

ORIGINAL ARTICLE

Documenting the NICU design dilemma: parent and staff perceptions of open ward versus single family room units

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Objective: With neonatal intensive care units (NICUs) evolving from multipatient wards toward family-friendly, single-family room units, the study objective was to compare satisfaction levels of families and health-care staff across these differing NICU facility designs.

Study Design: This prospective study documented, by means of institutional review board-approved questionnaire survey protocols, the perceptions of parents and staff from two contrasting NICU environments.

Result: Findings showed that demographic subgroups of parents and staff perceived the advantages and disadvantages of the two facility designs differently. Staff perceptions varied with previous experience, acclimation time and employment position, whereas parental perceptions revealed a naïveté bias through surveys of transitional parents with experience in both NICU facilities.

Conclusion: Use of transitional parent surveys showed a subject naïveté bias inherent in perceptions of inexperienced parents. Grouping all survey participants demographically provided more informative interpretations of data, and revealed staff perceptions to vary with position, previous training and hospital experience. *Journal of Perinatology* (2010) 30, 343–351; doi:10.1038/jp.2009.195; published online 14 January 2010

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Introduction

As medical advances increase the survival of critically ill neonates, the need for neonatal intensive care units (NICUs) increases concomitantly. This growth is occurring within a health-care environment that is increasingly competitive and consumer driven.^{1,2} Responding to these pressures, neonatal intensive care is rapidly evolving in both facility design and health-care delivery practice. NICUs are trending away from multi-patient, open bay wards (OPEN), to single family room (SFR) designs, while

neonatal health-care practices are becoming more family centered. White³ called attention to the dilemma inherent in this design movement. Private rooms favor the patient–parent by affording greater privacy, environmental control and space customization to the patient's individual developmental needs. However, these benefits are not without disadvantages for hospital staff and administrators. Caregivers can feel more isolated from their colleagues and patient charges and may get fewer opportunities for experiential learning. Administrators must commit greater space and financial resources to accommodate this transition and remain competitive.

To date, there are minimal data to document the contradictory aspects of this trend as it affects patients, parents and health-care staff. Carter *et al.*,⁴ approached this informational deficiency by surveying parents of preterm infants during a transition from an older, multi-patient ward into a new, private room facility. Their methodology, by addressing *transitional* parents, established a means to avoid the 'subject naïveté' ambiguity encountered when surveying parents whose experience with the NICU environment is minimal and limited to only one facility design.

Cabell Huntington Hospital in Huntington, West Virginia, USA, recently completed construction of a SFR NICU to replace an older, open bay ward. Constructed in the 1950s, the previous 419 m² OPEN unit accommodated 29 neonates, with no more than a 3.35 m² space for the patient, visiting parents and medical equipment. The new, 1302 m² SFR unit occupies a half floor of a multi-story addition to the existing facility and accommodates 36 patient positions split between 20 private and 8 semi-private rooms. Semi-private rooms are intended to be reserved for twins or triplets, rather than shared by two families. The notable contrast between the two facilities provides an ideal scenario for comparing the relative satisfaction experienced by parents and professional staff as it relates to facility design before, during and after the relocation.

Methods

Three groups of parents were surveyed over the course of the study using the *nurse parent support tool* copyrighted and validity-tested by Margaret S Miles.⁵ The nurse parent support tool is a 21-question,

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Likert scaled questionnaire, designed to measure parents' perceptions of nursing support during their child's hospitalization. Fourteen similarly styled questions were appended to the nurse parent support tool to determine perceptions of the physical facility (11 questions) and to collect demographic data (3 questions). Parent groups were established based on the NICU facility in which their child was treated: one group experienced only the old, open bay ward, while another was treated in the new, private–semi-private room unit. A third group of *transitional* parents was present during the move from the old to the new NICU and uniquely experienced both facility environments. Except for the transitional group, parental surveying was timed to avoid the interval around and including the actual move by suspending data collection for at least 90 days before and after the relocation.

Marshall University Institutional Review Board approval was secured for the study protocol, and parent participation was anonymous and entirely voluntary. All parent groups were convenience sampled based on availability around the time of their infant's discharge. Each completed questionnaire was tagged with the length of stay (LOS) of their infant and with the physician's estimate of mortality risk (PEMR)⁶ assigned by the research neonatologist as an index of initial illness. Using this scale, the severity of illness increases with the PEMR value with PEMR 4 being the most severely ill child included in the study. Parents of deceased infants (PEMR 5) were excluded. This 'triage' protocol was simpler to administer than the Neonatal Therapeutic Intervention Survey Score adopted by Wielenga *et al.*,⁷ and correlated positively with LOS. Mortality rates over the course of the study were monitored in both facilities and separated by prognosis into 'expected' (PEMR 5) and 'unexpected' (PEMRs 1 to 4) categories for comparison. Causes of death were recorded as well.

The staff survey was internally generated by the researchers with input from neonatologists, neonatal nurse practitioners, practicing staff nurses and nurse managers. The questionnaire consisted of 36 Likert scaled items covering demographics along with perceptions of the work environment, the physical facility, the accommodation of health-care practice and the extent of parental involvement in health-care procedures and decision making. Specific questions were included to address the issues affecting neonatal nurse job satisfaction as advanced by Archibald.⁸ As with the parental survey protocol, staff members were surveyed before and after the move to the new facility while avoiding the actual time interval around the move. The same survey was repeated 18 months post-relocation to detect changes in staff perceptions with extended experience in the new facility. Participation was anonymous and voluntary. As no new staff were added in preparation for the move, no transitional group was necessary. All surveyed staff experienced both facility designs, and survey results were sorted into *medical doctor/nurse practitioner (MD/NP)* and *Nurse* subgroups. Responses for each survey subgroup were compiled, averaged and the means were compared for statistical significance using the Mann–Whitney Rank Sum nonparametric analysis.

Sound measurements were conducted in both facilities by a consultant from *Performance beating, ventilating, air conditioning (HVAC) Systems* using a Quest Soundprobe DL-2 (Quest Technologies, Oconomowoc, WI). Measurements were made within a closed Omnibed in bays or rooms located near the entrances and nursing stations of both facilities at peak activity during shift change and visitation.

Results

Survey participation and mortality rates

Survey participation/return rates were as follows: parent group, OPEN = 45%, SFR = 74%; MD/NP subgroup, OPEN = 67%, SFR = 78%; Nurse subgroup, OPEN = 69%, SFR = 59%. The second staff survey showed rates of 67% MD/NP and 90% Nurses. The difference in parental participation rates between the two facilities reflected the increased staff access to parents in the SFR unit. Research staff administering the surveys anecdotally reported parents spending more time in the SFR unit compared with the OPEN facility.

Mortality incidences in the two facilities for the study time intervals showed 11 events in the OPEN unit and 9 in the SFR. In the OPEN facility, 3 of the 11 mortality events (27%) were unexpected with causes of death of necrotizing enterocolitis, severe intracranial hemorrhage and nosocomial sepsis. The SFR showed only one unexpected event (11%) from necrotizing enterocolitis.

Parental perceptions

Except for LOS, *inexperienced* parent groups showed no appreciable demographic differences. Survey results from these parents were separated according to LOS by subdividing the parental groups by the PEMR categories of their infants (Table 1). PEMRs 1 and 2 were combined as *short stay* parents and PEMRs 3 and 4 represented the *long stay* group. The *short stay* parents showed mean LOSs of 9.1 and 7.9 days for the OPEN and the SFR facilities, while *long stay* parents averaged 32.2 and 26.2 days, respectively. It is significant to note that the SFR parents had 8% more seriously ill infants (Table 1), but had average LOSs reduced by 13% with the *short stay* subgroup and 18% with their *long stay* cohort.

When physical facility issues were compiled from the *inexperienced* parental subgroups, who had observed only one of the two facilities, LOS generally increased favorable perceptions of the SFR (Table 2). Even the *short stay* parents, with their limited exposures to the two facilities, appreciated the ability to control light levels in the SFR facility. The longer stay parental subgroups were generally more discerning. With experience in only one facility design, the parents in the SFR facility significantly preferred the comfort, privacy and light control aspects of that unit. Although noise levels were shown higher in the OPEN unit (L_{eq} levels were approximately 20 dB higher), neither of the *inexperienced* parental subgroups in either facility perceived noise as being a significant

Table 1 Parent survey group demographics

Demographic criterion	OPEN		Transition		SFR	
	n	%	n	%	n	%
<i>Parent surveyed</i>						
Mother	49	80	15	94	72	86
Father	12	20	1	6	12	14
<i>Parent LOS subgroup</i>						
Short stay	29	48	—	—	33	40
Long stay	32	52	—	—	51	60
<i>Marital status</i>						
Single	21	34	6	38	25	30
Married	40	66	10	62	59	70
<i>Age group</i>						
18–25 years	28	46	9	56	41	49
26–30 years	19	31	4	25	27	32
31–35 years	11	16	1	6	11	13
>35 years	4	7	2	13	5	6

Abbreviations: LOS, length of stay; SFR, single family room.

disturbance for their infants. However, 56% of the *transitional* controls felt that noise was a greater disturbance in the OPEN unit.

Short stay parents were less discriminating between the two units when queried regarding aspects of the physical facility and, like their longer stay cohorts, were strongly positive regarding staff performance (Table 2). The most important observation from these data was the fact that scores for all staff performance topics were comparably high for both facilities. On a Likert scale from one to five, with one being *almost never* and five being *almost always*, the means never dropped below four. Both subgroups of *inexperienced* parents tended to be quite favorable in their evaluations of staff performance in both facilities—so much so that subject naiveté had to be ruled out before staff performance could be concluded better or worse in either of the facility designs.

Transitional parents, who were present during the move, uniquely experienced both facilities and served as naiveté controls (Table 3). With this parent group, 93% perceived staff performance to be either 'better in the SFR' (25%) or 'about the same in both' (68%). The open bay facility never scored above 25% preference on any staff performance issue with this control group, indicating an element of naiveté bias in the *inexperienced* parent data.

It is noteworthy that inter-parental socialization difficulties were posed by the relative isolation of parents in the SFR design. This issue was reflected in the responses of both *transitional* and *inexperienced* parents alike. When asked regarding the ease of 'meeting other parents' and the role of 'parental support in making the hospital stay better', the OPEN facility outperformed the SFR with both parental groups regardless of previous experience.

Staff perceptions

Neonatologists–nurse practitioners and staff nurses completed the same questionnaire, but the results were analyzed separately. Within these two staff subgroups, interesting differences and similarities emerged with certain survey topic areas (Tables 4 and 5). With the initial staff survey, the *MD/NP* subgroup's perceptions in all topic categories trended toward favoring the SFR facility, while *Nurses* favored the OPEN design in every topic category except for privacy and environmental quality aspects. Perceptual differences between these two subgroups diminished somewhat with the second staff survey with noteworthy shifts in impressions of the SFR work environment.

When specific work environment topics were examined, the *MD/NP* subgroup showed no statistically significant preference between the two facilities. However, initial data from this subgroup trended toward work in the OPEN unit being more physically demanding, more mentally stressful and more rewarding. Over time, this subgroup found work in the SFR somewhat less physically demanding, but more stressful and more rewarding than in the OPEN unit. The Nurse subgroup showed the greater shift in perception of the work environment with the second survey. Nurses initially perceived their work in the SFR to be more physically demanding, more stressful and less rewarding with workloads more difficult to manage. However, the second survey showed a shift in perceptions of this subgroup toward more favorable opinions of the SFR unit, but never to the same extent observed in the OPEN facility.

To determine whether nursing experience might have influenced these survey results, Pearson's Product Moment Correlations were performed to assess the extent to which health-care experience correlated with perceptions of the demands and manageability of nursing workloads in the SFR facility. When asked if their work was physically demanding, the responses significantly positively correlated with health-care experience ($r = 0.39$, $P = 0.029$). However, when asked if their workload was manageable, the responses were significantly negatively correlated with total health-care experience ($r = -0.42$, $P = 0.018$). These correlations had disappeared with the second SFR survey. In addition, the same correlations with the same nurses from the OPEN facility were not statistically significant in that environment. Experienced nurses were more likely to perceive the SFR workload as more demanding and more difficult to manage than were their less experienced coworkers, and their initial concerns were allayed somewhat with accrued experience in the new SFR.

When aspects of parental involvement were queried, the *MD/NP* subgroup showed no significant differences between the two facilities, but trended toward favoring the SFR unit. Their preferences remained consistent through the second survey. *Nurses* trended toward agreeing that the convenience of parental visits was better in the SFR. However, they perceived the availability of parents

Table 2 *Inexperienced* parent perceptions

Topic category	Survey questions (1 = almost never, 5 = almost always)	PEMR subgroups					
		Short stay			Long stay		
		OPEN	SFR	P level	OPEN	SFR	P level
STAFF PERFORMANCE	Q1-HELPED ME TALK ABOUT CONCERNS	4.6	4.4	0.196	4.5	4.6	0.239
	Q2-EXPLAINED TREATMENTS	4.8	4.8	0.520	4.8	4.8	0.849
	Q3-TAUGHT ME HOW TO GIVE CHILD CARE	4.8	4.7	0.739	4.8	4.8	0.691
	Q4-MADE ME FEEL IMPORTANT AS PARENT	4.7	4.4	0.087	4.6	4.4	0.409
	Q5-LET ME DECIDE TO STAY FOR PROCEDURES	4.6	4.5	0.190	4.5	4.4	0.497
	Q6-ANSWERED MY QUESTIONS	4.7	4.5	0.243	4.8	4.7	0.473
	Q7-INFORMED ABOUT CHANGES IN CONDITION	4.7	4.7	0.418	4.9	4.6	0.030*
	Q8-INVOLVED ME IN CARE DECISIONS	4.4	4.5	0.510	4.4	4.3	0.728
	Q9-HELPED TO UNDERSTAND CHILD'S BEHAVIOR	4.6	4.6	0.439	4.7	4.5	0.066
	Q10-TAUGHT ME HOW TO COMFORT CHILD	4.7	4.4	0.016*	4.4	4.4	0.719
	Q11-INFORMED OF MY QUALITY OF CHILD CARE	4.4	4.2	0.097	4.2	4.1	0.483
	Q12-RESPONDED TO MY CONCERNS	4.6	4.5	0.339	4.5	4.5	0.664
	Q13-SHOWED CONCERN FOR MY WELLBEING	4.4	4.1	0.108	4.1	4.1	0.943
	Q14-TOLD ME NAMES & JOBS OF STAFF	4.4	4.3	0.702	4.7	4.5	0.328
	Q15-GAVE GOOD CARE TO MY CHILD	4.9	4.8	0.185	4.9	4.9	0.524
	Q16-ENCOURAGED MY QUESTIONS	4.6	4.5	0.349	4.8	4.8	0.583
	Q17-SENSITIVE TO MY CHILD'S NEEDS	4.8	4.8	0.642	4.9	4.7	0.226
	Q18-INVOLVED ME IN MY CHILD'S CARE	4.8	4.8	0.427	4.7	4.9	0.126
	Q19-SHOWED THAT THEY LIKE MY CHILD	4.8	4.8	0.846	4.8	4.9	0.891
	Q20-TIMELY RESPONSE TO CHILD'S NEEDS	4.8	4.7	0.227	4.8	4.6	0.183
	Q21-WERE OPTIMISTIC ABOUT MY CHILD	4.8	4.6	0.183	4.9	4.5	0.04*
Topic category (column) means	4.7	4.6		4.7	4.6		
PHYSICAL FACILITY	Q22-PARENT COMFORTABLE VISITING	4.8	4.8	0.413	4.6	4.8	0.019*
	Q23-FAMILY COMFORTABLE VISITING	4.6	4.7	0.966	4.4	4.6	0.415
	Q24-ADEQ. PRIVACY FOR BONDING	4.4	4.7	0.300	4	4.8	<0.001*
	Q25-ADEQ. PRIVACY FOR BREASTFEEDING	4.1	4.8	0.111	4	4.9	0.076
	Q26-NOISE DISTURBED CHILD	1.8	1.6	0.890	1.5	1.6	0.657
	Q27-COULD CONTROL LIGHT	3.5	4.7	<0.001*	2.8	4.5	<0.001*
	Q28-MET OTHER PARENTS	3.4	2.8	0.065	3.9	3.3	0.036*
	Q29-OTHER PARENTS MADE STAY EASIER	3.8	3	0.142	3.8	3.7	0.542
	Q30-NURSES EASY TO REACH	4.6	4.5	0.343	4.7	4.4	0.104
	Q31-ABLE TO RELAX WITH CHILD	4.5	4.5	0.879	4.1	4.6	0.012*
	Topic category (column) means	4.0	4.0		3.8	4.1	

Abbreviations: PEMR, physician's estimate of mortality risk; SFR, single family room.*Mann-Whitney Rank Sum statistical significance ($P \leq 0.05$).

to be significantly better in the OPEN unit in both surveys. This perception contradicted the anecdotal research staff reports that parents were easier to reach in the SFR unit as evidenced by the greater survey questionnaire response level observed with parents in that facility.

Concerns for the level of parental preparedness at discharge and for patient care issues in the SFR were reflected in the *Nurses* perceptions on both surveys. The *MD/NP* group initially disagreed on this issue, but showed increased agreement over time. *Nurses*

similarly felt that the capacity to care for critical patients and the general adequacy of time for patient attention were less satisfactory in the SFR. The *MD/NP* subgroup trended toward disagreement. Over time, however, the perceptions of these two subgroups came closer to agreement that the OPEN unit outperformed the SFR on these topics. In the category of patient care, the early detection of medical crises was observed by both staff subgroups as better in the OPEN facility. With the *Nurses* subgroup, this perceptual difference was highly significant.

Table 3 Transitional parent perceptions

Topic category	Survey questions	Response (%)		
		Better in OPEN	Better in SFR	Same in both
STAFF PERFORMANCE	Q1-HELPED ME TALK ABOUT CONCERNS	6	31	64
	Q2-EXPLAINED TREATMENTS	6	19	75
	Q3-TAUGHT ME HOW TO GIVE CHILD CARE	6	31	63
	Q4-MADE ME FEEL IMPORTANT AS PARENT	12	38	50
	Q5-LET ME DECIDE TO STAY FOR PROCEDURES	0	31	69
	Q6-ANSWERED MY QUESTIONS	0	12	88
	Q7-INFORMED ABOUT CHANGES IN CONDITION	12	38	50
	Q8-INVOLVED ME IN CARE DECISIONS	6	31	63
	Q9-HELPED TO UNDERSTAND CHILD'S BEHAVIOR	0	19	81
	Q10-TAUGHT ME HOW TO COMFORT CHILD	6	25	69
	Q11-INFORMED OF MY QUALITY OF CHILD CARE	0	19	81
	Q12-RESPONDED TO MY CONCERNS	6	32	62
	Q13-SHOWED CONCERN FOR MY WELLBEING	12	32	56
	Q14-TOLD ME NAMES & JOBS OF STAFF	6	38	56
	Q15-GAVE GOOD CARE TO MY CHILD	6	19	75
	Q16-ENCOURAGED MY QUESTIONS	13	6	81
	Q17-SENSITIVE TO MY CHILD'S NEEDS	0	19	81
	Q18-INVOLVED ME IN MY CHILD'S CARE	12	44	44
	Q19-SHOWED THAT THEY LIKE MY CHILD	6	19	75
	Q20-TIMELY RESPONSE TO CHILD'S NEEDS	25	12	63
	Q21-WERE OPTIMISTIC ABOUT MY CHILD	6	19	75
	Topic category (column) means	7	25	68
PHYSICAL FACILITY	Q22-PARENT COMFORTABLE VISITING	12	82	6
	Q23-FAMILY COMFORTABLE VISITING	13	81	6
	Q24-ADEQ. PRIVACY FOR BONDING	6	94	0
	Q25-ADEQ. PRIVACY FOR BREASTFEEDING	0	75	25
	Q26-NOISE DISTURBED CHILD	56	0	44
	Q27-COULD CONTROL LIGHT	0	100	0
	Q28-MET OTHER PARENTS	56	6	38
	Q29-OTHER PARENTS MADE STAY EASIER	50	25	25
	Q30-NURSES EASY TO REACH	31	31	38
	Q31-ABLE TO RELAX WITH CHILD	6	94	0
	Topic category (column) means	23	59	18

Abbreviation: SFR, single family room.

Physical aspects of the two facilities revealed areas in which both staff subgroups agreed. Regarding the issues of meeting Health Insurance Portability and Accountability Act (HIPAA) guidelines, noise disturbance, lighting control, problematic foot traffic and general privacy, both staff subgroups preferred the SFR facility over the OPEN unit. SFR preferences on these issues were apparent with both surveys.

Major differences were observed between the *MD/NP* and *Nurse* subgroups regarding interpersonal communication topics. These differences persisted through both surveys. *Nurses* perceived communication among coworkers to be more difficult and

coworker access to be less convenient in the SFR. They also found the SFR environment to be less conducive to mutually supportive communication among parents, and all parental groups affirmed this communication problem.

Discussion

Although the survey questionnaire has become an established tool for measuring staff and parental opinions regarding NICU design issues, it is essential to emphasize that data compiled from such

Table 4 Staff survey group demographics

Demographic criterion	OPEN		SFR ^a	
	n	%	n	%
<i>Employment position</i>				
MD/NP	5	10	6/5	15/9
Nurse manager	1	2	1/1	2/2
Nurse	42	88	34/52	83/89
<i>NICU experience (Nurses)</i>				
< 10 years	25	60	21/36	62/69
> 10 years	17	40	13/16	38/31

Abbreviations: NICU, neonatal intensive care unit; SFR, single family room.

^aSurvey #1/Survey #2.

questionnaires measure only the perceptions of polled individuals regarding a given topic. These perceptions can be influenced by the different experiential backgrounds of individual participants¹ and can introduce biases into any interpretations. Consequently, this study protocol collected sufficient demographic data with all surveys to allow better identification of trends, both negative and positive, that appeared with each demographic subgroup of participants.

White³ and Walsh *et al.*,⁹ recognized that the 'evolution' of NICU design from multi-patient, open wards toward SFRs was paradoxical in its effects on parents, hospital staff and administrators. Although favoring neonates and their parents by providing increased environmental control and privacy, it disadvantaged staff by isolating them from coworkers and patient charges and placed greater demands on hospital administrators for increased space and financial commitments. This study supported, in part, these contradictory effects while showing that subsets of parental and staff subjects varied in their perceptions of the two NICU designs.

Parental perceptions and subject naiveté

Whenever the perceptions of inexperienced subjects are polled, data interpretation should take into consideration some degree of naiveté. In this study, the *inexperienced* parents' perceptions of staff performance had naiveté bias. Simply averaging the responses of *inexperienced* parents to questions pertaining only to staff performance produced highly favorable ratings with means of 4.7 of 5 in the OPEN and a comparably high 4.6 in the SFR. Averaging the responses to the same questions from the *transitional* parent group, who had observed both facilities, showed that only 7% found staff performance to be better in the open bay. Even with the specific issue of 'timely response to needs', 63% of the *transitional* parents saw no difference between the two facilities. In fact, this was the only aspect of staff performance in which the open bay facility received noteworthy preference with this control group.

Although this suggests a degree of naiveté, it is probably not the only factor influencing these data. The fact that 68% of these experienced parents found no difference in staff performance in the two units also suggests that staff, even with no additional hires, were able to sustain a perceptibly high level of patient care in the larger SFR facility. Thus, both staff adaptability and parental naiveté were likely operative and impossible to separate quantitatively through this study protocol.

Parental naiveté was also evident with questions regarding physical aspects of the two facilities. Even the *long stay*, *inexperienced* parents gave the OPEN and the SFR units comparably high average scores of 3.8 and 4.1, respectively. When experienced, *transitional* parents' responses to the same question block were averaged, 59% preferred the SFR facility with only 18% seeing them as similar. Carter *et al.*,⁴ surveyed *transitional* parents with an abbreviated questionnaire and found them to be appreciative of the advantages of an SFR facility. Clearly, parents with experience in both NICU designs prefer the SFR environment.

Staff perceptions favoring SFRs

Separating staff into *MD/NP* and *Nurse* subgroups revealed noteworthy similarities in perceptions of the SFR design. Both subgroups agreed that the SFR facility was superior when privacy for breastfeeding and bonding, HIPAA compliance and environmental quality topics were queried. On issues regarding the work environment and parental involvement, their perceptions diverged, with only the *MD/NP*'s favoring the SFR. This finding was unexpected because previous literature reports of similar transitions found nurses to be generally favorable regarding the SFR design with only modest concerns for workload issues.^{9,10}

This perceptual divergence between the two study subgroups may have had an experiential basis; the second survey, after 18 months' acclimation, showed some convergence of opinion regarding the SFR. Physicians have been accustomed through training to treating critically ill patients in private room environments. Nurses were more likely to have been trained in open bay units because of the relative scarcity of SFR facilities. Differences in health-care roles could also have contributed to their perceptual differences. The workloads of *MD/NP* staff are less influenced by the physical environment than are those of neonatal *Nurses*. Specifically, the larger facility, with its isolation from coworkers and greater dependence on electronic communication and monitoring, would have been a more drastic departure from the experiential norm for nurses and could have negatively influenced their perceptions of the SFR unit.

Staff perceptions favoring the open bay

After 18 months acclimation, the *MD/NP* subgroup trended toward favoring the open bay environment only on patient care issues regarding adequacy of patient attention and early detection of medical crises. Although statistically insignificant, this trend may

Table 5 Staff perceptions by employment position

Topic category	Staff survey question <i>(1 = almost never, 5 = almost always)</i>	Staff subgroup					
		MD/NP ^a			Nurse ^a		
		OPEN	SFR	P level	OPEN	SFR	P level
WORK ENVIRONMENT	Q10-WORK PHYS. DEMANDING	3.3	3.1/2.9	0.731/0.278	2.8	3.1/3.1	0.113/0.011*
	Q11-WORK MENT. STRESSFUL	3.5	3.4/3.7	0.836/0.534	3.3	3.5/3.4	0.281/0.494
	Q12-WORK REWARDING	4.2	4.1/4.3	0.945/0.836	4.2	3.6/4.1	0.003*/0.485
	Q13-COWORKERS OPEN TO IDEAS	3.7	3.9/3.9	0.678/0.628	3.7	3.3/3.5	0.022*/0.132
	Q14-WORKLOAD MANAGEABLE	3.3	3.9/3.9	0.234/0.235	4.2	3.7/4.0	0.003*/0.101
	Q34-STAFF WILLING TO ASSIST	3.7	4.3/4.1	0.181/0.278	4.7	4.2/4.3	0.002*/0.006*
	Topic category (column) means	3.6	3.8/3.8		3.8	3.6/3.7	
PARENTAL INVOLVEMENT	Q17-CONVEN. PARENT VISITS	3.7	4.3/4.7	0.181/0.014*	4.2	4.4/4.5	0.155/0.010*
	Q18-PARENTS AVAILABLE	3.3	3.7/3.7	0.295/0.199	3.4	3.2/3.1	0.038*/0.008*
	Q19-PARENT PREPARED FOR CARE	3.8	4.3/3.9	0.295/0.945	4.1	3.8/3.8	0.026*/0.019*
	Q20-PARENT INVOLVED IN CARE	3.8	4.4/4.0	0.181/0.628	4	3.8/3.8	0.154/0.177
	Q21 AT EASE DISCUSSING COND.	4.2	4.3/4.3	0.836/0.836	4.1	4.0/4.1	0.155/0.459
	Topic category (column) means	3.8	4.2/4.1		4.0	3.8/3.9	
PATIENT CARE	Q15-ADQ. CARE FOR I.C. PATIENT	4.3	4.3/4.3	0.836/0.836	4.6	4.0/4.3	<0.001*/0.014*
	Q16-ADQ. PATIENT ATTENTION	4.2	4.4/4.1	0.628/0.945	4.3	3.5/4.0	<0.001*/0.013*
	Q35-MED. CRISES SEEN EARLY	4.2	4.1/4.0	0.945/0.628	4	3.6/3.6	0.001*/0.002*
	Topic category (column) means	4.2	4.3/4.1		4.3	3.7/4.0	
<i>PHYSICAL FACILITY</i>							
ENVIRON. QUALITY	Q26- LIGHTING CONTROLLABLE	3.2	4.3/3.9	0.022*/0.181	3.5	4.0/4.0	0.015*/0.006*
	Topic category (column) means	3.2	4.3/3.9		3.5	4.0/4.0	
	Q25-NOISE DISTURBS BABY	3.7	2.4/2.3	0.022*/<0.001*	3.3	2.7/2.7	0.002*/<0.001*
	Q27-FOOT TRAFFIC A PROBLEM	4.2	2.3/2.1	0.022*/0.001*	3.4	2.4/2.4	<0.001*/<0.001*
	Topic category (column) means ^b	4.0	2.4/2.2		3.4	2.6/2.6	
PRIVACY	Q22-MEET HIPAA GUIDELINES	2.5	4.7/4.6	0.001*/0.002*	3.6	4.4/3.9	0.003*/0.002*
	Q28-PRIVACY AIDS INTERACTION	2.7	4.6/4.6	0.001*/0.001*	2.9	3.9/3.9	<0.001*/<0.001*
	Q29-PRIV. FOR B'FEEDING/BONDING	2.3	4.4/4.6	0.001*/0.001*	3	4.4/4.1	<0.001*/<0.001*
	Topic category (column) means	2.5	4.6/4.6		3.2	4.2/4.0	
UTILITY	Q23-SUPPLIES READILY AVAILABLE	3.7	4.1/3.6	0.234/0.836	3.7	3.1/3.3	<0.001*/0.003*
	Q24-HANDWASHING PRACTICED	4	4.3/4.3	0.678/0.480	4.6	4.6/4.7	0.995/0.688
	Topic category (column) means	3.9	4.2/4.0		4.2	3.9/4.0	
COMMUNICATION	Q30-AIDS STAFF COMMUNICATION	3	3.7/3.9	0.138/0.035*	3.7	3.1/3.2	0.005*/0.001*
	Q31-OTHER PARENTS SUPPORTIVE	3.2	3.6/3.4	0.534/0.479	3.8	2.9/3.4	<0.001*/0.006*
	Q32-AIDS STAFF CONSULTS	3.7	4.4/4.3	0.073/0.048*	4.2	4.1/4.1	0.607/0.808
	Q33-AIDS COWORKER ACCESS	3.7	4.1/4.1	0.295/0.234	4.6	3.6/3.9	<0.001*/<0.001*
	Topic category (column) means	3.4	4.0/3.9		4.1	3.4/3.7	

Abbreviation: SFR, single family room.

^aSurvey #1/Survey #2.

^bLower scores on these questions are desirable.*Mann-Whitney Rank Sum statistical significance ($P = <0.05$).

reflect safety concerns that are addressed later in the discussion. *Nurses* shared these concerns regarding the SFR environment, and their perceptions were highly significant.

Nurses initially found every aspect of the work environment and some aspects of parental involvement to be better in the OPEN unit. Their perceptions of the SFR improved by the second survey, suggesting that some of their concerns may have been experientially based and were moderated with acclimation to the SFR unit. Of particular interest was their perception that parents were better prepared for infant care in the OPEN facility. *MD/NPs* perception of parental preparedness for care shifted more in line with that of the *Nurses* by the second survey. Although irresolvable from the survey data, this may reflect some unanticipated parental education or parent–staff communication difficulty with the SFR design.

Regarding other communication issues, the *Nurses* significantly perceived the open bay to be better for staff communication, mutual parental support and coworker access. The *MD/NP* subgroup did not share these perceptions. As these differences were resolving by the second survey, they may relate to initial dissatisfaction with the increased isolation and dependence on electronic communication in the SFR. *Nurses* also perceived the mutually supportive interactions among parents to be consistently better in the OPEN unit, and parental surveys supported their perceptions on this issue. Both the *inexperienced* and *transitional* parent surveys affirmed that inter-parental socialization and the associated development of informal peer support groups suffered in the SFR. Harris *et al.*,¹⁰ reported that while the SFR design eliminated undesirable foot traffic, parent-to-parent contact became limited to chance encounters in hallways or other public spaces. Although a parent lounge area was provided in this study's SFR unit, both *inexperienced* and *transitional* parents preferred the OPEN design for 'meeting other parents'. This finding emphasizes an inherent socialization difficulty in the SFR design that merits future attention by hospital designers and health-care administrators.

Perceptions of comparative safety

Whether the SFR is, in reality, less safe for critical patients than the open bay, or whether it is just perceived to be so, is an important issue in NICU health-care practice. Given the isolation of patient charges in separate rooms of the SFR with limited 'line of sight' and with increased dependence on electronic monitoring and communication, concerns for patient safety among staff would be expected. *MD/NP* perceptions of patient care in the two facilities were not significantly different. *Nurses'* perceptions were more definitively in favor of the open bay for early crisis detection and for managing intensive care patients. Parental surveys did not reveal major concerns with this issue. Among the experienced, *transitional* parents, only 31% felt that nurses were easier to reach in the open bay. Only 25% of this group perceived the responses to

their child's needs to be more timely in the open ward. Even the *inexperienced* parents showed no significant preference between the two facilities on these topics, and these questionnaire items should be less influenced by their naiveté.

This study focused on perceived satisfaction with the two facility designs and was not constructed to distinguish true safety issues. However, given the reduced LOS and lower 'unexpected' mortality rates observed in the SFR, we found no convincing evidence that it was less safe than the OPEN unit. Instead, patient progress appeared to be better in the SFR.

Conclusion

Survey data supported previously predicted disparate effects of NICU design on the perceptions of neonate parents and their clinical staff. It was shown that these perceptions varied with demographics and the experiential status of study participants. Although all parent groups perceived the open bay unit to be more conducive to social interaction with other parents, when physical aspects of open bay versus SFR designs were queried, parental perceptions varied with LOS. When LOS tripled, parents were more appreciative of the comfort, privacy and environmental control aspects of the SFR facility. In addition, transitional parents, familiar with both facilities, showed a strong preference for the SFR design, indicating that naiveté bias decreases as experience and LOS increase.

Inexperienced parents, who had observed only one of the two contrasting designs, evaluated staff performance extremely favorably in both facilities. That naiveté bias was minimal in these data were confirmed by comparison with experienced parents that had observed both facilities. Approximately, two-thirds of these experienced parents found staff performance 'about the same' in both facilities.

Health-care staff preferences varied with demographic subgroup. Perceptions of *MD/NP* staff generally favored the SFR unit while *Nurses* preferred the open bay. This difference was most pronounced with survey topics regarding the work environments of the two facility designs, and the initial differences diminished somewhat after 18 months in the SFR. However, both staff subgroups concurred that the SFR facility was preferable regarding issues of HIPAA compliance, environmental control, and privacy for bonding and breastfeeding. Staff perceptions reflected concerns for early detection of medical crises and adequate patient care in the SFR, suggesting an issue with patient safety in the SFR. However, reduced mortality and shortened LOS in the SFR did not support this perception, and parents did not detect significant differences in patient care between the two facilities. Consequently, in survey studies of this type, it is important to determine demographic variables and relative experience levels of survey subjects, both of which can influence data interpretations when subjective perceptions are surveyed.

Conflict of interest

The authors declare no conflict of interest.

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