 16.3           |
|   | 3 or more                       | 3,507                         | 10.5           | 1,927                        | 13.5           |
| Number of new outpatient attendances                        | 0                               | 17,675                        | 53.1           | 6,088                        | 42.7           |
|   | 1                               | 8,966                         | 26.9           | 3,855                        | 27.0           |
|   | 2                               | 4,160                         | 12.5           | 2,537                        | 17.8           |
|   | 3 or more                       | 2,493                         | 7.5            | 1,793                        | 12.6           |
| Number of acute psychiatric admissions                      | 0                               | 32,406                        | 97.3           | 14,005                       | 98.1           |
|   | 1                               | 591                           | 1.8            | 184                          | 1.3            |
|   | 2 or more                       | 297                           | 0.9            | 84                           | 0.6            |
| <b>Comorbidities</b>  |                                 |                               |                |                              |                |
| Number of comorbidities present                             | 0                               | 14,685                        | 44.1           | 5,769                        | 40.4           |
|   | 1                               | 10,275                        | 30.9           | 4,596                        | 32.2           |
|   | 2                               | 4,991                         | 15.0           | 2,256                        | 15.8           |
|   | 3 or more                       | 3,343                         | 10.0           | 1,652                        | 11.6           |
| Myocardial infarction                                       | Yes                             | 1,616                         | 4.9            | 995                          | 7.0            |
| Cardiovascular disease                                      | Yes                             | 1,922                         | 5.8            | 1,036                        | 7.3            |
| Peripheral vascular disease                                 | Yes                             | 1,593                         | 4.8            | 654                          | 4.6            |
| Cerebrovascular disease                                     | Yes                             | 1,270                         | 3.8            | 550                          | 3.9            |
| Dementia  | Yes                             | 105                           | 0.3            | 40                           | 0.3            |
| Respiratory disease   | Yes                             | 4,152                         | 12.5           | 1,740                        | 12.2           |
| Rheumatic disease   | Yes                             | 547                           | 1.6            | 228                          | 1.6            |
| Peptic ulcer disease  | Yes                             | 706                           | 2.1            | 252                          | 1.8            |
| Liver disease   | No                              | 31,564                        | 94.8           | 13,654                       | 95.7           |
|   | Mild                            | 636                           | 1.9            | 234                          | 1.6            |

| Characteristic                              |                                    | Development cohort<br>(N=33,294)                 |                   | Validation cohort<br>(N=14,273) |                   |      |
|---|------------------------------------|--|-------------------|---------------------------------|-------------------|------|
|   |                                    | n or<br>median                                   | % or<br>quartiles | n or<br>median                  | % or<br>quartiles |      |
| Diabetes mellitus                           | Moderate or severe                 | 1,094  | 3.3               | 385                             | 2.7               |      |
|   | No                                 | 30,610   | 91.9              | 12,879                          | 90.2              |      |
|   | Yes - without chronic complication | 2,253  | 6.8               | 1,219                           | 8.5               |      |
|   | Yes - with chronic complication    | 431  | 1.3               | 175                             | 1.2               |      |
| Hemiplegia or paraplegia                    | Yes                                | 254  | 0.8               | 90                              | 0.6               |      |
| Renal disease                               | Yes                                | 1,296  | 3.9               | 661                             | 4.6               |      |
| Cancer                                      | No                                 | 26,295   | 79.0              | 10,773                          | 75.5              |      |
|   | Yes - without metastases           | 5,866  | 17.6              | 2,927                           | 20.5              |      |
|   | Yes - with metastases              | 1,133  | 3.4               | 573                             | 4.0               |      |
| Immunosuppression                           | Yes                                | 961  | 2.9               | 338                             | 2.4               |      |
| Alcohol misuse                              | Yes                                | 4,175  | 12.5              | 1,415                           | 9.9               |      |
| Drug misuse                                 | Yes                                | 2,036  | 6.1               | 1,430                           | 10.0              |      |
| <b>Indices of critical illness severity</b> |                                    |  |                   |                                 |                   |      |
| Type of admission to ICU                    |                                    | Elective surgery                                 | 6,177             | 18.6                            | 5,232             | 36.7 |
|   |                                    | Emergency surgery                                | 8,925             | 26.8                            | 2,943             | 20.6 |
|   |                                    | Non-operative                                    | 18,192            | 54.6                            | 6,098             | 42.7 |
| Diagnosis at admission to ICU               | Cardiovascular                     | Trauma including head injury                     | 893               | 2.7                             | 237               | 1.7  |
|   |                                    | Aortic aneurysm rupture                          | 444               | 1.3                             | 131               | 0.9  |
|   |                                    | Cardiogenic shock                                | 142               | 0.4                             | 52                | 0.4  |
|   |                                    | Post cardiac arrest                              | 757               | 2.3                             | 354               | 2.5  |
|   |                                    | Septic shock                                     | 1,964             | 5.9                             | 717               | 5.0  |
|   |                                    | Vascular surgery                                 | 1,230             | 3.7                             | 434               | 3.0  |
|   |                                    | Other CVS  | 848               | 2.5                             | 2,115             | 14.8 |
|   | Respiratory                        | ARDS   | 206               | 0.6                             | 48                | 0.3  |
|   |                                    | Asthma   | 473               | 1.4                             | 131               | 0.9  |
|   |                                    | COPD   | 283               | 0.9                             | 83                | 0.6  |
|   |                                    | Pneumonia  | 3,360             | 10.1                            | 1,054             | 7.4  |
|   |                                    | Other respiratory                                | 2,393             | 7.2                             | 1,636             | 11.5 |
|   | Gastrointestinal<br>/Liver         | GI bleed   | 715               | 2.1                             | 186               | 1.3  |
|   |                                    | GI neoplasm                                      | 1,836             | 5.5                             | 720               | 5.0  |
|   |                                    | GI obstruction                                   | 1,174             | 3.5                             | 451               | 3.2  |
|   |                                    | GI perforation/ischaemia/<br>peritonitis/abscess | 2,787             | 8.4                             | 818               | 5.7  |
|   |                                    | Other GI   | 1,844             | 5.5                             | 709               | 5.0  |
|   |                                    | Liver failure                                    | 160               | 0.5                             | 41                | 0.3  |
|   |                                    | Oesophageal variceal bleed                       | 317               | 1.0                             | 90                | 0.6  |
|   |                                    | Pancreatitis                                     | 384               | 1.2                             | 135               | 0.9  |
|   | Nervous system                     | Intracranial bleed                               | 923               | 2.8                             | 327               | 2.3  |
|   |                                    | Seizures   | 898               | 2.7                             | 315               | 2.2  |
|   |                                    | Other CNS  | 1,326             | 4.0                             | 498               | 3.5  |
|   | Other                              | Diabetic ketoacidosis                            | 382               | 1.1                             | 112               | 0.8  |
|   |                                    | Renal  | 989               | 3.0                             | 387               | 2.7  |
|   |                                    | Self poisoning                                   | 1,954             | 5.9                             | 655               | 4.6  |
| Trauma excluding head injury                |                                    | 1,582  | 4.8               | 609                             | 4.3               |      |
| Miscellaneous                               |                                    | 3,030  | 9.1               | 1,228                           | 8.6               |      |
| CPR prior to admission to ICU               | Yes                                | 1,222  | 3.7               | 465                             | 3.3               |      |
| APACHE II score at admission to ICU         | Median and Quartiles               | 16   | 11, 20            | 14                              | 10, 19            |      |
| Acute physiology score at admission to ICU  | Median and Quartiles               | 12   | 8, 16             | 10                              | 7, 15             |      |

| Characteristic  |                      | Development cohort<br>(N=33,294) |                   | Validation cohort<br>(N=14,273) |                   |
|---|----------------------|----------------------------------|-------------------|---------------------------------|-------------------|
|   |                      | n or<br>median                   | % or<br>quartiles | n or<br>median                  | % or<br>quartiles |
| Number of days with mechanical ventilation during ICU stay        | 0                    | 11,693                           | 35.1              | 6,076                           | 42.6              |
|   | 1                    | 6,693                            | 20.1              | 3,085                           | 21.6              |
|   | 2                    | 5,710                            | 17.2              | 2,172                           | 15.2              |
|   | 3 or more            | 9,198                            | 27.6              | 2,940                           | 20.6              |
| Number of days with renal replacement therapy during ICU stay     | 0                    | 30,440                           | 91.4              | 13,382                          | 93.8              |
|   | 1                    | 411                              | 1.2               | 138                             | 1.0               |
|   | 2                    | 482                              | 1.4               | 174                             | 1.2               |
|   | 3 or more            | 1,961                            | 5.9               | 579                             | 4.1               |
| Number of days with cardiovascular system support during ICU stay | 0                    | 21,307                           | 64.0              | 8,179                           | 57.3              |
|   | 1                    | 3,260                            | 9.8               | 1,620                           | 11.4              |
|   | 2                    | 3,404                            | 10.2              | 1,680                           | 11.8              |
|   | 3 or more            | 5,323                            | 16.0              | 2,794                           | 19.6              |
| Maximum number of organs supported on any day during ICU stay     | 0                    | 9,304                            | 27.9              | 4,617                           | 32.3              |
|   | 1                    | 13,771                           | 41.4              | 4,863                           | 34.1              |
|   | 2                    | 8,429                            | 25.3              | 4,262                           | 29.9              |
|   | 3                    | 1,790                            | 5.4               | 531                             | 3.7               |
| Tracheostomy during ICU stay                                      | Yes                  | 3,893                            | 11.7              | 1,098                           | 7.7               |
| Length of stay prior to ICU stay (days)                           | Median and Quartiles | 1                                | 0, 2              | 1                               | 0, 1              |
| Length of ICU stay (days)   | Median and Quartiles | 2                                | 1, 5              | 2                               | 1, 5              |
| Length of stay post ICU stay (days)                               | Median and Quartiles | 11                               | 5, 25             | 7                               | 4, 17             |
| Length of index hospital stay (days)                              | Median and Quartiles | 17                               | 8, 36             | 13                              | 7, 26             |
| <b>Event within 90 days of discharge from index hospital stay</b> |                      |                                  |                   |                                 |                   |
| Unplanned hospital admission                                      | Yes                  | 8,051                            | 24.2              | 3,562                           | 25.0              |
| Unplanned hospital admission or death                             | Yes                  | 8,507                            | 25.6              | 3,707                           | 26.0              |

The 47,567 patients with data available for all the variables being considered for the prognostic model were allocated to the development and validation cohorts based on their date of discharge from index hospital stay being on or before 17 January 2012 or after this date with the proportions in the two cohorts were 70% and 30% respectively.

**eTable 6 Coefficients for variables in model predicting unplanned hospital admission within 90 days of discharge from index hospital stay and model predicting unplanned hospital admission or death within 90 days of discharge from index hospital stay in development cohort**

| Predictor   |             | Outcome: 90d readmission |             | Outcome: 90d readmission or death |             |
|---|-------------|--------------------------|-------------|-----------------------------------|-------------|
|   |             | Coefficient              | SE          | Coefficient                       | SE          |
| Intercept   |             | -2.5945                  | 0.1321      | -2.6102                           | 0.1310      |
| Age at admission to ICU (years)                             | 16 - 25     | 0                        | (reference) | 0                                 | (reference) |
|   | 26 - 35     | 0.0722                   | 0.0739      | 0.0720                            | 0.0735      |
|   | 36 - 45     | 0.1163                   | 0.0685      | 0.1268                            | 0.0680      |
|   | 46 - 55     | 0.0723                   | 0.0678      | 0.0876                            | 0.0673      |
|   | 56 - 65     | 0.0447                   | 0.0676      | 0.0897                            | 0.0670      |
|   | 66 - 75     | -0.0165                  | 0.0691      | 0.0377                            | 0.0685      |
|   | 76 - 85     | -0.1129                  | 0.0742      | -0.0183                           | 0.0732      |
|   | 86 or older | 0.1103                   | 0.1152      | 0.2948                            | 0.1118      |
| Remoteness of residence                                     | Urban area  | 0                        | (reference) | 0                                 | (reference) |
|   | Accessible  | -0.1099                  | 0.0325      | -0.0970                           | 0.0319      |
|   | Remote      | -0.1976                  | 0.0661      | -0.2064                           | 0.0650      |
|   | Very remote | -0.0160                  | 0.0732      | -0.0212                           | 0.0722      |
| Admissions/attendances in year prior to index hospital stay |             |                          |             |                                   |             |
| Number of unplanned inpatient admissions                    | 0           | 0                        | (reference) | 0                                 | (reference) |
|   | 1           | 0.2929                   | 0.0352      | 0.2944                            | 0.0347      |
|   | 2           | 0.5315                   | 0.0510      | 0.5367                            | 0.0506      |
|   | 3           | 0.8335                   | 0.0716      | 0.8540                            | 0.0714      |
|   | 4           | 1.0515                   | 0.0985      | 1.0658                            | 0.0988      |
|   | 5           | 1.2572                   | 0.1373      | 1.2428                            | 0.1382      |
|   | 6 or more   | 1.8269                   | 0.1144      | 1.8970                            | 0.1172      |
| Number of elective inpatient & daycase admissions           | 0           | 0                        | (reference) | 0                                 | (reference) |
|   | 1           | 0.1701                   | 0.0502      | 0.1787                            | 0.0497      |
|   | 2           | 0.0482                   | 0.0460      | 0.0480                            | 0.0454      |
|   | 3           | 0.0872                   | 0.0762      | 0.0753                            | 0.0754      |
|   | 4           | 0.0141                   | 0.0777      | -0.0112                           | 0.0770      |
|   | 5           | 0.2347                   | 0.1203      | 0.2183                            | 0.1195      |
|   | 6           | 0.3736                   | 0.1255      | 0.3559                            | 0.1252      |
|   | 7 or more   | 0.0545                   | 0.0831      | 0.0880                            | 0.0820      |
| Number of new outpatient attendances                        | 0           | 0                        | (reference) | 0                                 | (reference) |
|   | 1           | 0.1297                   | 0.0327      | 0.1202                            | 0.0322      |
|   | 2           | 0.1434                   | 0.0434      | 0.1177                            | 0.0429      |
|   | 3           | 0.1633                   | 0.0629      | 0.1186                            | 0.0624      |
|   | 4           | 0.2470                   | 0.0992      | 0.2117                            | 0.0983      |
|   | 5 or more   | -0.0269                  | 0.1316      | -0.1045                           | 0.1310      |
| Number of acute psychiatric admissions                      | 0           | 0                        | (reference) | 0                                 | (reference) |
|   | 1           | 0.1930                   | 0.0992      | 0.2704                            | 0.0973      |
|   | 2 or more   | 0.3377                   | 0.1348      | 0.3989                            | 0.1332      |
| Comorbidities   |             |                          |             |                                   |             |
| Number of comorbidities present                             | 0           | 0                        | (reference) | 0                                 | (reference) |
|   | 1           | 0.2440                   | 0.0376      | 0.2503                            | 0.0371      |
|   | 2           | 0.4283                   | 0.0467      | 0.4165                            | 0.0466      |
|   | 3           | 0.5737                   | 0.0629      | 0.5466                            | 0.0637      |
|   | 4           | 0.5316                   | 0.0916      | 0.4847                            | 0.0934      |

| Predictor                           |                                    | Outcome: 90d readmission                     |             | Outcome: 90d readmission or death |             |        |
|-------------------------------------|------------------------------------|--|-------------|-----------------------------------|-------------|--------|
|                                     |                                    | Coefficient                                  | SE          | Coefficient                       | SE          |        |
|                                     | 5 or more                          | 0.7664                                       | 0.1290      | 0.7914                            | 0.1323      |        |
| Myocardial infarction               | No                                 | 0  | (reference) | 0                                 | (reference) |        |
|                                     | Yes                                | -0.1726                                      | 0.0648      | -0.1712                           | 0.0642      |        |
| Peripheral vascular disease         | No                                 | 0  | (reference) | 0                                 | (reference) |        |
|                                     | Yes                                | -0.1843                                      | 0.0682      | -0.1846                           | 0.0674      |        |
| Diabetes mellitus                   | No                                 | 0  | (reference) | 0                                 | (reference) |        |
|                                     | Yes - without chronic complication | -0.0305                                      | 0.0547      | -0.0092                           | 0.0541      |        |
|                                     | Yes - with chronic complication    | 0.4153                                       | 0.1075      | 0.4344                            | 0.1090      |        |
| Renal disease                       | No                                 | -  | -           | 0                                 | (reference) |        |
|                                     | Yes                                | -  | -           | 0.1549                            | 0.0680      |        |
| Cancer                              | No                                 | 0  | (reference) | 0                                 | (reference) |        |
|                                     | Yes - without metastases           | 0.0590                                       | 0.0459      | 0.1138                            | 0.0454      |        |
|                                     | Yes - with metastases              | 0.2673                                       | 0.0739      | 0.4756                            | 0.0724      |        |
| Type of admission to ICU            | Elective surgery                   | 0  | (reference) | 0                                 | (reference) |        |
|                                     | Emergency surgery                  | 0.1521                                       | 0.0510      | 0.1717                            | 0.0503      |        |
|                                     | Non-operative                      | 0.1848                                       | 0.0530      | 0.2109                            | 0.0523      |        |
| Diagnosis at admission to ICU       | Trauma including head injury       | 0  | 0           | (reference)                       | (reference) |        |
|                                     | Cardiovascular                     | Aortic aneurysm rupture                      | 0.1566      | 0.1721                            | 0.1638      | 0.1666 |
|                                     |                                    | Cardiogenic shock                            | 0.4603      | 0.5552                            | 0.2112      | 0.2166 |
|                                     |                                    | Post cardiac arrest                          | 0.2189      | 0.3375                            | 0.1307      | 0.1333 |
|                                     |                                    | Septic shock                                 | 0.1913      | 0.1896                            | 0.1127      | 0.1136 |
|                                     |                                    | Vascular surgery                             | 0.2414      | 0.2750                            | 0.1305      | 0.1319 |
|                                     |                                    | Other CVS                                    | 0.4302      | 0.4603                            | 0.1268      | 0.1279 |
|                                     | Respiratory                        | ARDS   | 0.3904      | 0.4162                            | 0.1868      | 0.1884 |
|                                     |                                    | Asthma                                       | 0.4238      | 0.4326                            | 0.1472      | 0.1478 |
|                                     |                                    | COPD   | 0.4625      | 0.5029                            | 0.1672      | 0.1691 |
|                                     |                                    | Pneumonia                                    | 0.1425      | 0.1706                            | 0.1079      | 0.1087 |
|                                     |                                    | Other respiratory                            | 0.2175      | 0.2668                            | 0.1119      | 0.1130 |
|                                     | Gastrointestinal/Liver             | GI bleed                                     | 0.3453      | 0.3569                            | 0.1343      | 0.1355 |
|                                     |                                    | GI neoplasm                                  | 0.3557      | 0.3740                            | 0.1217      | 0.1228 |
|                                     |                                    | GI obstruction                               | 0.3261      | 0.3515                            | 0.1244      | 0.1257 |
|                                     |                                    | GI perforation/ischaemia/peritonitis/abscess | 0.4035      | 0.4262                            | 0.1120      | 0.1128 |
|                                     |                                    | Other GI                                     | 0.2914      | 0.2905                            | 0.1167      | 0.1174 |
|                                     |                                    | Liver failure                                | 0.3570      | 0.3650                            | 0.2024      | 0.2029 |
|                                     |                                    | Oesophageal variceal bleed                   | 0.6881      | 0.8162                            | 0.1561      | 0.1568 |
|                                     |                                    | Pancreatitis                                 | 0.8827      | 0.8632                            | 0.1470      | 0.1475 |
|                                     | Nervous system                     | Intracranial bleed                           | 0.3235      | 0.3535                            | 0.1250      | 0.1262 |
|                                     |                                    | Seizures                                     | 0.5453      | 0.5421                            | 0.1237      | 0.1243 |
|                                     |                                    | Other CNS                                    | 0.2326      | 0.3034                            | 0.1177      | 0.1191 |
|                                     | Other                              | Diabetic ketoacidosis                        | 0.3599      | 0.3891                            | 0.1564      | 0.1576 |
|                                     |                                    | Renal  | 0.5100      | 0.4810                            | 0.1239      | 0.1243 |
|                                     |                                    | Self poisoning                               | 0.1464      | 0.1757                            | 0.1180      | 0.1191 |
|                                     |                                    | Trauma excluding head injury                 | 0.1433      | 0.2129                            | 0.1170      | 0.1184 |
| Miscellaneous                       |                                    | 0.1139                                       | 0.1226      | 0.1108                            | 0.1116      |        |
|                                     |                                    |  |             |                                   |             |        |
| APACHE II score at admission to ICU | 1 - 7                              | 0  | (reference) | 0                                 | (reference) |        |
|                                     | 8 - 10                             | -0.0120                                      | 0.0657      | -0.0060                           | 0.0652      |        |
|                                     | 11 - 12                            | 0.0862                                       | 0.0678      | 0.0722                            | 0.0674      |        |

| Predictor                               |            | Outcome: 90d readmission |             | Outcome: 90d readmission or death |             |
|---|------------|--------------------------|-------------|-----------------------------------|-------------|
|   |            | Coefficient              | SE          | Coefficient                       | SE          |
|   | 13 - 14    | 0.0980                   | 0.0664      | 0.0892                            | 0.0659      |
|   | 15 - 16    | 0.1202                   | 0.0665      | 0.1370                            | 0.0659      |
|   | 17 - 18    | 0.1035                   | 0.0681      | 0.1342                            | 0.0674      |
|   | 19 - 21    | 0.1717                   | 0.0670      | 0.2026                            | 0.0663      |
|   | 22 - 25    | 0.1835                   | 0.0697      | 0.2224                            | 0.0689      |
|   | 26 or more | 0.2150                   | 0.0729      | 0.2624                            | 0.0721      |
| Tracheostomy during ICU stay            | No         | 0                        | (reference) | 0                                 | (reference) |
|   | Yes        | -0.1243                  | 0.0458      | -0.1203                           | 0.0449      |
| Length of stay prior to ICU stay (days) | 0          | 0                        | (reference) | 0                                 | (reference) |
|   | 1          | 0.0561                   | 0.0379      | 0.0415                            | 0.0374      |
|   | 2 - 3      | 0.0327                   | 0.0454      | 0.0212                            | 0.0448      |
|   | 4 - 7      | 0.0448                   | 0.0531      | 0.0292                            | 0.0524      |
|   | 8 or more  | 0.2700                   | 0.0499      | 0.3244                            | 0.0491      |
| Length of stay post ICU stay (days)     | 0 - 1      | 0                        | (reference) | 0                                 | (reference) |
|   | 2 - 3      | 0.1706                   | 0.0712      | 0.1347                            | 0.0702      |
|   | 4 - 5      | 0.2164                   | 0.0720      | 0.1765                            | 0.0709      |
|   | 6 - 7      | 0.2747                   | 0.0725      | 0.2290                            | 0.0714      |
|   | 8 - 9      | 0.3317                   | 0.0758      | 0.2816                            | 0.0747      |
|   | 10 - 13    | 0.4417                   | 0.0694      | 0.3829                            | 0.0683      |
|   | 14 - 18    | 0.5006                   | 0.0720      | 0.4561                            | 0.0708      |
|   | 19 - 28    | 0.5881                   | 0.0707      | 0.5423                            | 0.0696      |
|   | 29 - 52    | 0.5668                   | 0.0718      | 0.5316                            | 0.0705      |
| 53 or more                              | 0.4634     | 0.0733                   | 0.4895      | 0.0718                            |             |

#### Outcome: 90 day unplanned hospital readmission

Prognostic model was derived using backward elimination with a significance level of 0.05 for predictors to remain in the model. Thirty nine predictors were considered and the final model included the 17 predictors above after removal of following 22 predictors; sex, Scottish Index of Multiple Deprivation, comorbidities of cardiovascular disease, cerebrovascular disease, dementia, respiratory disease, rheumatic disease, peptic ulcer disease, liver disease, hemiplegia or paraplegia, renal disease, immunosuppression, alcohol misuse, and drug misuse, CPR prior to admission to ICU, acute physiology score at admission to ICU, number of days with mechanical ventilation during ICU stay, number of days with renal replacement therapy during ICU stay, number of days with cardiovascular system support during ICU stay, maximum number of organs supported on any day during ICU stay, length of ICU stay (days), length of index hospital stay (days).

#### Outcome: 90 day unplanned hospital readmission or death

Prognostic model was derived using backward elimination with a significance level of 0.05 for predictors to remain in the model. Thirty nine predictors were considered and the final model included the 18 predictors above after removal of following 21 predictors; sex, Scottish Index of Multiple Deprivation, comorbidities of cardiovascular disease, cerebrovascular disease, dementia, respiratory disease, rheumatic disease, peptic ulcer disease, liver disease, hemiplegia or paraplegia, immunosuppression, alcohol misuse, and drug misuse, CPR prior to admission to ICU, acute physiology score at admission to ICU, number of days with mechanical ventilation during ICU stay, number of days with renal replacement therapy during ICU stay, number of days with cardiovascular system support during ICU stay, maximum number of organs supported on any day during ICU stay, length of ICU stay (days), length of index hospital stay (days).



**eTable 7 Performance of risk prediction model as a screening tool to identify patients at risk of unplanned hospital readmission with 95% confidence intervals**

| <b>Threshold of predicted risk for screening positive</b> | <b>Number Screening Positive</b> | <b>% Screening Positive</b> | <b>Sensitivity (%)</b> | <b>Specificity (%)</b> | <b>Positive Predictive Value (%)</b> | <b>Negative Predictive Value (%)</b> | <b>Positive Likelihood Ratio</b> | <b>Negative Likelihood Ratio</b> |
|---|----------------------------------|-----------------------------|------------------------|------------------------|--------------------------------------|--------------------------------------|----------------------------------|----------------------------------|
| ≥ 20%   | 7734                             | 54.2 (53.4, 55.0)           | 69.3 (67.7, 70.8)      | 50.8 (49.9, 51.8)      | 31.9 (30.9, 33.0)                    | 83.3 (82.3, 84.2)                    | 1.41 (1.37, 1.45)                | 0.60 (0.57, 0.64)                |
| ≥ 30%   | 2806                             | 19.7 (19.0, 20.3)           | 32.6 (31.1, 34.2)      | 84.7 (84.0, 85.3)      | 41.4 (39.6, 43.3)                    | 79.1 (78.3, 79.8)                    | 2.13 (1.99, 2.27)                | 0.80 (0.78, 0.82)                |
| ≥ 40%   | 1129                             | 7.9 (7.5, 8.4)              | 16.7 (15.5, 18.0)      | 95.0 (94.6, 95.4)      | 52.7 (49.7, 55.6)                    | 77.4 (76.7, 78.1)                    | 3.35 (3.00, 3.74)                | 0.88 (0.86, 0.89)                |
| ≥ 50%   | 484                              | 3.4 (3.1, 3.7)              | 8.6 (7.7, 9.6)         | 98.3 (98.1, 98.6)      | 63.2 (58.8, 67.5)                    | 76.4 (75.7, 77.1)                    | 5.17 (4.31, 6.19)                | 0.93 (0.92, 0.94)                |
| ≥ 60%   | 226                              | 1.6 (1.4, 1.8)              | 4.4 (3.7, 5.1)         | 99.4 (99.2, 99.5)      | 69.0 (62.6, 75.0)                    | 75.8 (75.0, 76.5)                    | 6.74 (5.07, 8.86)                | 0.96 (0.96, 0.97)                |

**eTable 8 Characteristics and outcomes of patients screening positive and negative using the risk prediction model illustrated at a threshold of  $\geq 20\%$  and  $\geq 50\%$  predicted probability of 90 day unplanned hospital readmission**

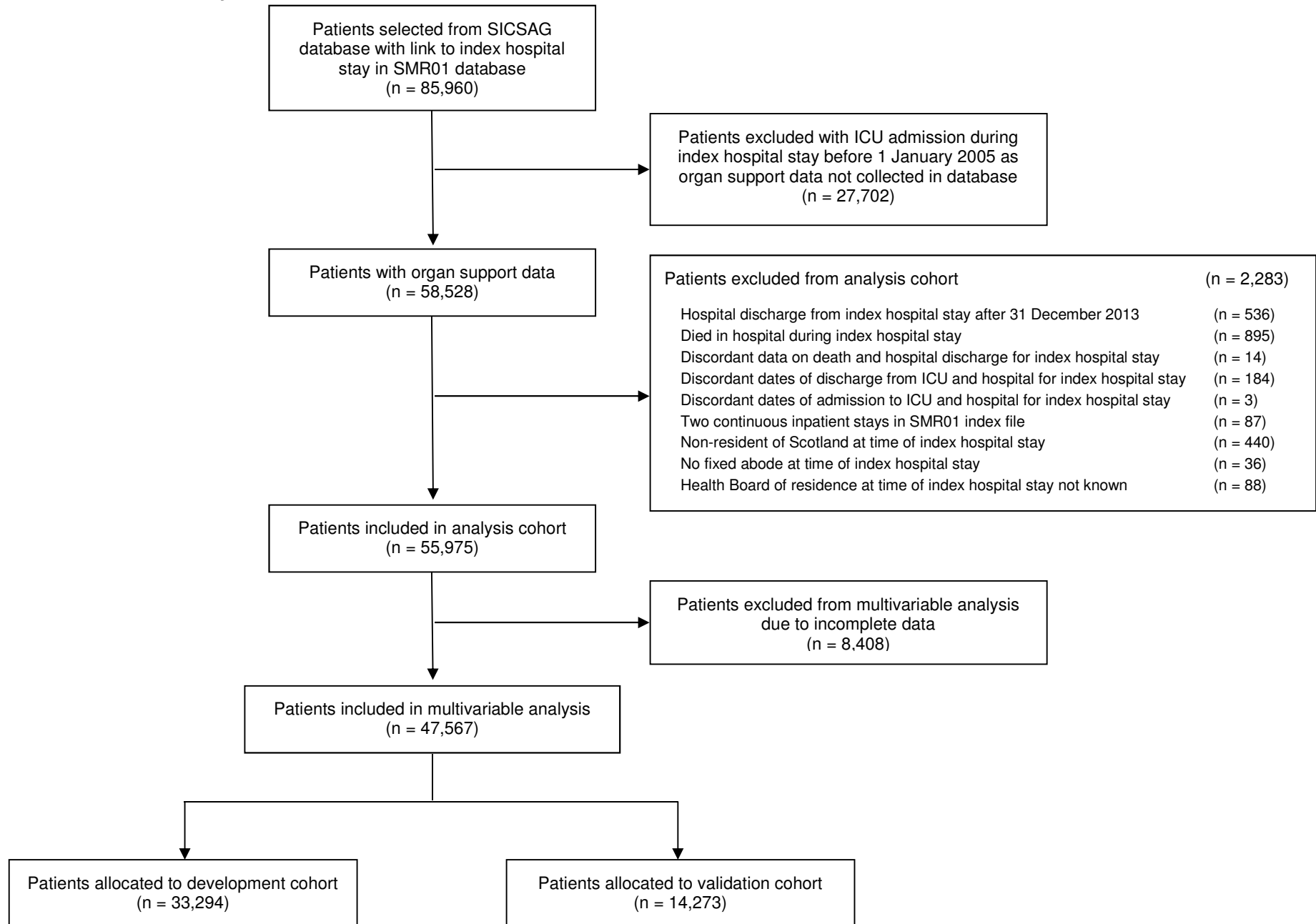
|  |    | Screen Negative<br>Predicted probability < 0.20 | Screen Positive<br>Predicted probability $\geq 0.20$ | Screen Negative<br>Predicted probability < 0.50 | Screen Positive<br>Predicted probability $\geq 0.50$ |
|--|----|---|--|---|--|
| Number (% of n=14,273)                                       |    | 6397 (44.8%)                                    | 7876 (55.2%)   | 13799 (96.7%)                                   | 474 (3.3%)   |
| Age mean (SD)  |    | 55.4 (18.9)                                     | 61 (15.1)  | 58.6 (17.2)                                     | 55.2 (15.2)  |
| Number of comorbidities                                      | 0  | 4494 (70.3%)                                    | 1275 (16.2%)   | 5760 (41.7%)                                    | 9 (1.9%)   |
|  | 1  | 1633 (25.5%)                                    | 2963 (37.6%)   | 4539 (32.9%)                                    | 57 (12.0%)   |
|  | 2  | 214 (3.4%)                                      | 2042 (25.9%)   | 2118 (15.4%)                                    | 138 (29.1%)  |
|  | 3+ | 56 (0.9%)                                       | 1596 (20.3%)   | 1382 (10.0%)                                    | 270 (57.0%)  |
| Number of previous unplanned hospital admissions in one year | 0  | 5902 (92.3%)                                    | 3701 (47.0%)   | 9602 (69.6%)                                    | 1 (0.2%)   |
|  | 1  | 460 (7.2%)                                      | 2404 (30.5%)   | 2850 (20.7%)                                    | 14 (3.0%)  |
|  | 2  | 33 (0.5%)                                       | 901 (11.4%)  | 898 (6.5%)                                      | 36 (7.6%)  |
|  | 3+ | 2 (0.0%)  | 870 (11.1%)  | 449 (3.3%)                                      | 423 (89.2%)  |
| APS mean (SD)  |    | 10.4 (5.9)                                      | 12.4 (6.2)   | 11.4 (6.1)                                      | 14.6 (6.3)   |
| Number of organs supported                                   | 0  | 2369 (37.0%)                                    | 2248 (28.5%)   | 4506 (32.7%)                                    | 111 (23.4%)  |
|  | 1  | 2277 (35.6%)                                    | 2586 (32.8%)   | 4697 (34.0%)                                    | 166 (35.0%)  |
|  | 2  | 1621 (25.3%)                                    | 2641 (33.5%)   | 4095 (29.7%)                                    | 167 (35.2%)  |
|  | 3  | 130 (2.0%)                                      | 401 (5.1%)   | 501 (3.6%)                                      | 30 (6.3%)  |
| Diagnosis on admission (5 most common specific diagnoses)    | 1  | Pneumonia 555 (8.7%)                            | Acute GI pathology* 586 (7.4%)                       | Pneumonia 1015 (7.4%)                           | Pneumonia 39 (8.2%)                                  |
|  | 2  | Self-poisoning 482 (7.5%)                       | GI neoplasm 526 (6.7%)                               | Acute GI pathology* 792 (5.7%)                  | Seizures 35 (7.4%)                                   |
|  | 3  | Trauma ex head injury 428 (6.7%)                | Pneumonia 499 (6.3%)                                 | GI neoplasm 715 (5.2%)                          | Septic shock 31 (6.5%)                               |
|  | 4  | Vascular surgery 290 (4.5%)                     | GI obstruction 281 (3.6%)                            | Septic shock 686 (5.0%)                         | Renal 25 (5.3%)                                      |
|  | 5  | Acute GI pathology* 232 (3.6%)                  | Trauma ex head injury 181 (2.3%)                     | Trauma ex head injury 605 (4.4%)                | Self-poisoning 17 (3.6%)                             |
| ICU length of stay median (IQR)                              |    | 2 (1, 4)  | 2 (2, 5)   | 2 (1, 5)  | 2 (1, 5)   |
| Hospital length of stay median (IQR)                         |    | 9 (5, 16)                                       | 17 (9, 33)   | 12 (7, 25)                                      | 22 (12, 43)  |
| 90 day readmission   |    | 1067 (16.7%)                                    | 2495 (31.7%)   | 3263 (23.7%)                                    | 299 (63.1%)  |
| 90 day readmission or death                                  |    | 1108 (17.3%)                                    | 2599 (33.0%)   | 3402 (24.7%)                                    | 305 (64.4%)  |

\*Acute GI pathology comprises gastrointestinal perforation/ischaemia/ peritonitis/abscess

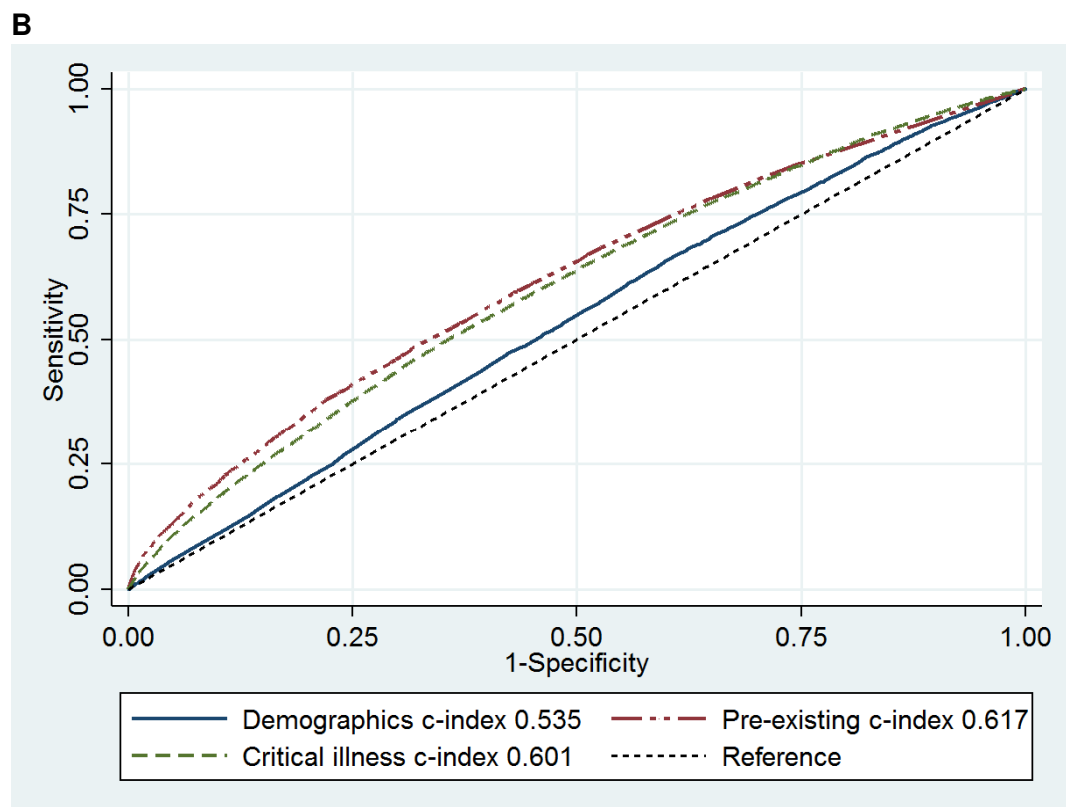
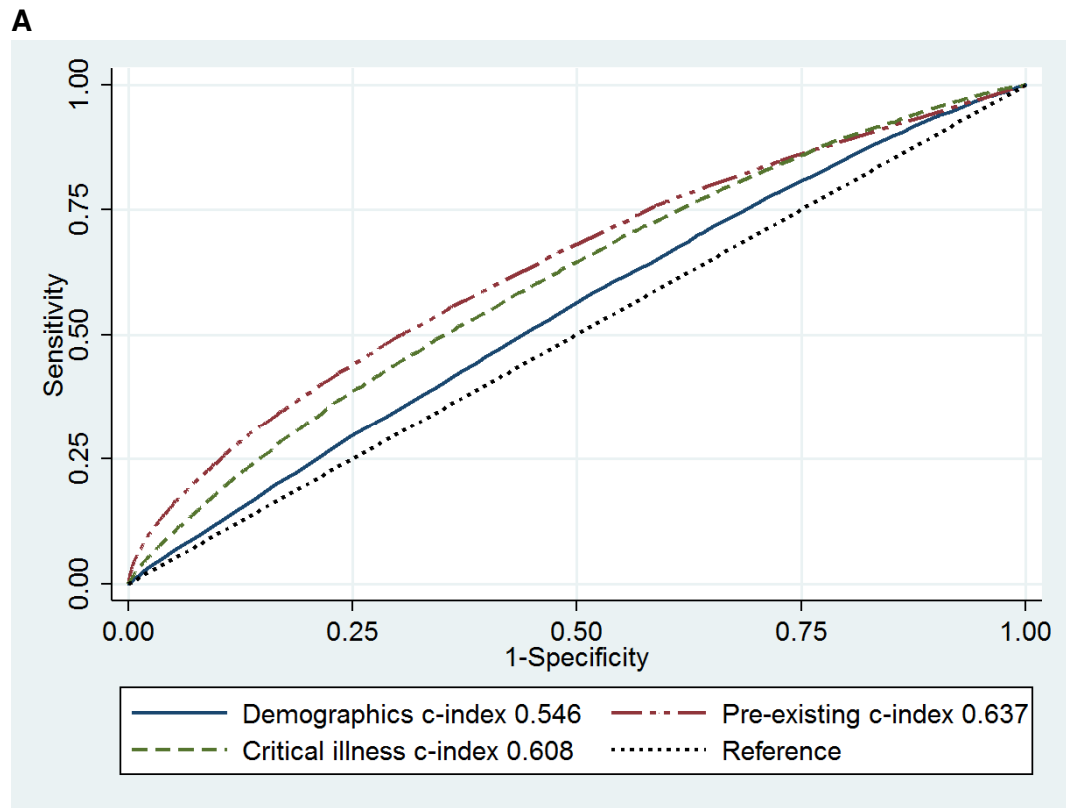
**eTable 9 Comparison of c-indices from receiver operating characteristics analyses for subgroup and sensitivity analyses.**

| Groups of variables in model | Whole cohort      |                          |                   | Subgroup analyses               |  |
|------------------------------|-------------------|--------------------------|-------------------|---------------------------------|--|
|                              | 90d readmission   | 90d readmission or death | 30d readmission   | 90d readmission: no comorbidity | 90d readmission: emergency ICU admission |
| Demographics                 | 0.54 (0.54, 0.55) | 0.55 (0.54, 0.55)        | 0.54 (0.53, 0.54) | 0.55 (0.54, 0.56)               | 0.54 (0.54, 0.55)                        |
| Pre-existing health indices  | 0.63 (0.63, 0.64) | 0.64 (0.63, 0.64)        | 0.62 (0.61, 0.62) | 0.56 (0.55, 0.57)               | 0.65 (0.64, 0.65)                        |
| Critical illness indices     | 0.60 (0.60, 0.61) | 0.61 (0.60, 0.61)        | 0.60 (0.59, 0.61) | 0.62 (0.61, 0.63)               | 0.61 (0.60, 0.61)                        |
| All variables                | 0.66 (0.66, 0.67) | 0.67 (0.66, 0.67)        | 0.65 (0.64, 0.66) | 0.64 (0.63, 0.65)               | 0.67 (0.67, 0.68)                        |

**eFigure 1. Derivation of study cohort**

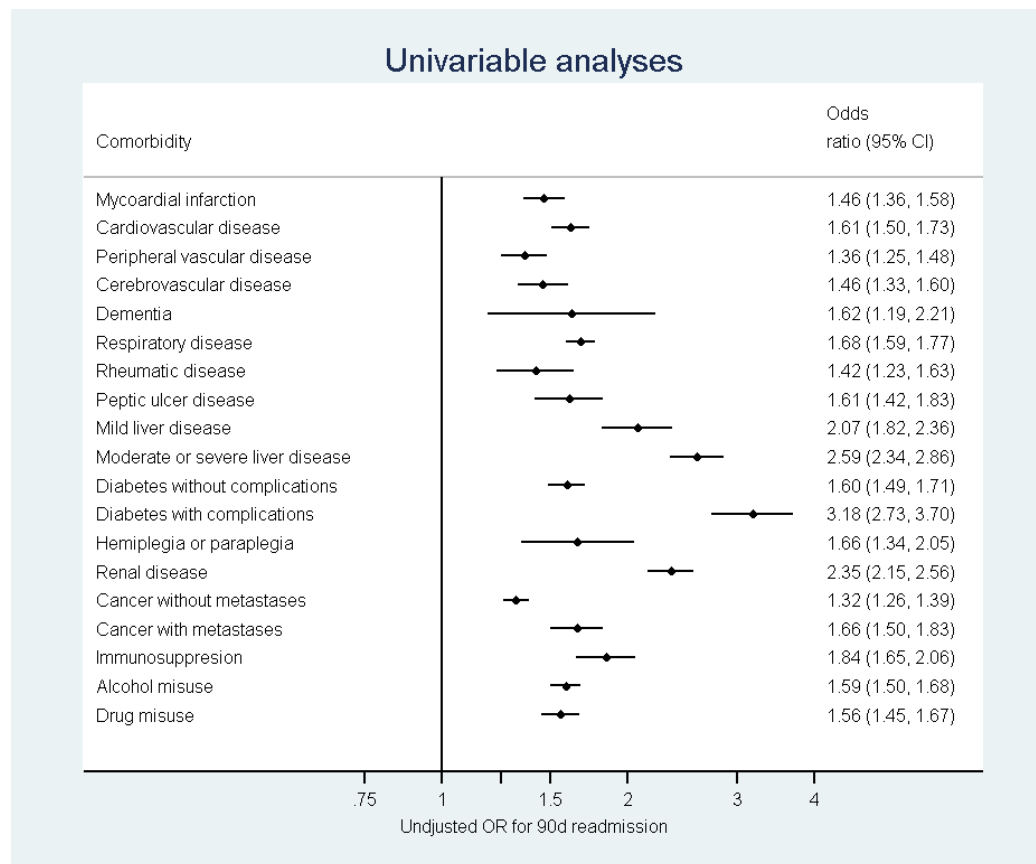


**eFigure 2. Receiver operating characteristics curves illustrating discriminant ability of variables combined into three mutually exclusive groups for (A) 90-day unscheduled hospital readmission or death; (B) 30-day unscheduled hospital readmission: patient demographics, indices of pre-existing patient health, and indices of critical illness severity**

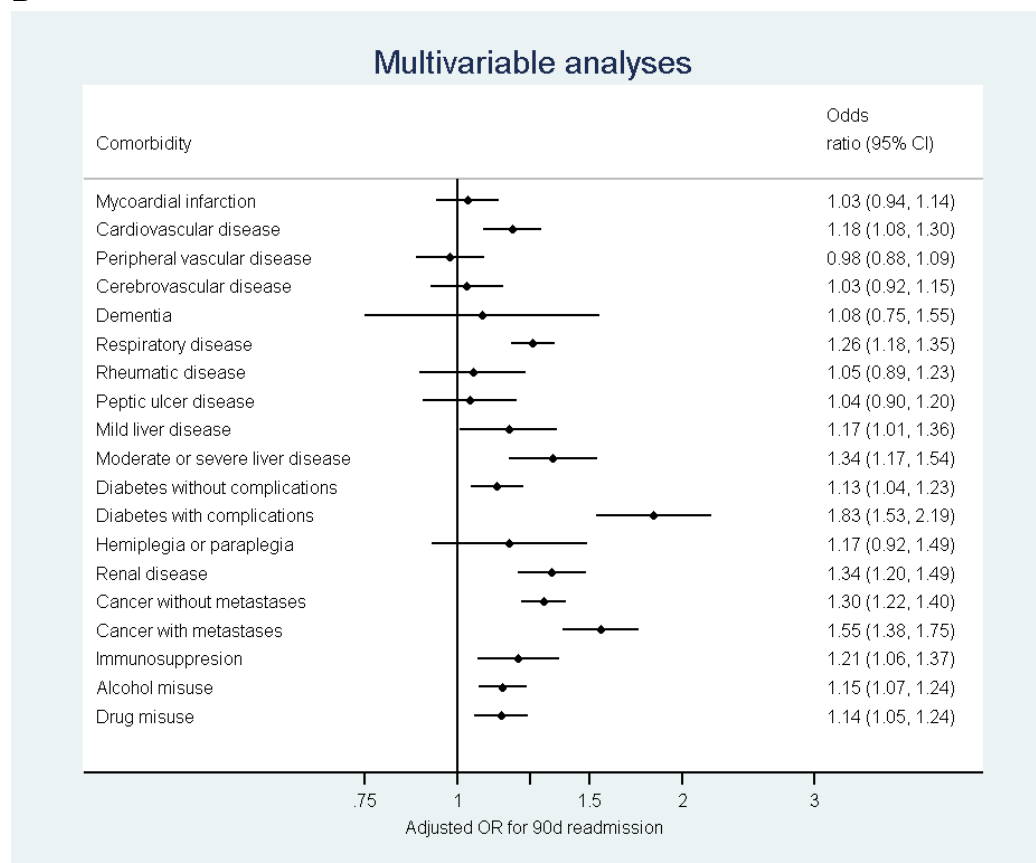


**eFigure 3. Associations between comorbidities and unplanned hospital admission within 90 days of discharge from index hospital stay from logistic regression analyses: (A) univariable; (B) multivariable.** Multivariable analyses include all covariates listed in eTable 3 replacing number of comorbidities with individual comorbidities.

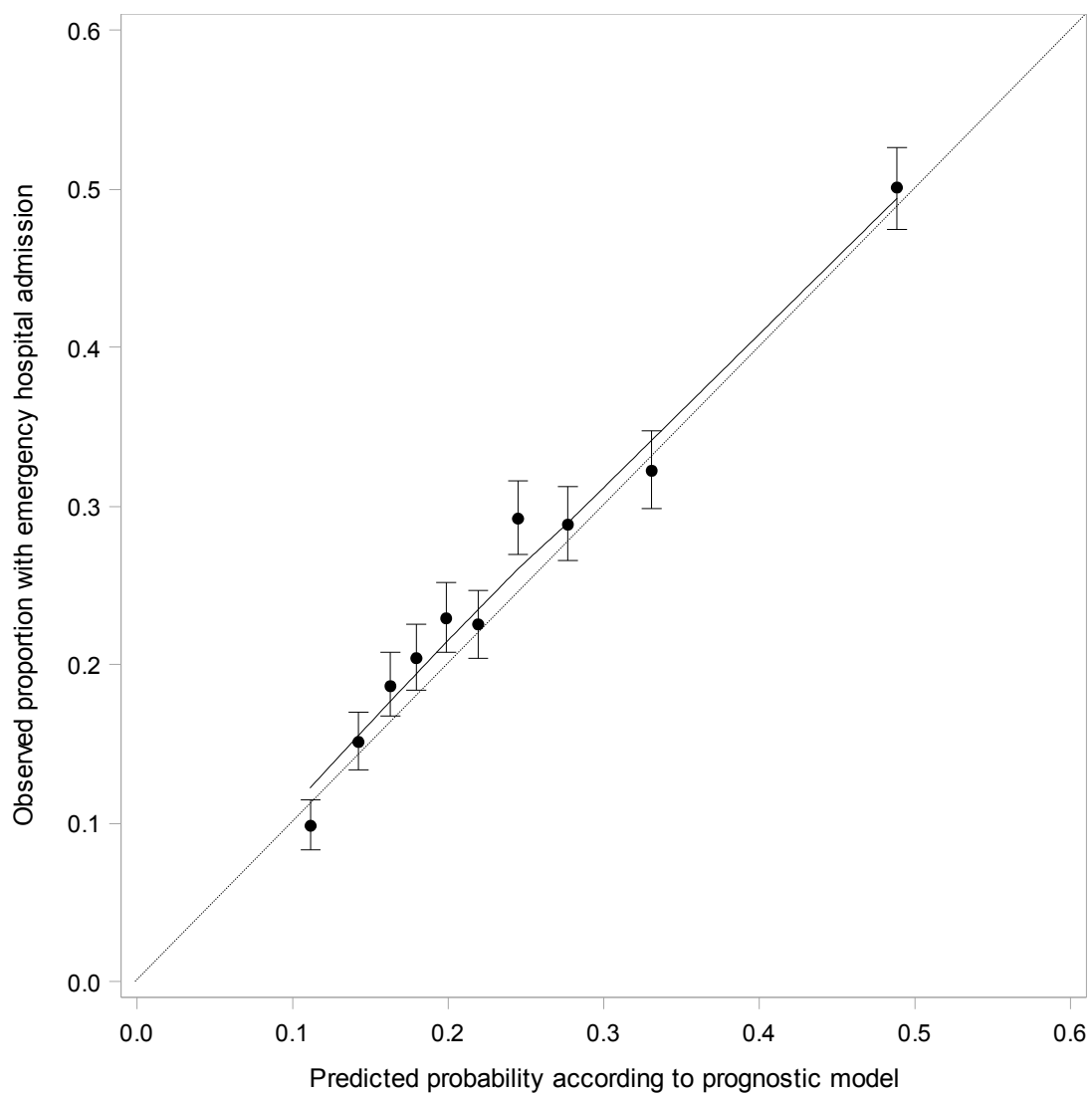
**A**



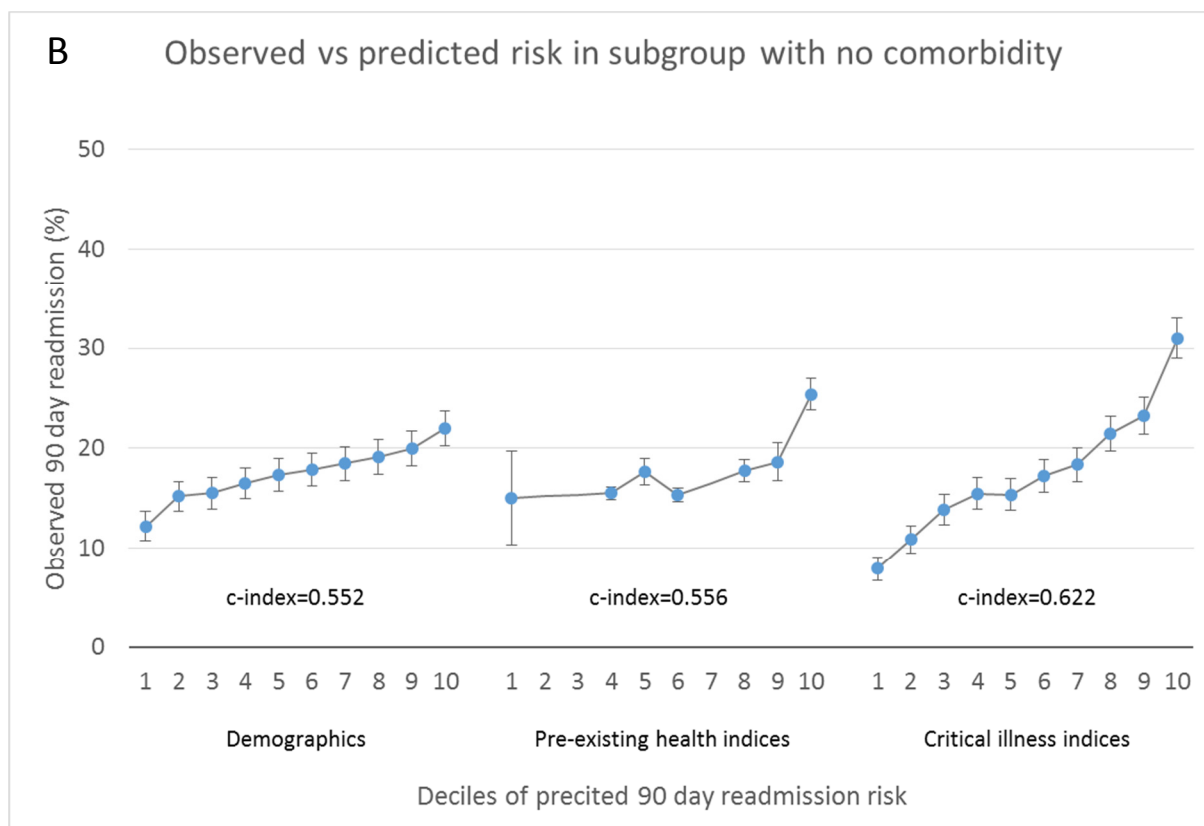
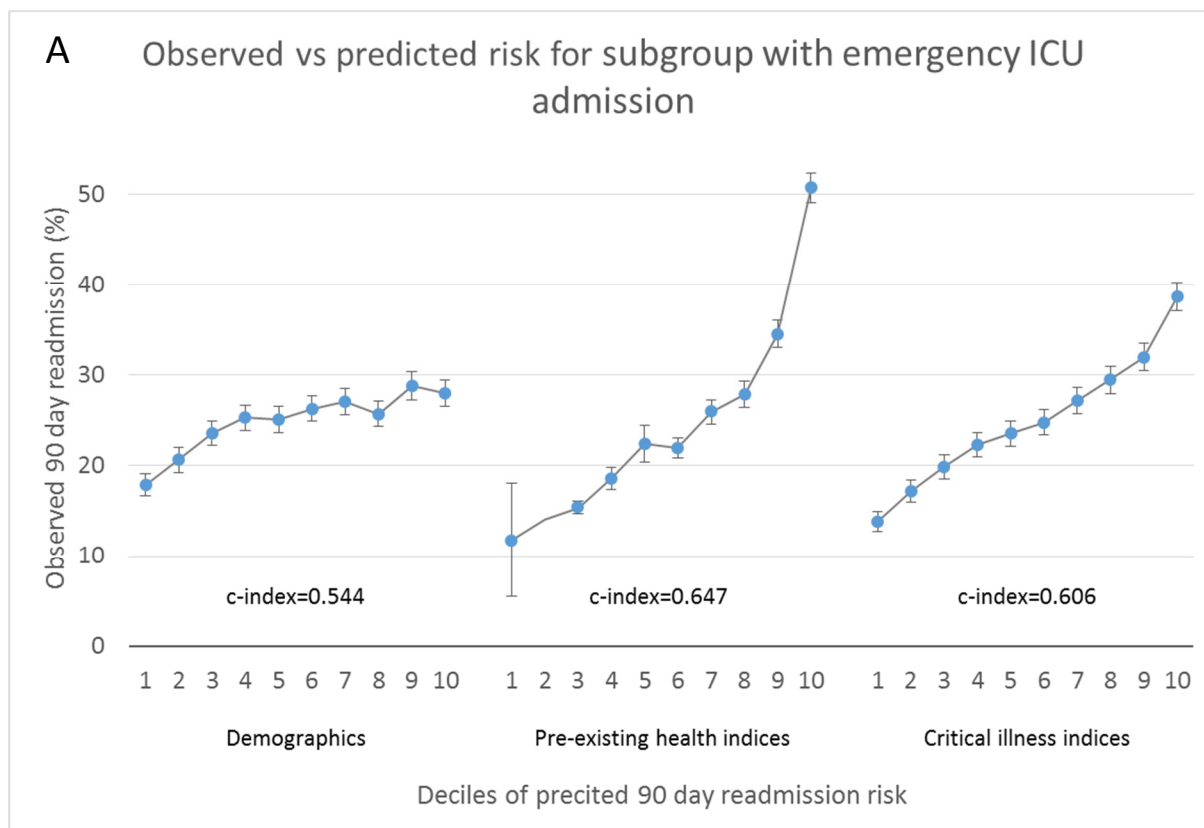
**B**



**eFigure 4. Calibration plot for model predicting unplanned hospital readmission within 90 days of discharge from index hospital stay in the validation cohort (n=14,273)**



**eFigure 5. Observed risk of 90 day unscheduled hospital readmission by deciles of predicted risk in subgroups A: restricted to patients with an emergency ICU admission (n=40020, 72.0% of cohort); B: restricted to patients with no recorded comorbidity (n=24420, 43.6% of cohort).** Characteristics are combined into three groups: patient demographics, indices of pre-existing patient health, and indices of critical illness severity.





**eFigure 6. Receiver operating characteristics curves illustrating discriminant ability of variables combined into three mutually exclusive groups for 90-day unscheduled hospital readmission restricted to (A) patients with an emergency ICU admission; and (B) patients with no recorded comorbidity.**

