# Web Appendix A: Validation of the One to One Nursing Variable

The key variable of interest in the NNRD for this study is a binary indicator for each care day equal to one if an infant received one to one nursing and zero otherwise. An affirmative response for a particular day could represent either: whether an infant *should have* received one to one nursing, or whether an infant *did* receive one to one nursing. For the purposes of this study, we require that the one to one nursing variable represents the latter option. The purpose of this section is to determine whether this is the case. While each of the following methods of validation do not determine definitively the interpretation of the variable, together they provide strong evidence to support the claim that the variable represents whether an infant did receive one to one nursing on a particular day. It is not possible to determine whether the variable indicates that the infant received 1:1 nursing for all 24 hours of a particular day or less.

## Qualitative Evidence

The uncertainty surrounding the one to one nursing variable revolves around not knowing the criteria by which staff members entering data each day choose whether to respond in the affirmative to the one to one nursing variable. As such, staff members responsible for data entry were contacted at three units by SIW (Unpublished Correspondence, 2013). In all units, each infant’s record was completed at night by the nurse attending that infant. Staff members at all units reported that the one to one nursing variable reflects whether an infant actually received one to one nursing rather than should have received one to one nursing. In one case, the member of staff reported (where “1:1” is equivalent to “one to one nursing”):

At [name of unit], it reflects whether the baby received 1:1 rather than whether it should have had 1:1. The numbers would be very different in the latter case. (Unpublished correspondence, 2013)

This comment also suggests that there should be some discrepancy between the level of one to one nursing recommended for intensive care in the guidelines and what the one to one nursing variable reflects.

## Clinical Guidelines

The BAPM guidelines indicate that an infant receiving intensive care should also receive one to one nursing. It is therefore possible to identify those days where an infant should have received one to one nursing which can then be compared to those days where the one to one variable is completed in the affirmative. The data presented in this study show that under 10% of intensive care days had one to one nursing provided; the BAPM guidelines recommend that this figure should be 100%.

## Infant Severity

If the one to one nursing variable reflects whether an infant did actually receive one to one nursing rather than should have received one to one nursing then we should expect to see a relationship between the risk of mortality and the probability of receiving one to one nursing. Of all the intensive care days provided to infants who eventually died in hospital 16.97% were one to one nursing care days compared to 9.43% of the intensive care days provided to infants who survived to discharge. A test of the null hypothesis of no difference in the proportion of one to one nursing days between the two groups yielded a p-value of <0.001 providing evidence of a relationship between infant mortality and one to one nursing. In addition, 25.23% of days on which infants received surgery were one to one nursing days. Of IC days on which an infant died, 45.13% were one to one nursing days. Again, according to the BAPM guidelines, these figures should be 100%.

## Nurse to Patient Ratios

A further test of the one to one nursing variable is to examine its relationship with average nurse to patient ratios. Arguably, the numbers of nurses employed on the unit, at least in part, determines the provision of one to one nursing. This will depend on how units prioritise nursing decisions; some may opt for lower nurse to patient ratios for healthier infants in order to provide more one to one nursing to less healthy infants whereas other units may prefer a balance in the other direction. However, it is likely that units choose a solution somewhere in between the two extremes, in which case there should be a correlation between average nurse to patient ratios and the proportion of care days that are one to one nursing days, although this correlation may not necessarily be particularly strong. In order to examine this, we use data from the Unit Profile Survey (UPS) which collected information on the number of whole time equivalent (WTE) medical and nursing staff within UK neonatal units for November 2011. For units completing the UPS, IC days provided in November 2011 were extracted from the NNRD and the proportion of IC days provided that were also one to one nursing care days determined. The ratio of WTE nurses to IC days was calculated from the UPS. Figure B.1 shows the correlation between the two variables; the correlation coefficient is 0.42.

## Transfers

As a final check, the care received by infants receiving inter-unit transfers is examined. If the 1:1 variable reflects care actually received then there should be some differences between units in the provision of 1:1 nursing owing to both different criteria used to determine whether an infant receives 1:1 nursing or not and differing labour constraints affecting their ability to actually provide 1:1 nursing. Here, we examined the proportion of infants who were entered as affirmative in the 1:1 nursing variable who received 1:1 nursing following a transfer. If the units are following guidelines, there should be very little difference either side of the transfer; whereas there should be some discrepancy if the variable reflects actual care received in the context of less than clinically optimal nursing staff inputs. Given evidence suggests that inter-unit transfers may have a deleterious effect on infant health,1,2 a null hypothesis of no variation in one to one nursing provision between units would be equivalent to a 100% correspondence between pre- and post-transfer 1:1 nursing. The difference between pre- and post-transfer 1:1 nursing may provide some indication of the heterogeneity in 1:1 nursing provision between hospitals. The NNRD data reveal that there were 1,724 IC days between 2009 and 2011 on which an infant received both 1:1 nursing (at the unit from which an infant was transferred) and an inter-unit transfer, of these 1,254 (72.74%) received 1:1 nursing at the hospital to which the infant was transferred.

## References

1 Kelley-Quon, L. I., Tseng, C.-H., Scott, A., Jen, H. C., Calkins, K. L., & Shew, S. B. Does hospital transfer predict mortality in very low birth weight infants requiring surgery for necrotizing enterocolitis? *Surgery* 2012; ***152*(3):** 337–343.

2 Towers, C. V, Bonebrake, R., Padilla, G., & Rumney, P. (2000). The effect of transport on the rate of severe intraventricular hemorrhage in very low birth weight infants. *Obstetrics and Gynecology* 2000; ***95*(2):** 291–5.

**Figures**

Figure B1. Correlation between the number of whole time equivalent nurses per careday and the proportion of intensive care days on which one to one nursing was provided.

