

Web Appendix C: Additional Results

In this appendix we present the results from the sensitivity analyses conducted for this study, all results in this section are from the instrumental variables estimator. Tables C1 and C2 present the results from the sensitivity analyses where the one to one nursing rate is measured as a percentage of care days. Tables C3 and C4 present the results from the sensitivity analyses where the one to one nursing rate is measured as the percentage of intensive care admissions who received at least one day of one to one care. All analyses, except where indicated, control for the mean values of gestational age, birth weight z-score, antenatal steroid receipt, gender, and monthly volume of intensive care as well as year and calendar month and neonatal unit indicator.

We conducted a number of analyses to examine the sensitivity of the results to various possible misspecifications and issues of sample selection bias – discrepancies between the estimated effect in these analyses and those in the primary analysis presented in the main paper may indicate the presence of bias in the estimator.

To explore whether the observed effect was being driven by those units joining later in the sample we re-estimated the model using a balanced panel, i.e. using only those units that appeared in each month of the panel (tables C1 and C3, column (1)). We removed outlying units identified by graphical analysis (one unit had apparently high levels of one to one nursing in 2008, we also removed 2008 data as a sensitivity analysis, see below) (table C1 and C3, column (2)). Our primary sample comprised tertiary neonatal units, since these units are those which are designated to provide intensive care and hence one to one nursing; however, since some non-tertiary units may also provide a large amount of neonatal intensive care, we include these units as a sensitivity analysis (tables C1 and C3, column (3)). We also estimate a model with no covariates except for neonatal unit indicators and the one to one variable (tables C1 and C3, column (4)). A large discrepancy between this ‘crude’ model and the main results may indicate that the instrumental variable estimator is invalid since the instrumental variables may then be correlated with infant health. For the primary analysis we utilised unit classifications reported to NNAP in 2010, however, two neonatal units changed their classification during the course of the sample. We therefore examine the robustness of our results to using unit classifications reported to NNAP in 2008 and 2012 (tables C1 and C3, columns (5) and (6)). Table 1 in the main paper showed that one to one nursing rates appear significantly higher in 2008 than the other years in the sample; we therefore removed data from 2008 to see if these data were driving our results (tables C1 and C3, column (7)). Finally, we explored the effects of using different lags as instrumental variables (tables C2 and C4).

Table C1 Results from sensitivity analyses examining the effect of different samples of units and removing covariates from the model.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Balanced panel	Removal of outlying unit	Inclusion of high intensive care volume units	No covariates	2008 unit classifications	2012 unit classifications	2008 observations excluded
Effect of a ten percentage point increase in one to one	-0.95 [†]	-0.98 [†]	-0.55*	-0.66*	-0.84*	-0.70*	-0.57
95 % Confidence interval	[-2.08, 0.19]	[-2.09, 0.13]	[-1.09, -0.08]	[-1.23, -0.09]	[-1.15, -0.13]	[-1.27, -0.14]	[-1.77, 0.64]
Number of unique neonatal units	27	42	47	43	44	42	43
Total number of observations	1,487	2,014	2,239	2,054	2,109	1,997	1,820
Hansen J-stat p-value	0.771	0.747	0.712	0.709	0.647	0.622	0.354

[†]p<0.10 *p<0.05 **p<0.01 ***p<0.001.

One to one nursing is measured as the percentage of intensive care days on which one to one nursing was provided. Results are interpreted as the change in the number of deaths per 100 infants receiving neonatal intensive care per month resulting from a ten percentage point increase in one to one nursing. Regressions control for the mean values of gestational age, birth weight z-score, antenatal steroid receipt, and gender as well as year, calendar month, and neonatal unit effects (Appendix B).

Balanced panel: only neonatal units for which data were available in all months of the sample. Removal of outlying unit: one unit was identified as being an outlier from a graphical analysis of the data. Inclusion of high intensive care volume units: any neonatal unit providing a volume of neonatal care at least as great as the lowest volume tertiary unit in addition to tertiary level units. No covariates: crude model containing only neonatal unit effects and one to one nursing variables. 2008/2012 unit classifications: using neonatal unit levels reported to NNAP in the respective years. 2008 observations excluded: removal of 2008 data during which a large decrease in one to one nursing rates were observed which was not observed in subsequent years.

Table C2 Results from sensitivity analyses examining the effect of using different lags for instrumental variables

Lags ^a	(1) 1-2	(2) 1-3	(3) 1-5	(4) 1-6	(5) 2-4
Effect of a ten percentage point increase in one to one	-0.33	-0.43	-0.74*	-0.74*	-0.68
95 % Confidence interval	[-1.01, 0.35]	[-1.11, 0.26]	[-1.38, -0.11]	[-1.42, -0.07]	[-1.55, 0.19]
Number of unique neonatal units	43	43	43	43	43
Total number of observations	2,141	2,097	2,009	1,965	2,053
Hansen J-stat p-value	0.690	0.809	0.343	0.496	0.473

[†]p<0.10 *p<0.05 **p<0.01 ***p<0.001

^a 'Lags' indicates which lags of the 1:1 nursing variable are used as instruments: 2-3 indicates that one_{t-2} and one_{t-3} were used as instruments. One to one nursing is measured as a percentage of intensive care days on which one to one nursing was provided. Results are interpreted as change in the number of deaths per 100 infants receiving neonatal intensive care per month resulting from a ten percentage point increase in one to one nursing. Regressions control for the mean values of gestational age, birth weight z-score, antenatal steroid receipt, and gender as well as year, calendar month, and neonatal unit effects (Appendix B).

Table C3 Results from sensitivity analyses: effect of an increase in the percentage of infants admitted to intensive care who received at least one day of one to one nursing on the mortality rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Balanced panel	Removal of outlying unit	Inclusion of high intensive care volume units	No covariates	2008 unit classifications	2012 unit classifications	2008 observations excluded
Effect of a ten percentage point increase in one to one nursing	-0.35*	-0.33 [†]	-0.23	-0.37 [†]	-0.37*	-0.42*	-0.40 [†]
95 % Confidence interval	[-0.64, -0.07]	[-0.69, 0.03]	[-0.53, 0.08]	[-0.74, 0.03]	[-0.67, -0.07]	[-0.74, -0.10]	[-0.86, 0.05]
Number of unique neonatal units	27	42	47	43	44	42	43
Total number of observations	1,487	2,014	2,239	2,053	2,108	1,996	1,819
Hansen J-stat. p-value	0.614	0.747	0.495	0.351	0.445	0.583	0.644

[†]p<0.10 *p<0.05 **p<0.01 ***p<0.001.

One to one nursing is measured as the percentage of intensive care admissions who received at least one day of one to one nursing. Results are interpreted as change in the number of deaths per 100 infants receiving neonatal intensive care per month resulting from a ten percentage point increase in one to one nursing. Regressions control for the mean values of gestational age, birth weight z-score, antenatal steroid receipt, and gender as well as year, calendar month, and neonatal unit effects (Appendix B).

Balanced panel: only neonatal units for which data were available in all months of the sample. Removal of outlying unit: one unit was identified as being an outlier from a graphical analysis of the data. Inclusion of high intensive care volume units: any neonatal unit providing a volume of neonatal care at least as great as the lowest volume tertiary unit in addition to tertiary level units. No covariates: crude model containing only neonatal unit effects and one to one nursing variables. 2008/2012 unit classifications: using neonatal unit levels reported to NNAP in the respective years. 2008 observations excluded: removal of 2008 data during which a large decrease in one to one nursing rates were observed which was not observed in subsequent years.

Table C4 Results from sensitivity analyses: effect of an increase in the percentage of infants admitted to intensive care who received at least one day of one to one nursing on the mortality rate

	(1)	(2)	(3)	(4)	(5)
Lags ^a	1-2	1-3	1-5	1-6	2-4
Effect of a ten percentage point increase in one to one nursing	-0.36 [†]	-0.36*	-0.47**	-0.60***	-0.64*
95 % Confidence interval	(-0.78, 0.06)	(-0.72, -0.02)	(-0.80, -0.13)	(-0.96, -0.25)	(-0.13, -0.01)
Number of unique neonatal units	43	43	43	43	43
Total number of observations	2,141	2,097	2,009	1,965	2,053
Hansen J-stat. p-value	0.126	0.333	0.549	0.772	0.509

[†]p<0.10 *p<0.05 **p<0.01 ***p<0.001.

^a 'Lags' indicates which lags of the 1:1 nursing variable are used as instruments: 2-3 indicates that one_{t-2} and one_{t-3} were used as instruments. One to one nursing is measured as the percentage of intensive care admissions who received at least one day of one to one nursing. Results are interpreted as change in the number of deaths per 100 infants receiving neonatal intensive care per month resulting from a ten percentage point increase in one to one nursing. Regressions control for the mean values of gestational age, birth weight z-score, antenatal steroid receipt, and gender as well as year, calendar month, and neonatal unit effects (Appendix B).