APPENDIX

A. THREE-LEVEL MEDIATION MODEL

The equation for the three-level mediation model equals:

$$\text{probit}\left(\text{p}\left(y_{ijk} = 1 \middle| x, z, m, \mathbf{c}, \mathbf{d}\right)\right) = \beta_0 + \boldsymbol{\beta}_c^T \mathbf{c}_{jk} + \boldsymbol{\beta}_d^T \mathbf{d}_{ijk} + u_{jk} + u_k + \beta_x x_{jk} + \beta_z z_{jk} + \beta_m m_{jk}$$

$$u_{jk} \sim N\left(0, \sigma_{hospital}^2\right), \qquad u_k \sim N\left(0, \sigma_{country}^2\right),$$

$$m_{jk} = \gamma_{10} + \gamma_{1x} x_{jk} + \varepsilon_{1jk}$$

$$\varepsilon_{1jk} \sim N(0, \sigma_{m1}^2)$$

Where y_{ijk} represents the binary outcome (30-day mortality) measured on patient i from hospital j in country k. The link function is probit() which corresponds to the inverse of the cumulative distribution function of the standard normal distribution. x_{jk} is the nurse staffing variable at the hospital level with coefficient β_x. m_{jk} represents missed care as the potential hospital-level mediator with coefficient β_m. z_{jk} is the measure of bachelor prepared nurses at the hospital level with coefficient β_z. $\mathbf{c}_{jk}$ represents the vector of all other hospital-level covariates included (practice environment, teaching status, bed size and technology level) with $\boldsymbol{\beta}_c$ the coefficient vector. $\mathbf{d}_{ijk}$ represents the vector of all patient-level covariates included (comorbidities present on admission, surgical procedure undergone, patient age, sex and admission type) with $\boldsymbol{\beta}_d$ the coefficient vector. u_{jk} and u_k represent the random effects at the hospital level and country level respectively. In the model of the mediator m_{jk}, x_{jk} is included with the coefficient γ_x.

B. TWO-LEVEL HIERARCHICAL MODEL WITH SIMPLIFIED PATIENT RISK-ADJUSTMENT: FINDINGS FOR MODELS 1, 2 AND 3

| | 30-day inpatient mortality | | | |
	Odds ratio	Lower 2.5% CI	Upper 2.5% CI	*p*-value
Model 1				
Nurse staffing	1.071	1.034	1.110	0.0001
Nurse education	0.942	0.901	0.985	0.0093
Model 2				
Missed care	1.169	1.050	1.302	0.0042
Model 3				
Missed care	1.121	1.008	1.246	0.0349
Nurse staffing	1.059	1.022	1.099	0.0018
Nurse education	0.942	0.900	0.985	0.0093

All models adjusted for hospital characteristics (bed size, teaching status, and technology) and patient characteristics (age, sex, admission type, type of surgery, and comorbidities present on admission) unless specified otherwise. Models 1 and 3 are also adjusted for practice environment. CI = Confidence Interval. Simplified risk-adjustment by summarizing the 17 comorbidities into an index using established procedures and by collapsing the 43 dummy variables for type of surgery into three categories: orthopaedic, general or vascular surgery.

C. THREE-LEVEL BAYESIAN MODEL: FINDINGS FOR MODELS 1, 2 AND 3

| | 30-day inpatient mortality | | | | |
	Estimate	Post. SD	Lower 2.5% CI	Upper 2.5% CI	Highest PSRF
Model 1					
Nurse staffing	0.021	0.009	0.004	0.039	
Nurse education	-0.034	0.010	-0.054	-0.014	
Model 2					
Missed care	0.063	0.021	0.019	0.104	1.043
Model 3					
Missed care	0.046	0.023	0.001	0.092	
Nurse staffing	0.017	0.010	-0.003	0.037	
Nurse education	-0.031	0.010	-0.052	-0.012	

All models adjusted for hospital characteristics (bed size, teaching status, and technology), and patient characteristics (age, sex, admission type, type of surgery, and comorbidities present on admission) unless specified otherwise. Models 1 and 3 are also adjusted for practice environment. CI = Credibility Interval. PSRF = Potential Scale Reduction Factor.