**Supplemental Digital Content**

**1. Title**

Increasing the number of medical emergency calls does not improve hospital mortality

**2. Authors**

John D Santamaria

John Moran

David Reid

**3. Institutions & Departments**

Dr John Santamaria MBBS, MD, FRACP, FCICM, FCCP:   
Department of Critical Care Medicine,   
St Vincent’s Hospital (Melbourne), Fitzroy VIC 3065, AUSTRALIA

Dr John Moran MBBS, MD, FRACP, FCICM, FANZCA:   
Intensive Care Unit,   
The Queen Elizabeth Hospital, Woodville, SA 5011, AUSTRALIA

Mr David Reid GradCert AppSc (Statistics), DipCouns  
Department of Critical Care Medicine  
St Vincent’s Hospital (Melbourne), Fitzroy VIC 3065, AUSTRALIA

**Legend of Supplemental Digital Content**

**Table E1.** Activity within the 15 Victorian Hospitals from 2003/4 to 2014/15

**Figure E1:** Mortality rate in the 15 Victorian hospitals over 12 years

**Table E2.** Patient and call characteristics of the SVHM cohort.

**Table E3.** Characteristics of admissions to the 15 Victorian Hospitals

**Table E4.** Characteristics by hospital level (Tertiary, Metropolitan, Regional) for the 15 Victorian Hospitals

**Table E5.** Results of the logistic regression predicting mortality for the SVHM cohort.

**Figure E2.** Marginal probability of death and emergency calling rate for the multivariable analysis of SVHM data

**Table E6.** Results of the fixed effects logistic regression predicting mortality for the VIC cohort.

**Figure E3.** Marginal probability of death and emergency calling rate for the multivariable analysis of VIC data.

**Table E1.**  Activity within the 15 Victorian Hospitals from 2003/4 to 2014/15

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **03/04** | **04/05** | **05/06** | **06/07** | **07/08** | **08/09** | **09/10** | **10/11** | **11/12** | **12/13** | **13/14** | **14/15** |
| **All Hospitals** | 689445 | 721500 | 748227 | 773299 | 800405 | 826111 | 850217 | 892294 | 817900 | 848749 | 889786 | 935655 |
| Deaths | 8441 | 8137 | 8360 | 8385 | 8903 | 8585 | 8071 | 8432 | 7833 | 7010 | 7154 | 7512 |
| Deaths/1000 discharges | 12.24 | 11.28 | 11.17 | 10.84 | 11.12 | 10.39 | 9.49 | 9.45 | 9.58 | 8.26 | 8.04 | 8.03 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Tertiary Hospitals** | 338012 | 349183 | 352736 | 366417 | 381245 | 371914 | 377473 | 394161 | 405477 | 385833 | 394958 | 414481 |
| Deaths | 3825 | 3552 | 3718 | 3708 | 3974 | 3918 | 3504 | 3914 | 3672 | 3246 | 3334 | 3480 |
| Deaths/1000 discharges | 11.32 | 10.17 | 10.54 | 10.12 | 10.42 | 10.53 | 9.28 | 9.93 | 9.06 | 8.41 | 8.44 | 8.40 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Metropolitan Hospitals** | 208905 | 223339 | 241289 | 248798 | 256743 | 282077 | 297091 | 313609 | 317999 | 287662 | 311282 | 329776 |
| Deaths | 3198 | 3183 | 3244 | 3293 | 3461 | 3265 | 3193 | 3266 | 2977 | 2665 | 2743 | 2977 |
| Deaths/1000 discharges | 15.31 | 14.25 | 13.44 | 13.24 | 13.48 | 11.57 | 10.75 | 10.41 | 9.36 | 9.26 | 8.81 | 9.03 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Regional Hospitals** | 142528 | 148978 | 154202 | 158084 | 162417 | 172120 | 175653 | 184524 | 194424 | 175254 | 183546 | 191398 |
| Deaths | 1418 | 1402 | 1398 | 1384 | 1468 | 1402 | 1374 | 1252 | 1184 | 1099 | 1077 | 1055 |
| Deaths/1000 discharges | 9.95 | 9.41 | 9.07 | 8.75 | 9.04 | 8.15 | 7.82 | 6.79 | 6.09 | 6.27 | 5.87 | 5.51 |

**Figure E1.** Mortality rate in the 15 Victorian hospitals over 12 years  
Tertiary – Tertiary referral hospital: Metro — Metropolitan hospitals: Regional — Regional/Rural hospitals.  
Financial years span July to June.

**Table E2**. Patient and call characteristics of the SVHM cohort.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016\*** | **All** |
| **Patient** |  |  |  |  |  |  |  |  |  |  |
| Number | 49841 | 50350 | 51645 | 53631 | 51040 | 49634 | 53742 | 53815 | 27331 | 441029 |
| Age, years | 60.6 45-74 | 60.6 45-74 | 61.1 45-74 | 60.6 45-75 | 60.9 44-74 | 61.4 45-74 | 61.4 46-74 | 61.5 46-74 | 60.7 45-74 | 61.0 45-74 |
| Men | 57.6% | 58.8% | 58.6% | 57.7% | 57.6% | 57.6% | 57.4% | 56.8% | 57.2% | 57.2% |
| Origin-Home | 93.8% | 94.8% | 94.0% | 94.1% | 94.7% | 94.3% | 94.6% | 94.5% | 94.2% | 94.3% |
| Origin-Transfer In | 5.5% | 4.6% | 4.9% | 4.6% | 4.4% | 4.7% | 4.3% | 4.4% | 4.7% | 4.7% |
| Same-day admit | 59.9% | 59.7% | 59.3% | 59.5% | 57.4% | 57.8% | 58.7% | 60.0% | 60.7% | 59.2% |
| Emergency admit | 34.9% | 36.6% | 32.8% | 38.2% | 35.8% | 32.0% | 31.9% | 32.2% | 32.8% | 34.8% |
| Required ICU | 2.0% | 2.4% | 2.3% | 2.4% | 2.5% | 2.6% | 2.9% | 3.0% | 2.8% | 2.5% |
| Length stay, All, days | 0.3 0.2-1.9 | 0.3 0.2-1.8 | 0.3 0.2-1.8 | 0.3 0.2-1.7 | 0.3 0.2-2.0 | 0.3 0.2-1.9 | 0.3 0.2-1.8 | 0.3 0.2-1.5 | 0.3 0.2-1.4 | 0.3 0.2-1.8 |
| Length stay, multiday admit, days | 2.9 1.1-7.1 | 2.9 1.1-7.0 | 2.9 1.1-7.0 | 2.9 1.1-6.7 | 2.8 1.1-6.8 | 2.8 1.1-6.8 | 2.6 1.1-6.4 | 2.5 1.0-6.4 | 2.4 1.0-6.2 | 2.8 1.1-6.8 |
| Deaths/1000 discharges | 7.99 | 7.90 | 8.00 | 7.18 | 7.07 | 6.14 | 6.14 | 6.04 | 5.60 | 6.96 |
| Charlson score ≥2 | 10.1% | 8.3% | 7.4% | 7.0% | 8.4% | 10.9% | 11.6% | 11.3% | 11.0% | 9.5% |
|  |  |  |  |  |  |  |  |  |  |  |
| Neurosurgery | 2.61% | 2.60% | 2.70% | 2.93% | 2.62% | 2.75% | 2.61% | 2.60% | 2.34% | 2.66% |
| Cardiothoracic Surgery | 1.74% | 1.63% | 1.53% | 1.46% | 1.55% | 1.57% | 1.46% | 1.46% | 1.47% | 1.56% |
| General Medicine | 5.29% | 5.29% | 4.94% | 5.12% | 5.30% | 5.53% | 5.68% | 5.63% | 5.24% | 5.34% |
| General Surgery | 6.63% | 6.31% | 6.45% | 5.88% | 6.67% | 7.17% | 7.09% | 6.78% | 6.17% | 6.59% |
|  |  |  |  |  |  |  |  |  |  |  |
| **Calls** |  |  |  |  |  |  |  |  |  |  |
| Emergency calls | 758 | 728 | 876 | 920 | 1030 | 1025 | 998 | 1189 | 1400 | 8924 |
| Call rate/1000 | 15.21 | 14.46 | 16.96 | 17.15 | 20.18 | 20.65 | 18.57 | 22.09 | 25.00 | 19.00 |
| First call with LOMT | 12.2% | 12.1% | 15.7% | 12.5% | 15.9% | 14.1% | 8.4% | 13.4% | 15.1% | 13.2% |
| Any call with LOMT | 22.4% | 20.7% | 25.5% | 23.0% | 26.0% | 21.2% | 15.9% | 19.8% | 23.9% | 21.9% |
|  |  |  |  |  |  |  |  |  |  |  |

\* The 2016 data relate to the first six months of the year LOMT is limitation of medical treatment order.

**Table E3**. Characteristics of the 15 Victorian Hospitals

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Patients** | **Age** | **Male** | **SameDay** | **ICU** | **LOS all** | **LOS MD** | **Charl≥2** | **Call/1000** | **Death/1000** |
| **Tertiary** |  |  |  |  |  |  |  |  |  |  |
| T1 | 368235 | 60.0 43-73 | 59.1% | 57.3% | 3.2% | 1 1-2 | 3 1-6 | 12.2% | 64.1 42.5-68.3 | 8.7 8.6-9.5 |
| T2 | 351318 | 65 50-76 | 55.7% | 60.6% | 3.0% | 1 1-2 | 3 1-7 | 15.9% | 34.2 31.4-35.1 | 10.9 10.3-11.0 |
| T3 | 312400 | 62.0 43-74 | 47.7% | 60.3% | 2.1% | 1 1-2 | 3 1-5 | 11.2% | 30.8 27.9-31.7 | 8.8 8.6-9.1 |
| T4 | 278250 | 52 34-71 | 44.9% | 54.8% | 2.6% | 1 1-2 | 3 1-6 | 9.4% | 21.9 20.9-25.3 | 9.5 8.6-10.0 |
| T5 | 428898 | 60.0 43-73 | 55.0% | 64.8% | 2.4% | 1 1-1 | 3 1-6 | 10.1% | 17.4 15.6-23.0 | 7.8 7.6-8.1 |
| T6 | 255820 | 61.0 45-74 | 57.1% | 59.0% | 2.7% | 1 1-2 | 3 1-6 | 9.6% | 18.5 18.1-20.6 | 6.4 6.3-7.3 |
| **Metropolitan** |  |  |  |  |  |  |  |  |  |  |
| M1 | 240723 | 56.0 37-72 | 48.9% | 50.8% | 2.7% | 1 1-2 | 2 1-5 | 9.6% | 22.9 22.6-27.3 | 7.8 7.7-9.2 |
| M2 | 175048 | 63.0 47-76 | 49.5% | 59.7% | 2.1% | 1 1-2 | 3 1-6 | 9.9% | 29.9 27.0-34.7 | 7.2 6.8-8.0 |
| M3 | 252596 | 60.0 40-74 | 46.2% | 47.7% | 1.9% | 1 1-2 | 2 1-5 | 10.6% | 22.2 18.7-24.7 | 10.7 10.1-11.9 |
| **Regional** |  |  |  |  |  |  |  |  |  |  |
| R1 | 156055 | 59.0 40-72 | 47.0% | 59.6% | 1.4% | 1 1-2 | 2 1-5 | 11.5% | 19.9 14.7-22.7 | 7.1 7.0-7.9 |
| R2 | 168991 | 63.0 45-75 | 51.0% | 61.7% | 1.9% | 1 1-1 | 2 1-4 | 12.6% | 35.7 35.0-35.9 | 5.7 5.0-6.1 |
| R3 | 110563 | 62.0 44-74 | 47.8% | 59.3% | 3.5% | 1 1-2 | 2 1-5 | 12.5% | 7.7% 5.5-14.5 | 5.4 5.3-5.7 |
| R4 | 51236 | 64.0 47-76 | 47.8% | 64.0% | 6.3% | 1 1-1 | 1 1-5 | 15.8% | 16.0 13.7-30.0 | 7.0 6.3-7.1 |
| R5 | 134426 | 62.0 46-74 | 46.7% | 66.6% | 3.2% | 1 1-1 | 3 1-5 | 13.0% | 11.6 11.1-14.8 | 4.1 3.8-4.2 |
| R6 | 55230 | 63.0 45-73 | 47.1% | 62.8% | 2.3% | 1 1-2 | 3 1-5 | 8.2% | 51.3 36.9-52.6 | 6.9 6.6-7.9 |

SameDay are same day admissions. ICU indicates that the admission included time in ICU. LOS-all is length of stay for all patient cohort. LOS MD is length of stay days for patients with multi-day admissions. Charl≥2 is percentage of patients who have Charlson comorbidity scores ≥2.   
Results are median (interquartile range) and percentages.

**Table E4** – Characteristics by hospital level (Tertiary, Metropolitan, Regional) for the 15 Victorian Hospitals

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Patients** | **Age** | **Male** | **SameDay** | **ICU** | **LOS all** | **LOS MD** | **Charl≥2** | **Call/1000** | **Death/1000** |
|  |  |  |  |  |  |  |  |  |  |  |
| Tertiary | 1994921 | 60.0 43-74 | 53.6% | 59.8% | 2.7% | 1 1-2 | 3 1-6 | 11.5% | 27.9 20.6-35.1 | 8.6 7.9-10.0 |
| Metropolitan | 668367 | 60.0 41-74 | 48.0% | 52.0% | 2.3% | 1 1-2 | 2 1-5 | 10.0% | 24.7 22.1-29.6 | 8.9 7.7-10.1 |
| Regional | 676501 | 62.0 44-74 | 48.4% | 62.1% | 2.7% | 1 1-2 | 2 1-5 | 12.3% | 18.4 13.5-35.0 | 6.1 5.0-7.0 |

LOS is Length of Stay (days), LOS MD is Length of Stay (days) for multi-day admissions, Charl≥2 is percentage of patients with Charlson comorbidity scores equal to or greater than 2.

**Table E5** Detailed results of the logistic regression on the SVHM cohort.

Logistic regression Number of obs = 441,028

LR chi2(28) = 10051.59

Prob > chi2 = 0.0000

Log likelihood = -13273.587 Pseudo R2 = 0.2746

-------------------------------------------------------------------------------

died | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

--------------+----------------------------------------------------------------

age | 1.028576 .0014187 20.43 0.000 1.0258 1.031361

|

gender |

M | 1.097899 .0423353 2.42 0.015 1.017981 1.18409

|

admitin |

Transfer | 2.920322 .1509825 20.73 0.000 2.638901 3.231754

Nursing home | 1.688135 .1790038 4.94 0.000 1.371352 2.078096

Statistical | 14.78391 2.323452 17.14 0.000 10.8646 20.11708

|

emergency | 4.359687 .2681744 23.94 0.000 3.864523 4.918296

nonsame | 2.633511 .2032103 12.55 0.000 2.263881 3.063491

|

charl2 |

1 | 3.212972 .1817577 20.63 0.000 2.875772 3.58971

2 | 6.091379 .3567894 30.85 0.000 5.430731 6.832394

3 | 8.775204 .6197267 30.75 0.000 7.640877 10.07793

4 | 12.45762 1.180422 26.62 0.000 10.34617 14.99999

5 | 11.78951 1.940457 14.99 0.000 8.53876 16.27783

6 | 32.46398 9.046925 12.49 0.000 18.8015 56.05457

|

crm | 1.019354 .0060406 3.23 0.001 1.007583 1.031262

|

yeardischarge |

2009 | 1.080531 .0800876 1.04 0.296 .9344311 1.249474

2010 | 1.078058 .0800308 1.01 0.311 .9320776 1.246901

2011 | 1.017528 .0770702 0.23 0.819 .8771504 1.180371

2012 | .8649905 .0705333 -1.78 0.075 .737229 1.014893

2013 | .6409784 .0552552 -5.16 0.000 .5413348 .7589633

2014 | .6352322 .0510912 -5.64 0.000 .5425891 .7436935

2015 | .5726852 .05062 -6.31 0.000 .4815902 .6810112

2016 | .5654471 .0625467 -5.15 0.000 .455236 .7023399

|

nsurg | 2.242052 .173026 10.46 0.000 1.927329 2.608168

cts | 2.425818 .2230706 9.64 0.000 2.025743 2.904906

gensurg | 1.433328 .1124108 4.59 0.000 1.229104 1.671484

ort | 1.060022 .140248 0.44 0.660 .8178907 1.373835

renal | .3997025 .0463837 -7.90 0.000 .3183895 .501782

genmed | 2.495012 .1242914 18.35 0.000 2.26292 2.750908

\_cons | .000049 7.84e-06 -62.00 0.000 .0000358 .000067

-------------------------------------------------------------------------------

Admitin is source of admissions (transfer is interhospital transfer, statistical is change in status from rehabilitation/mental-health), nonsame is multi-day admission, charl2 is Charlson Comorbidity Score, crm is emergency calls in the month of discharge/1000 discharges, nsurg is neurosurgery, cts is cardiothoracic surgery, gensurg is general surgery, ort is orthopedic, renal is nephrology, genmed is general medicine. Month of discharge had been included in a preliminary model but did not achieve statistical significance.

**Figure E2.** Marginal probability of death and emergency calling rate for the multivariable analysis of SVHM data



**Table E6.** Detailed results of the mixed effects logistic regression on the VIC cohort

Mixed-effects logistic regression Number of obs = 3264195

-------------------------------------------------------------

| No. of Observations per Group

Group Variable | Groups Minimum Average Maximum

----------------+--------------------------------------------

level | 3 592,773 1088065.0 1994921

campus | 15 51,236 217,613.0 428,898

-------------------------------------------------------------

Integration method: mvaghermite Integration pts. = 7

Wald chi2(26) = 65866.07

Log likelihood = -113798.85 Prob > chi2 = 0.0000

------------------------------------------------------------------------------

died | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

c\_admit | 1.003178 .0012394 2.57 0.010 1.000751 1.00561

|

monthcode |

Aug | 1.050532 .0322435 1.61 0.108 .9891986 1.115667

Dec | .9378084 .0297058 -2.03 0.043 .8813566 .9978759

Feb | .9309353 .0303236 -2.20 0.028 .8733596 .9923066

Jan | 1.006151 .0320618 0.19 0.847 .9452331 1.070995

Jul | 1.037279 .0319409 1.19 0.235 .9765281 1.10181

Jun | .9811965 .0306711 -0.61 0.544 .9228866 1.04319

Mar | .9292067 .0295707 -2.31 0.021 .8730196 .98901

May | .9601895 .0298679 -1.31 0.192 .9033984 1.020551

Nov | .9480808 .0301585 -1.68 0.094 .8907762 1.009072

Oct | .9664736 .0301937 -1.09 0.275 .9090705 1.027502

Sep | .9934691 .0309983 -0.21 0.834 .9345341 1.056121

|

fincode |

2 | .9061723 .0185014 -4.83 0.000 .8706262 .9431696

3 | .7079473 .0165643 -14.76 0.000 .6762151 .7411686

4 | .6669052 .0165937 -16.28 0.000 .6351625 .7002343

5 | .6573522 .0182336 -15.12 0.000 .6225692 .6940787

|

icu | 7.261844 .1097303 131.21 0.000 7.04993 7.480128

male | .9718953 .0125972 -2.20 0.028 .9475163 .9969016

|

charl2 |

1 | 2.520873 .0486419 47.92 0.000 2.427317 2.618035

2 | 5.31236 .1039045 85.38 0.000 5.112565 5.519963

3 | 7.543337 .1757612 86.72 0.000 7.206599 7.895809

4 | 10.17226 .3177881 74.25 0.000 9.56809 10.81458

5 | 11.76148 .6024949 48.12 0.000 10.63795 13.00366

6 | 16.2205 1.455139 31.06 0.000 13.60514 19.33861

|

samedayc | .1358676 .0029807 -90.99 0.000 .1301494 .1418371

age | 1.050607 .0005107 101.55 0.000 1.049606 1.051608

\_cons | .0002068 .0000197 -89.25 0.000 .0001717 .0002492

-------------+----------------------------------------------------------------

level |

var(\_cons)| .0078212 .0148408 .0001897 .3224301

-------------+----------------------------------------------------------------

level>campus |

var(\_cons)| .0529184 .0219672 .0234564 .1193857

------------------------------------------------------------------------------

C\_admit is the emergency calls in the year of discharge /1000 discharges, fincode is financial year code (2 = 2011/12, 3 = 2012/13, 4 = 2013/14, 5 = 2014/15), ICU is need for ICU (1/0), male is male gender(1), charl2 is Charlson comorbidity score, samedayc is same day admission (1). Monthcode is month of discharge with April as baseline.

**Figure E3**. Marginal probability of death and emergency calling rate for the multivariable analysis of VIC data

