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Awareness of Pediatricians About Neonatal Intensive Care Unit Quality Assurance and Unit Outcomes in Imamein Kadhymein Medical City, Baghdad

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Abstract

Background: Neonatal care standards vary widely across countries due to differences in medical practices, healthcare accessibility, and equipment availability. Neonatal intensive care unit (NICU) outcomes offer critical insights into factors influencing neonatal mortality, enabling targeted interventions to improve neonatal survival. Ongoing quality improvement initiatives are essential to enhancing care quality and minimizing complications. **Objectives:** Assess pediatricians' awareness of NICU quality assurance practices, analyze the characteristics of neonates admitted to the NICU in 2013 and 2014 and determine admission outcomes and identify contributing factors. **Methods:** This study consisted of two components: Pediatricians' Knowledge: A cross-sectional survey conducted at Imamein Kadhymein Medical City from April 15 to June 1, 2015. Pediatricians answered true/false questions, with scores ranging from 0 to 10. Neonatal Outcomes: A record-based cross-sectional analysis of NICU admissions between January 2013 and December 2014. Data included mortality rates and case fatality rates (CFR). Chi-square tests evaluated relationships between variables, with statistical significance set at $P \leq 0.05$. **Results:** Pediatricians' Awareness: The most frequent knowledge score among pediatricians was 7. Neonatal Outcomes: Of the admitted neonates (n = 1,694): 640 (37.8%) were discharged in good health. 624 (36.8%) were referred to pediatric or other hospital wards. 370 (21.8%) died. 19 (1.1%) were transferred to other hospitals. 41 (2.4%) were discharged on parental responsibility. Case Fatality Rates (CFR): The highest CFR occurred in cases of congenital anomalies (61.1%), while the lowest was among respiratory distress syndrome (RDS) cases (17%). Significant associations were observed between outcomes and gestational age, prematurity, and mode of delivery ($P = 0.0001$). **Conclusions:** Two-thirds of pediatricians demonstrated good knowledge of NICU quality assurance practices. Admission outcomes and contributing factors were identified, with significant associations between neonatal outcomes and gestational age, birth weight, and delivery type. This underscores the importance of targeted quality assurance measures in NICUs.

Key words: Awareness, Pediatricians, Neonatal Intensive Care Unit, Quality Assurance, Unit Outcomes, Baghdad.

1. Introduction

Definition and Levels of NICU The Neonatal Intensive Care Unit (NICU) is a tertiary healthcare facility providing specialized care for critically ill neonates【1】. According to the National Center for Statistics, NICUs are equipped for continuous mechanical ventilation support for newborns【2】

NICU levels of care vary significantly. The American Academy of Pediatrics (AAP) defines four levels based on equipment availability and staff expertise:

1. **Level I (Well Newborn Nursery):** Care for stable term newborns (≥37 weeks) and some preterm infants (35–37 weeks) until transfer if required. Care is provided by pediatricians and advanced practice nurses.
2. **Level II (Special Care Nursery):** Manages neonates ≥32 weeks or ≥1500 grams and moderately ill cases. Includes pediatric hospitalists and neonatologists.
3. **Level III (NICU):** Offers comprehensive care for neonates <32 weeks, <1500 grams, or critically ill newborns with specialized subspecialists【3】【4】.
4. **Level IV (Regional NICU):** Includes all Level III services plus advanced surgical interventions[4]

In other countries, NICU levels differ. For instance, the UK uses a three-level system, with Level 3 units managing the smallest, most premature, or critically ill neonates. In India, care levels are based on weight and gestational age, ranging from home-based care for stable neonates to specialized care for those <1200 grams or <30 weeks【2】【4】.

Guidelines and Quality Assurance

Globally, NICU care standards are diverse due to variations in medical practices and healthcare resources. Organizations like WHO and UNICEF emphasize the importance of standardization for effective neonatal care【5, 6】. The AAP's comprehensive guidelines for perinatal care advocate for consistent protocols to improve outcomes【7】. Quality assurance plays a pivotal role in enhancing NICU standards. Effective plans involve multidisciplinary teams, protocol development, outcome monitoring, and strategies to address complications such as medication errors, which contribute significantly to iatrogenic issues【8】.

Neonatal Mortality and Outcomes

Understanding NICU outcomes helps identify factors influencing neonatal mortality and provides insights for targeted interventions【9】. Neonatal mortality rates vary by region; for instance, Iraq's neonatal mortality rate was 19 per 1000 live births in 2014, higher than many developed countries【10】. In developing nations, neonatal deaths often result from respiratory distress syndrome, congenital anomalies, infections, and complications related to low birth weight【11】.

Iraq faces significant challenges in neonatal care. A 2016 report by the Ministry of Health and UNFPA highlighted gaps in emergency obstetric and neonatal services, with many facilities not meeting international standards【12】. Addressing these issues is essential to reducing neonatal mortality.

Objectives of the Study

1. Evaluate pediatricians' awareness of NICU quality assurance at Imamein Kadhymein Medical City.
2. Examine the characteristics of neonates admitted to the NICU during 2013–2014.
3. Assess admission outcomes and identify contributing factors.

Methodology:

Study Design: The study comprised two components:

1. Awareness of Pediatricians About NICU Quality Assurance: A cross-sectional survey.
2. Analysis of Admitted Neonates: A retrospective, record-based cross-sectional study.

Study Setting

The research was conducted at Imammein Kadhymein Medical City from April 15 to June 1, 2015. Neonatal records from January 2013 to December 2014 were reviewed.

NICU Infrastructure

The assessment included:

- Physical setup: Area, proximity to delivery and operating rooms, and availability of incubators, phototherapy devices, radiant warmers, weighing scales, and oxygen supply.
- Hygiene and safety measures: Availability of 24-hour soap and water, use of special gowns, masks, caps, and slippers.

Human Resources: The study evaluated:

- Number of doctors in the unit.
- Training duration in NICU.
- Bed-to-doctor ratio and daily bed occupancy rates.

Sample:

Part 1:

Fifty pediatricians working in Imammein Kadhymein Medical City were surveyed using a self-reporting questionnaire of 10 true/false questions. The questions were developed based on NICU guidelines by the British Association of Perinatal Medicine and included job descriptions, qualifications, and training duration in NICU. Scores ranged from 0 (all incorrect answers) to 10 (all correct).

Part 2:

Medical records of all neonates admitted to the NICU were reviewed, capturing details on gender, gestational age, weight, NICU stay duration, delivery type, cause of admission, and outcomes.

Statistical Analysis:

Data from both components were analyzed as follows:

1. **Pediatricians' Awareness:**

- Descriptive statistics (frequencies, percentages) were used to summarize job roles, training duration, and knowledge scores.
- Chi-square tests assessed the relationship between variables and pediatricians' knowledge.

2. Neonates' Admissions:

- Descriptive statistics (frequencies, percentages, means, standard deviations) summarized admission characteristics.
- Admission rate: Number of admissions divided by total live births during the study period.
- Mortality rate: Number of deaths divided by total admissions.
- Case fatality rate: Deaths due to a specific cause divided by admissions for that cause.
- Proportional death rate: Deaths from a specific cause divided by total deaths.
- Chi-square tests analyzed associations between outcomes and study variables.

All analyses were conducted using SPSS version 16, with a significance threshold of $P < 0.05$.

Ethical Considerations

- Approval was obtained from Imammein Kadhymein Medical City to access NICU records.
- Verbal consent was secured from pediatricians before distributing the questionnaire.

Results:

Input: Infrastructure

The NICU at Imamein Kadhymein Medical City is located 10 meters from the operation and delivery rooms, occupying a 105-square-meter area. It includes 27 incubators (21 functional), 2 intensive phototherapy incubators, 1 radiant warmer, 10 phototherapy units, 1 weighing scale, and 22 oxygen supplies. There is no dedicated generator, but 4 functional air conditioners and 24-hour soap and water availability support the unit. Staff adheres to infection control practices by wearing gowns, masks, caps, and slippers.

Human Resources: The NICU team comprises 2 senior pediatricians with 2 years of training and 4 residents trained for at least 6 months. The bed-to-doctor ratio is 3.5:1, and the nurse-to-bed ratio is 1.2:1. Bed occupancy was 90%, with 2 beds reserved for emergencies.

Awareness and Knowledge: Among 50 surveyed pediatricians, 44% scored 7 out of 10 on the NICU quality assurance questionnaire, while only 2% scored 4 or below. Senior doctors achieved higher scores (8–9), compared to residents with scores of 6–7. Training duration correlated significantly with higher scores ($p = 0.0001$).

Outcomes: Between 2013 and 2014, 1694 neonates were admitted to the NICU, with an admission rate of 7.38%. The male-to-female ratio was 1.6:1. respiratory distress syndrome (RDS) was the most common cause of admission (88.7%) and death (88.7%), followed by congenital anomalies (6.7% of deaths). Other causes, including sepsis, jaundice, and hypoglycemia, accounted for 4.6% of deaths.

Preterm neonates (72.7%) exceeded term admissions (27.3%), with a preterm-to-term ratio of 2.6:1. Caesarian section deliveries outnumbered normal vaginal deliveries (3:1). Low-birth-weight neonates (<2.5 kg) were more common than normal-weight neonates, with a ratio of 1.2:1. The average NICU stay was 3.89 ± 2.70 days, with 33.4% staying 1–2 days. Most neonates were discharged home (37.8%) or referred to wards (36.8%), while 21.8% died.

Case Fatality Rates: The highest case fatality rate (CFR) was among congenital anomalies (61.1%), while RDS had the lowest (17%). CFR was significantly higher among preterm (24.1%) and low-birth-weight neonates (28.3%) compared to term (15.9%) and normal-weight neonates (14.5%) ($p = 0.0001$). Better outcomes were associated with Caesarian sections (CFR 18.5%) than normal deliveries (31.8%) ($p = 0.0001$).

Key Associations: Outcome and Gestational Age: Preterm neonates had higher CFR but fewer discharges in good health compared to term neonates.

- Outcome and Birth Weight: LBW neonates had a higher CFR.
- Outcome and Delivery Type: Caesarian sections were associated with better outcomes.

Table:1 Frequency distribution regarding scoring of questionnaire

Score	Number	Percent
9	3	6%
8	9	18%
7	22	44%
6	14	28%

5	1	2%
4	1	2%
Total	50	100%

Table:2 Scoring of each question answered by the pediatricians

Question Asked	0 Score	%	1 Score	%	Total	%
Q1: Nurse and staff to beds ratio	46	92	4	8	50	100
Q2: Direction and management of the unit	47	94	3	6	50	100
Q3: Doctors responsibility of covering 24 hrs	25	50	25	50	50	100
Q4: Laboratory service for 24-hour	1.0	2	49	98	50	100
Q5: Facilities for monitoring	1.0	2	49	98	50	100
Q6: Presence of clinical guidelines	0.0	0.0	50	100	50	100
Q7: Parents role in care	12	24	38	76	50	100
Q8: Follow up of high risk survivors' infants	20	40	30	60	50	100
Q9: Aseptic technique	2.0	4	48	96	50	100
Q10: Average occupancy	0.0	0.0	50	100	50	100

Table3: The relation of and score of Pediatrician qualification and their knowledge

Score	Degree				Total	
	Senior N	Percent	Resident N	Percent	N	Percent
4-5	0.0	0.0	2.0	100	2.0	100
6-7	1.0	2.8	35	97.2	36	100
8-9	12	100	0.0	0.0	12	100
Total	13	26.0	37	74.0	50	100

X^2= 44.947 df=2 P= 0.0001

Table 4: The relation of duration of doctors training in NICU and score of questionnaire

Score	Duration of training in months		Total
	12-30	6	N
4-5	0.0	2.0	2.0

6-7	11	25	36
8-9	11	1.0	12
Total	22	28	50

X2=15.278 df=2 P=0.000

Table 5: Characteristics of neonates admitted to the NICU during 2013-2014

Variable	Number (1964)	Percent
Year of admission:		
2013	769	45.4
2014	925	54.6
Sex		
Male	1024	61.9
Females	629	38.1
Cause of admission:		
RDS	1503	88.7
Congenital anomalies	113	6.7
Others	78	4.6
Type of delivery:		
C/S	1238	74.9
NVD	415	25.1
Gestational age:		
Term	451	27.3
Preterm	1202	72.7
Mean ± Sd(weeks)	34.29±3.284	
Duration of admission:		
<3 days	566	33.4
3-7 days	991	58.5
8-14 days	122	7.2
15-21 days	11	0.6
>21 days	3.0	0.2
Mean ± Sd (days)	3.89±2.70	
Birth Weight(Kilograms)		
< 2.5	907	54.9
≥ 2.5	746	45.1

Mean ± Sd	2.260± 0 .80213

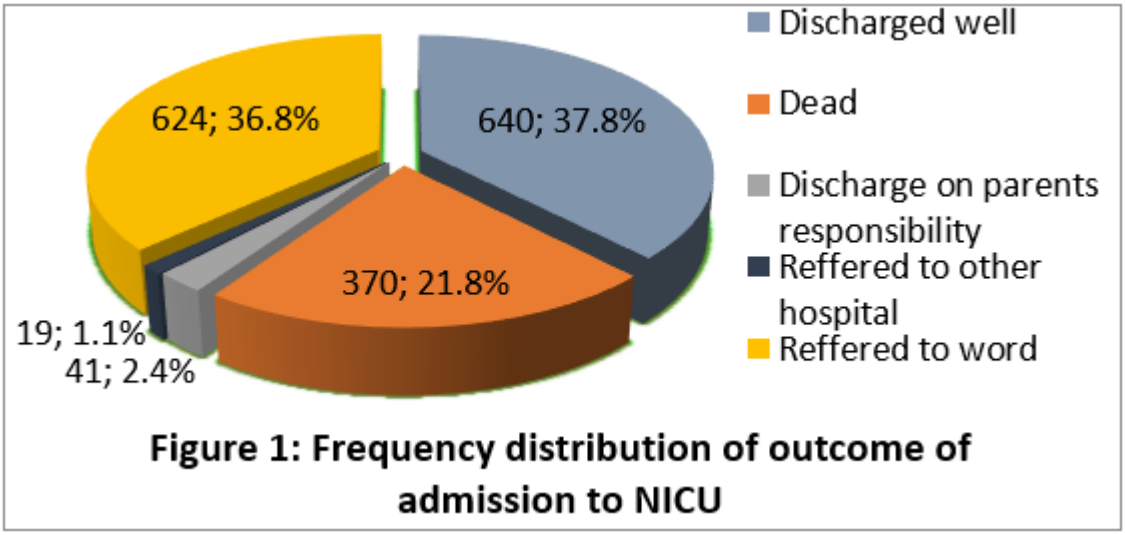

Figure 1: Frequency distribution of outcome of admission to NICU

Table 6: Mean time of staying in NICU for each cause of admission

Cause of admission	Mean time of staying in NICU by days	Sd
RDS	3.98	2.77
Congenital anomalies	3.09	2.07
Others	3.14	1.61
Total	3.89	2.70

F=8.938 P=0.0001

Table 7: Distribution of the outcome according to the cause of admission in NICU

Causes of admission	Outcome											
	Dead		Good		Discharged on P. Respon.		To other hospital		To Ward		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
RDS	256	17	609	40.5	41	2.7	8	0.5	589	39.2	1503	100
Congenital anomalies	69	61.1	13	11.5	0.0	0.0	11	9.7	20	17.7	113	100
Others	45	57.7	18	23.1	0.0	0.0	0.0	0.0	15	19.2	78	100
Total	370	21.8	640	37.8	41	2.4	19	1.1	624	36.8	1694	100

X^2 =2.750 df= 8 P value= 0.0001

Table 8: Distribution of the outcome according to the gender

Gender	Outcome											
	Dead		Good		Discharged on P. Respon.		To other hospital		To Ward		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Male	226	21.6	413	39.4	23	2.2	8	0.8	377	36.0	1047	100
Female	144	22.3	277	35.1	18	2.8	11	1.7	247	38.2	647	100
Total	370	21.8	640	37.8	41	2.4	19	1.1	624	36.8	1653	100

X^2= 6.296 df= 4 P = 0.178

Table9: Mean (duration, gestational age and birth weight) among outcome of NICU

Outcome	Variable					
	Duration of Stay (days)		Gestational Age (Weeks)		Birth Weight (Kg)	
	Mean	Sd	Mean	Sd	Mean	Sd
Dead	3.2	02.1	32.1	4.19	1.8	0.94
Good	3.8	2.37	35.7	1.99	2.6	0.62
Discharged on P. Response	2.8	1.35	35.5	2.29	2.4	0.59
To other hospital	2.8	0.73	34.0	2.51	2.4	0.72
To Ward	4.3	3.09	34.0	3.03	2.09	0.72
Significance	F=14.407 P=0.0001		F=88.2 P=0.0001		F=75.85 P=0.0001	

Table: 10 Outcome distribution according to the gestational age in the NICU

Gestational age	Outcome											
	Dead		Good		Dischargd on P. Respon.		To other hospital		To Ward		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Preterm	296	24.1	407	33.1	27	2.2	15	1.2	484	39.4	1229	100
Term	74	15.9	233	50.1	14	3.0	4	0.9	140	30.1	465	100

Total	370	21.8	640	37.8	41	2.4	19	1.1	624	36.8	1964	100

X2=45.281 d f=4 P value=0.0001

Table:11 Outcome distribution according to weight.

Weight in kg	**Outcome**											
	Dead		Good		Discharged on P. Respon.		To other hospital		To Ward		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
<2.5	262	28.3	229	24.7	19	2.1	8	0.9	408	44.1	926	100
2.5-5	108	14.1	411	53.5	22	2.9	11	1.4	216	28.1	768	100
Total	370	21.8	640	37.8	41	2.4	19	1.1	624	36.8	1964	100

X^2=1.623 df=4 P value=0.0001

Table :12 Distribution of outcome according to type of delivery

Type of delivery	**Outcome**											
	Dead		Good		Discharged on P. Respon.		To other hospital		To Ward		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
C/S	235	18.5	542	42.7	31	2.4	15	1.2	446	35.1	1269	100
NVD	135	31.8	98	23.1	10	2.4	4	0.9	178	41.9	425	100
Total	370	21.8	640	37.8	41	2.4	19	1.1	624	36.8	1964	100

X2=62.21 df=4 P value=0.0001

Discussion

Developing clinical guidelines is a cornerstone for improving healthcare quality by minimizing variation, enhancing outcomes, and reducing harm and costs【13】. Pediatricians' awareness of technical and adaptive strategies is essential to ensure patient safety【14】. In this study, all pediatricians recognized the importance of clinical guidelines despite the absence of written protocols in Imammein Kadhymein Medical City. Over-admission for observational purposes in the NICU increased the workload and bed occupancy rates, adversely affecting the quality of care. The bed occupancy rate in this study was 90%, aligning with reports from India, where occupancy ranged from 28% to 155%【15】. Admission policies are critical for optimizing NICU performance, yet many pediatricians lacked awareness of bed-to-nurse ratios and unit management, significantly affecting NICU outcomes【16】.

Hand hygiene is crucial for infection control, as healthcare-associated infections are a major concern in NICUs. Studies indicate that proper hand hygiene effectively reduces pathogen transmission and improves care quality【17】. A significant portion of pediatricians in this study showed awareness of infection control practices and the importance of aseptic techniques, as well as the availability of 24-hour laboratory services. Follow-up care for high-risk infants is essential, and parents must be actively involved in neonatal care. Breastfeeding benefits are undeniable, and facilities like milk expression areas should be readily available【18】. More than half of the pediatricians in this study were aware of the importance of follow-up and parental involvement in neonatal care.

NICU training plays a pivotal role in equipping residents to manage preterm infants and their long-term complications, emphasizing the importance of residency programs focused on developmental, pulmonary, and nutritional challenges【19】. The findings showed a significant correlation between high knowledge scores and longer NICU training durations. However, the absence of standardized care definitions and variations in training effectiveness may affect neonatal outcomes【4】【20】.

The admission rate to NICU in this study was 7.38%, slightly higher than the 6.29% reported in Iran【21】. The male-to-female ratio (1.6:1) matched previous studies in Baghdad and Iran【21】【22】. Respiratory distress syndrome (RDS) was the leading cause of admission (88.7%) and mortality (88.7%), consistent with global findings showing RDS as a significant contributor to neonatal mortality, particularly among preterm newborns【23】.

Other causes, such as sepsis, jaundice, asphyxia, and hypoglycemia, represented 5.1% of admissions and 4.6% of deaths, rates lower than those reported in similar studies【9,24】 Congenital anomalies accounted for 6.2% of admissions and 6.7% of deaths, lower than figures reported in Baghdad and Mosul but comparable to WHO estimates for South-East Asia【24,25】. Preterm neonates constituted 72.7% of admissions, higher than term neonates (27.3%), a finding consistent with other studies【26】. The mean NICU stay was 3.8 ± 2.7 days, shorter than the 15.5 days reported in Mosul【27】. The admission ratio of low-birth-weight neonates to normal-weight neonates was 1.2:1, similar to prior research【24】. Mortality in this study (21.8%) was lower than earlier reports from the same hospital (36.6%) but comparable to rates in Saudi Arabia (22.4%) and slightly higher than studies in Baghdad (19.2%) and India (18.69%)【23】【26】【27】. Case fatality rates were highest among congenital anomalies (61.1%) and lowest among RDS cases (17%). The significant association between admission outcomes, gestational age, birth weight, and delivery type highlights the need for targeted interventions【28-31】.

Conclusion

1. Two-thirds of pediatricians demonstrated good knowledge about NICU quality assurance.

2. RDS was the most common cause of admission, followed by congenital anomalies and other conditions like sepsis and jaundice.
3. The highest case fatality rate occurred in congenital anomalies, with the lowest in RDS, showing a significant association between causes of admission and outcomes.
4. Significant associations were observed between neonatal outcomes and factors such as gestational age, birth weight, and delivery type.

Recommendations

1. Implement clinical guidelines to improve NICU quality assurance.
2. Enhance pediatricians' training in essential newborn care to reduce neonatal mortality.
3. Focus on specialized care for preterm and low-birth-weight neonates, particularly those with respiratory conditions.
4. Strengthen Emergency Obstetric and Neonatal Care (EmONC) services to improve maternal and neonatal health outcomes.

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