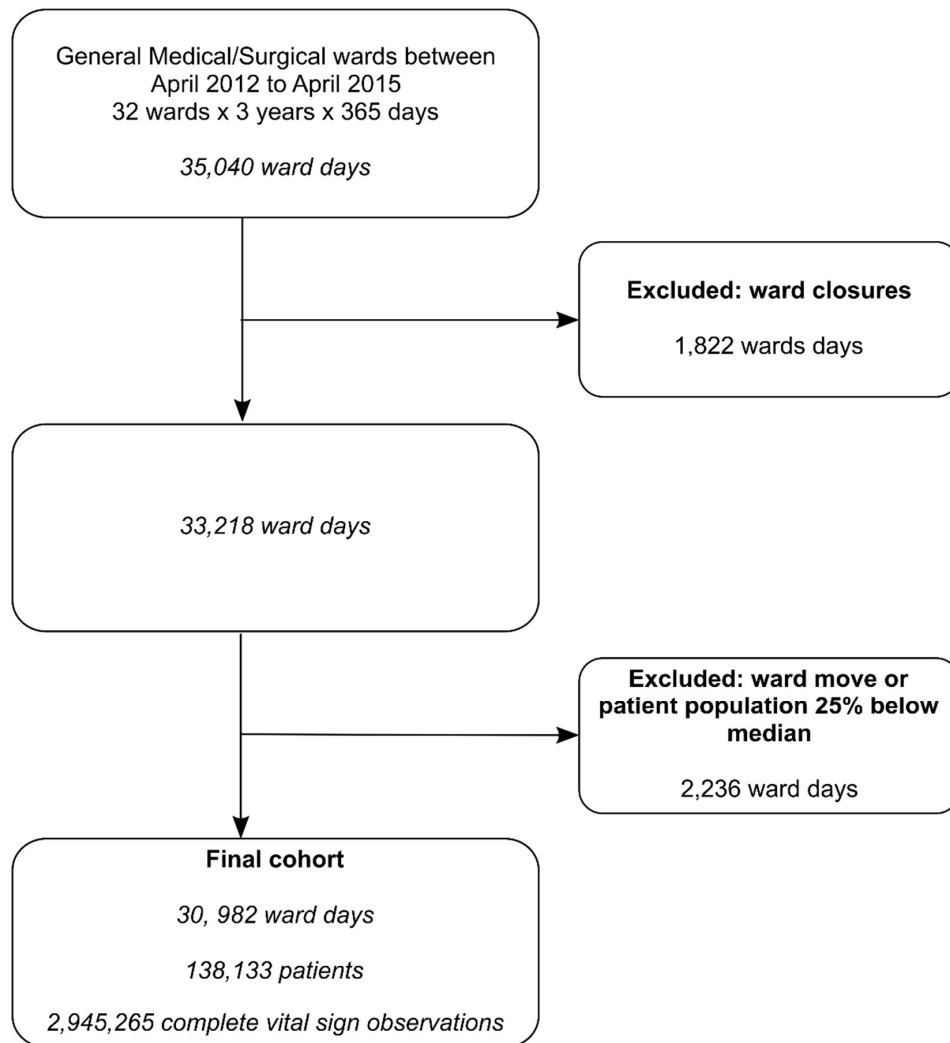


SUPPLEMENTARY MATERIAL

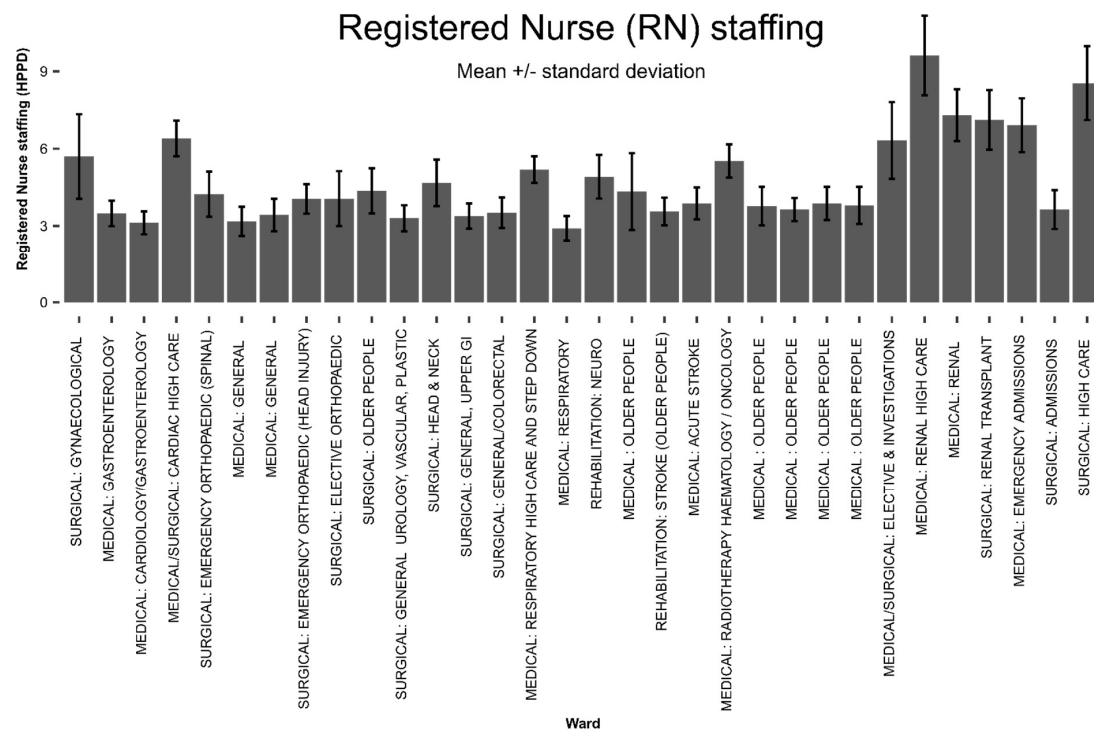
A1 Summary of study hospital escalation and vital sign monitoring protocol

Early warning Score	Risk category	Max interval between observations	Nurse Actions	Doctor Actions
0-1	Low	6 hours / 12 Hours If stable for 6 hours	(None specified – observations as per schedule)	
2	Low	6 hours	(None specified – observations as per schedule)	
3-5	Medium	4 hours	Inform nurse in charge	
<6, but with one or more individual triggers	High	4 hours	Registered nurse to inform doctor (FY2 / SHO)	See patient within 2 hours
6	High	4 hours	Registered nurse to inform doctor (FY2 / SHO)	See patient within 2 hours
7-8	High	1 hour	Registered nurse to inform doctor (FY2 / SHO) Consider continuous monitoring	See patient within 30 minutes Call SpR / outreach (after 8.30 SpR / ICU)
9+	Critical	30 minutes	Registered nurse to inform doctor (SpR) Consider continuous monitoring	See patient within 15 minutes Call SpR / outreach (after 8.30 SpR / ICU)

Extreme values on any one parameter may trigger a higher level of escalation than otherwise indicated
Full policy can be found at :
<http://www.porthosp.nhs.uk/about-us/policies-and-guidelines/policies/Clinical/Deteriorating%20Patient%20Policy%20-%20Management.doc> (accessed 13/1/2018).
Adapted from Griffiths P, Ball J, Bloor K, et al. Nurse staffing levels, missed vital signs and mortality in hospitals: retrospective longitudinal observational study. Heal Serv Deliv Res 2018;6:1–120.

A2 Study flowchart

A3 Mean staffing per ward



A4 Missed observations (low and medium acuity)

The tables below show the relationship of staffing levels with respect to the primary outcome (missed observations) for low and medium acuity observations.

Table A4a Low acuity

	IRR	95% confidence Interval	p-value
RN staffing	0.98	0.973-0.986	< 0.001
NA staffing	0.933	0.926-0.939	< 0.001
Patient turnover	1.04	1.03-1.04	< 0.001
Higher acuity patients	2.03	1.93-2.14	< 0.001
RN staffing x NA staffing	1.02	1.02-1.02	< 0.001

Table A4b Medium acuity

	IRR	95% confidence Interval	p-value
RN staffing	0.977	0.971-0.984	< 0.001
NA staffing	0.964	0.957-0.971	< 0.001
Patient turnover	0.989	0.984-0.995	< 0.001
Higher acuity patients	0.641	0.609-0.676	< 0.001
RN staffing x NA staffing	1.01	1.00-1.01	< 0.001

A5 Delayed observations

The tables below show the relationship of staffing levels with respect to the secondary outcome (delayed observations).

Table A5a All observations

	IRR	95% confidence Interval	p-value
RN staffing	0.984	0.981-0.987	< 0.001
NA staffing	0.98	0.976-0.983	< 0.001
Patient turnover	1	1.00-1.01	0.0186
Higher acuity patients	2.23	2.18-2.28	0
RN staffing x NA staffing	1.01	1.00-1.01	< 0.001

Table A5b High acuity observations

	IRR	95% confidence Interval	p-value
RN staffing	0.987	0.978-0.996	0.0043
NA staffing	1	0.993-1.01	0.55
Patient turnover	0.996	0.987-1.00	0.38
Higher acuity patients	1.03	0.960-1.10	0.415
RN staffing x NA staffing	1	0.995-1.00	0.943

A6 Missed observations (tertiles of nurse staffing levels)

The table below shows the model used to explore interactions between NA and RN staffing groups (see Figure 1 in main manuscript).

Table A6 Mixed-effects Poisson regression with staffing variables modelled as tertiles: Association between staffing and all missed observations AIC: 215,999 BIC: 216,099

	IRR	95% confidence interval	p-value
RN staffing Q2	0.974	0.963-0.985	p < 0.001
RN staffing Q3	0.934	0.923-0.946	p < 0.001
NA staffing Q2	0.92	0.910-0.931	p < 0.001
NA staffing Q3	0.919	0.908-0.931	p < 0.001
Patient turnover	1.01	1.01-1.02	p < 0.001
Higher acuity patients	4.83	4.68-4.99	0
RN staffing Q2 x NA staffing Q2	1.02	0.999-1.03	0.0603
RN staffing Q3 x NA staffing Q2	1.04	1.02-1.06	p < 0.001
RN staffing Q2 x NA staffing Q3	1.02	1.00-1.04	0.0525
RN staffing Q3 x NA staffing Q3	1.05	1.03-1.07	p < 0.001