Nurse staffing levels on the NPICU in the island of Malta

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Abstract

Purpose. Nurse staffing levels in neonatal paediatric intensive care units (NPICU) are often inadequate. Malta is a small Island in the centre of the Mediterranean (total population around 400,000) with a birth rate of just under 4000/annum, with one NPICU. This study analysed nurse staffing levels for a 1 year period in order to ascertain whether said levels are adequate or not.

Methods. Daily ward occupancies were classified by level of dependency, and ideal nursing requirements were estimated using internationally approved standards, on a daily basis, for the period 12 month period from 01/04/2008 to 31/03/2009. These were compared with the actual daily morning nursing levels to estimate deficit/s.

Results. There were a total of 373 admissions to the unit resulting in a total of 5464 patient days (daily census at 0700 hrs) and 1471 free bed days (occupancy 78.8%). Occupancy varied between 8 and 23 patients (mean 15). Staffing levels ranged between 7 and 17 nurses (mean 11). The overall mean deficit was of 3.3 nurses, but this ranged from a maximum of 11 to a rare surplus of 7 nurses.

Conclusions. This study only focused on a daily morning snapshot where the nursing staff is at its peak number – the nocturnal deficit is naturally worse. Furthermore, experience levels vary due to short rotations through the unit of inexperienced midwifery staff. Moreover, there are no staff designated as responsible for further education and training, extra staff for unpredictable high dependency situations, to compensate for leave, sickness, maternity leave, study leave, staff training and attendance at meetings. Clearly, the Maltese NPICU is overall understaffed.

Keywords: Hospital bed capacity/statistics & numerical data, humans, infant, newborn, intensive care units, neonatal/manpower/
*statistics & numerical data, personnel staffing and scheduling/statistics & numerical data, workload/statistics & numerical data

Introduction

The best quality neonatal care possible is crucial for the outcome of sick neonates as this minimises morbidity and mortality [1]. A reduction in morbidity will inevitably also reduce the long-term burden of care on the state [2]. It has been shown that throughout Europe, since the 1990s, with increasing utilization of surfactant and antenatal steroid administration for anticipated premature deliveries (and higher survival rates of such neonates), there has been an increased requirement for neonatal intensive cot utilization. Such cots are low-volume and high cost, and are required at a level of 1.0–1.9 cots per 1000 population with an average

70% occupancy [1]. It has been estimated that 1–2 neonates per 100 live births require at least 1 hour of intensive care [3].

It has been shown that for these neonates, the risk adjusted mortality rises linearly with level of occupancy, such that infants admitted to full units have 50% greater odds of dying than those admitted to units which are only half full [3]. It is clearly crucial that staff levels are appropriate to the dependency of the neonates, that is, to the recommended nurse to patient ratios depending on the severity of the condition being treated, as will be explained below [1]. For this reason, it is recommended that neonatal units should be planned to have an average occupancy of 70% [1]. Malta has strong links with the United Kingdom, with almost all trainees visiting the United Kingdom. Systems in place therefore are virtually identical to the British system. The staffing

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recommendations that are used in this study (see below) are those used in the UK. These recommendations remain in use although they are based on studies performed in the early 1990s, and must therefore be regarded as minimum standards [4,5].

The level of dependency is determined by the acuity and severity of the neonate's condition/s, and the greater the acuity and severity, the greater the recommended nurse to patient ratio will be [1].

Neonates in intensive care situations should have 1:1 nursing, and critically ill neonates (e.g. severe pulmonary hypertension) should have 2 nurses in attendance [6].

High dependency and special care should have nurse to baby ratios of at least 1:2 and 1:4 respectively [1]. Inclusion criteria for the various categories are shown in table 1.

Setting

The Maltese Neonatal Paediatric Intensive Care Unit (NPICU – formerly St. Luke's Hospital Special Care Baby Unit) is the only unit serving the Maltese

Archipelago, with a total catchment area of approximately 400,000 population and a live birth rate of just under 4000 per annum [7]. The NPICU is a Level 3 Unit providing the whole range of medical neonatal care. A Level 3 unit provides the whole range of medical neonatal care but not necessarily all specialist services such as neonatal surgery. Continuing neonatal intensive care is also provided and is staffed by consultants whose principal duties are to the unit. There is 24-hour resident cover by Higher Specialist Trainee in paediatrics who has worked a minimum of four months in neonatology. This doctor is available for the unit at all times and is not required to cover any other service. Two of the authors work on the unit, one as the Nursing Officer in charge of the unit and the other as the paediatric cardiologist for the country.

The unit officially has a total maximum capacity of 19 patients but this figure is not absolute in that since there are no other units in the country, the unit stretches to accommodate whatever number of admissions are needed. The medical staff consists of three consultants and two resident specialists, assisted by two basic specialist trainees. The on-call medical staff consists of a consultant covering the unit with two resident specialists on-site.

The nursing staff works on a 12 hour shift starting and ending at 0700 hours and 1900 hours respectively (day, night, rest and off) and each shift comprises 7 to 8 individuals. In addition, there are 4 to 5 nurses who work daytime hours, i.e. up to 1600 to 1900 hours. These figures do not include 2 unit nurses who manage the ward and also help out with general nursing care if the need arises. In our unit, vacation leave is only allowed for 1 member of rota staff and 1 member of day staff.

During the period under study, the nursing staff consisted of 39 full-time equivalents, with 45 individual nurses in total. There are a total of four shifts with no nominated educators.

For the purposes of patient safety, these nurses or midwives work completely supervised for the first 3 months of their rotation. Staff who work unsupervised therefore have a minimum of 3 months of experience. The level of individual experience varies from years to decades.

The case mix is similar, year by year, and for the last available year, admissions by gestational age were as follows: 3 under 25 weeks of gestation, 14 between 25 and 27 weeks, 38 between 31 and 33 weeks, 64 between 34 and 36 weeks. There were also a total of 136 term admissions and 44 paediatric admissions. Parent education is *ad hoc* and done by unit nurses.

Table 1

Inclusion criteria for babies on the neonatal paediatric intensive care unit

Intensive Care
Intubated and 1st 24 hours extubated.
NCPAP (nasal continuous positive airway pressure) at all and <5 days old.
NCPAP at all and <1000g and for 24 hours after removal.
<29 weeks of gestation and <48 hours old.
Requiring major emergency surgery preoperatively and 24 hrs postoperatively.
Complex procedures: Full exchange procedures, peritoneal dialysis, infusion of inotrope or pulmonary vasodilator or prostaglandin and for 24 hours after.
On day of death.
Other very unstable situations.
High Dependency
NCPAP and not filling any of the above criteria for intensive care.
<1000g and not filling any of the above criteria for intensive care.
Parenteral nutrition.
Fits.
Oxygen therapy and < 1500g.
Neonatal abstinence syndrome.
Complex procedures not as above: Partial exchange, arterial line, chest drain, tracheostomy.
Severe apnoeas requiring recurrent stimulation.
Special Care
Any other condition not reasonably expected to be looked after at home.

This study analyses admission data to the Maltese NPICU for the period 01/04/2008–31/03/2009, and compares unit patient occupancy with nurse staffing levels on a daily basis. This was done in order to estimate daily deficits (if any) of nurse staffing levels in relation to daily patient occupancy, after stratifying patients to level of acuity in order to determine the individual level of ideal nurse to patient ratio, and total ideal number of nurses that would have been needed on each and every day. This was compared with the actual number of staff present, on each day, in order to identify days where any staff deficits were definitely present.

Methods

Daily ward occupancies were compiled in an Excel spreadsheet, and patients were classified as per table 1 as per recommended guidelines, [1] by the Nursing Officer in charge of the unit, on a daily basis, as a morning snapshot. Morning nursing levels were also documented. The data was entered into Excel by the ward clerk, on a daily basis, and entry was checked by both authors.

Ideal daily nursing requirements were estimated based on the above daily number of patients and their dependency as per guidelines by diagnosis (table 1) [1] i.e. patients requiring critical care should have 2 staff in attendance, patients requiring intensive care should require 1:1 nursing, patients requiring high dependency and special care should have nurse to baby ratios of at least 1:2 and 1:4 respectively [1]. The daily morning nursing excess/deficit could therefore be calculated by subtracting the desired number of nurses from the actual number of nurses present as per above calculation.

The most severe condition requiring the greatest level of dependency was utilized in patients with multiple diagnoses.

Official hospital admission and occupancy statistics for NPICU for the period under study were also obtained. Ethical approval was not sought as no patients/parents were contacted and data was anonymised.

Results

There were a total of 373 admissions to the unit for the period 01/04/2008–31/03/2009. These produced a total of 5464 patient days (daily census at 0700 hrs). Cot days by diagnosis are shown in table 2. Based on an official estimate of a total maximum unit capacity of 19 patients, there were 1471 free bed days with a total

bed occupancy of 78.8%. The average length of stay was 14.6 days. There were a total of 38 non-neonatal patients, with an age up to 3 years.

Summary statistics are given in table 3. Unit occupancy varied widely, and never fell below 8 patients, and the maximum occupancy was 23 (mean 15). Staffing levels were equally variable, ranging between 7 and 17 nurses (mean 11). The overall mean deficit was of 3.3 nurses, but this ranged from a maximum of 11 to a surplus of 7 nurses. The deficits were unrelated to weekends, holiday periods or season.

The trend in nursing deficit (and occasional surplus) is depicted as a histogram in (Fig. 1). Values above the baseline are nursing staff deficits, while values below the baseline are nursing staff surpluses.

Discussion

Our study calculates desired daily staffing levels by assigning individual daily patient dependency according to the individual patient diagnosis, using published

Table 2
Cot days by diagnosis using table 1

Intensive Care	
Intubated and 1st 24 hours extubated.	564
NCPAP (nasal continuous positive airway pressure) at all and <5 days old.	900
NCPAP at all and <1000g and for 24 hours after removal.	14
<29 weeks of gestation and <48 hours old.	19
Requiring major emergency surgery preoperatively and 24 hrs postoperatively.	85
Complex procedures: Full exchange procedures, peritoneal dialysis, infusion of inotrope or pulmonary vasodilator or prostaglandin and for 24 hours after.	68
On day of death.	2
Other very unstable situations.	2806
High Dependency	
NCPAP and not filling any of the above criteria for intensive care.	0
<1000g and not filling any of the above criteria for intensive care.	0
Parenteral nutrition.	0
Fits.	4
Oxygen therapy and < 1500g.	28
Neonatal abstinence syndrome.	208
Complex procedures not as above: Partial exchange, arterial line, chest drain, tracheostomy.	12
Severe apnoeas requiring recurrent stimulation.	0
Special Care	
Any other condition not reasonably expected to be looked after at home.	536
Total	5464

Table 3
Summary statistics for unit occupancy, staffing levels, and staffing deficit for the entire period under study: 01/04/2008–31/03/2009

	Unit occupancy	Nursing staff	Nursing deficit
Mean	15	11	3.3
Standard Error	0.14	0.09	0.17
Median	15	11	4
Mode	17	11	4
Standard Deviation	2.6	1.7	3.2
Sample Variance	7.0	3.0	10.4
Minimum	8	7	-7
Maximum	23	17	11

recommendations, [1] and comparing the total derived daily ideal nursing complement with the actual nursing complement on that same day. This study shows an overall deficit in the ideal level of staffing, except for a few weeks toward the end of the study wherein the admission rate temporarily fell.

Our study is limited by the fact that it only takes into account one single unit, that is, the only such unit available in the country. This paper also focused on a daily morning snapshot where the nursing staff is at its peak number, and it is clear that the nocturnal deficit is therefore worse due to the absence of additional day only staff. Indeed, the night shift consists, on average, of 7–8 nursing staff. This study also could not take into consideration nursing experience levels as the staffing is usually a mixture of variably experienced nurses and midwives. For example, for the first 6 months of this

study (up to November 2008), a group of 6 midwives were completing a 1 year rotation in NPICU. The subsequent rotation comprised 5 midwives, only 2 of which were assigned to NPICU for a year, while the other 3 were only assigned for 6 months. For the purposes of patient safety, these midwives work completely supervised for the first 3 months of their rotation, hence their addition to the dataset as full members of staff is misleading. This rotation includes obstetric and gynaecology wards, antenatal clinics, antenatal ultrasound and labour ward, hence little experience or preparation is gained preparatory to a tour of work on NPICU.

In addition, the following paramedical staff does not exist in our unit but is also recommended: a designated nurse responsible for further education and training, extra staff for unpredictable situations, e.g. one nurse

Fig. 1. Nursing staff deficit over the period 01/04/2008–31/03/2009.

available on each shift for intensive or high dependency cover, and extra staff to compensate for leave, sickness, maternity leave, study leave, staff training and attendance at meetings [1]. This recommendation does not include administration and secretarial cover.

Nursing deficits are common worldwide, and such deficits, in themselves, may contribute to burnout, reduced quality of care and carers actually opting out of their profession [8]. Indeed, quality of care may deteriorate to levels such that unmet nursing care needs directly lead to adverse events, up to and including death [9].

A nursing deficit is not uncommon in neonatal units, and in the UK, it has been estimated that 79% of neonatal intensive care units have such deficits [10–12]. One may speculate that this may be due not only to a general lack of nursing cover, but also to the stress that these jobs engender in staff, making them unpalatable to employees in the long term. It has also been suggested that the increasing pressure to reduce the working hours all medical and paramedical staff and the increasing duration of neonatal nurse training inevitably makes it more difficult for units to maintain staff skills and to prioritise training [12,13].

It has been unequivocally shown that risk-adjusted mortality in very low birthweight or preterm infants is associated with levels of nursing provision. For example, increasing the ratio of experienced nurses is associated with a decrease in risk-adjusted mortality [14]. Increasing the total ratio of nurse to patient has also been shown to significantly reduce mortality on neonatal units [14]. Indeed, staffing variations across units within the same country (Canada) have also been shown to affect outcome [15]. Staffing levels appear to be such a contentious issue that some researchers have also suggested ways in which safer staffing of neonatal units may be achieved, including network-wide workforces, clinical support workers and neonatal housekeepers [12].

Conclusion

As measured against the quoted recommended staffing levels, the NPICU has often been understaffed during the period under study as measured by the data and methods used, albeit the situation

appears to have temporarily improved toward the study period. We hope that this analysis will prompt the local Health Authorities to assign a higher priority to staffing levels in our unit.

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