A Study of Drug Utilization Pattern in Neonatal Intensive Care Unit (Nicu) In a Tertiaty Care Hospital

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ABSTRACT

BACKGROUND: Neonatal intensive care management (NICM) may be required for high risk or critically ill neonates for survival or stabilization. Apart from various life support systems, NICM involves the use of different classes of drugs, and the pattern of use mainly determined by the prevailing clinical conditions and complications, and the desired therapeutic objectives. As there are few systemic studies reported in the Indian literature, the present study was taken up. **OBJECTIVES:** To study the pattern of drug use in NICM, criteria for drug selection and dose individualization, to assess the efficacy and safety of medications and record drug interactions. **METHODS:** The pattern of drug use was assessed prospectively in 500 consecutive subjects admitted to NICU. The number of drugs used, therapeutic class, dose, route, frequency and duration of administration, the purpose of use, criteria for selection were recorded. The efficacy and safety of the medications was assessed by the treatment outcome and observing for any adverse events or drug interactions. **RESULTS:** Different therapeutic classes of drugs were used as per the prevailing clinical conditions or complications. The total number of drugs available for prescription from different class of drugs was 18, with an average of 3.6 per subject. Anti microbial agents (AMAs) were the most commonly used drugs, chosen empirically and used in combination for prophylaxis or control of infections. Other classes of drugs were used for specific indications. The treatment outcome was very good in most of the subjects and no drug related adverse events or interactions were observed. **INTERPRETATION AND CONCLUSION:** Most of the problems and complications in high risk and critically ill neonates can be prevented or controlled by judicious use of several classes of drugs, properly chosen and individualized to the given situation, without producing serious adverse events and interactions. Drugs play an important role in improving the outcome.

KEYWORDS: NICU; NICM; AMAs

INTRODUCTION

Medicines have a vital role in health care system, disease prevention and cure. The availability and affordability of good quality drugs along with rational prescribing is needed worldwide and especially in a developing country like India. Although the paradigm shift from empirical approach to evidence based medicine is a reality in the western countries, a meticulous review of the existing literature reveals the problem of irrationality of prescription is still prevalent in the developing countries because of their empirical approach compounded by economic constraints of the patients[1].

Neonates are a special group of population for dosing because they have a rapidly changing body surface area and weight; a rapidly developing system of drug absorption, metabolism and excretion and inability to communicate with the provider. They are more prone to develop adverse drug reactions as they have deficiency of metabolizing enzyme, immature excretion of the drug[2]. Besides, due to economic and ethical issues, children do not often participate in clinical trials, and specific knowledge about the effect of drugs in children is often inadequate[3].

Though the number of the hospitals with NICU facilities is increasing in India, there are no standard guidelines for drug prescribing in NICM in most of the hospitals. Since there are a very few systematic studies and reports from Indian hospitals regarding the overall pattern and extent of drug utilization in NICM, the present study is taken up with the purpose of generating some valid data and useful information for improving the quality of neonatal care.

METHODOLOGY:

1. Study subjects:

Neonates admitted to NICU of tertiary care Hospital, Raichur and receiving one or more medications were included in the present study. Approval and clearance from the Institutional Ethics Committee was obtained before starting the study.

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Written informed consent was obtained from parents/ legal representatives of all the study subjects after fully explaining the study procedure to their satisfaction, in both English and vernacular language.

Sampling:
    Systematic sampling method, involving 500 neonates receiving one or more medications.
2. **Inclusion criteria:**
    a. All neonates admitted to NICU and receiving one or more medications.
    b. Willingness of parents / legal representatives to give written informed consent.
3. **Exclusion criteria:** Neonates not receiving any medications other than fluids/electrolyte solution, parenteral nutrition, nutritional supplements, blood and blood products, oxygen, phototherapy, vitamin K prophylaxis, vaccinations or ophthalmic prophylaxis.
    Neonates who were discharged or died within 24hrs of NICU admission

RESULTS

(A) DEMOGRAPHIC DATA
TABLE 1: Distribution of subjects according to age at the time of admission out of 500

Age at Admission (days)	Number	Percentage
1 to 7	194	38.8
8 to 14	171	34.2
15 to 21	97	19.4
22 to 28	38	7.6
Total	500	100
Mean ± SD = 3.76 ± 2.55		

TABLE 2: Distribution of subjects according to gestational age out of 500 cases

Gestational Age (weeks)	Category	Number	Percentage
< 28	Extremely Preterm	8	1.6
28 to 32	Very Preterm	39	7.8
32 to 37	Late Preterm	97	19.4
37 to 42	Term	342	68.4
> 42	Post-term	14	2.8
Total		500	100.0
Mean ± SD = 37.16 ± 2.33			

TABLE 3: Distribution of subjects according to gender out of 500 cases

Gender	Number	Percentage
Males	279	55.8
Females	221	44.2
Total	500	100

TABLE 4: Distribution of subjects according to place of birth out of 500 cases

Place of Birth	Number	Percentage
Inborn	483	96.6
Outborn	17	3.4
Total	500	100

TABLE 5: Distribution of subjects according to birth weight out of 500 cases

Birth weight	Number	Percentage
1-1.4	9	1.8
1.5-1.9	106	21.2
2-2.4	219	43.8
2.5 - 2.9	134	26.8
>3	32	6.4
Total	500	100
Mean ± SD = 2.43 ± 0.88		

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TABLE 6: Distribution of subjects according to socio-economic status out of 500 cases

Socioeconomic Status	Number	Percentage
Upper	0	0
Upper middle	56	11.2
Lower middle	56	11.2
Upper lower	86	17.2
Lower	302	60.4
Total	500	100

TABLE 7: Distribution of subjects according to religion out of 500 cases

Religion	Number	Percentage
Hindu	406	81.2
Muslim	63	12.6
Christian	31	6.2
Total	500	100

(B) CLINICAL DATA

TABLE 8: Distribution of subjects according to APGAR SCORE out of 500 cases

Agpar Score	1min	%	5min	%
<3	128	25.6	13	2.6
4-6	228	45.6	155	31
>7	144	28.8	332	66.4
Total	500	100	500	100
	Mean ± SD = 5.86 ± 2.58		Mean ± SD = 7.56 ± 2.31	

TABLE 9: Distribution of subjects according to mode of delivery out of 500 cases

Mode of Delivery	Number	Percentage
Normal Delivery	325	65
Caesarean Section	165	33
Instrumental Delivery	10	2
Total	500	100

TABLE 10: Distribution of subjects according to maternal age out of 500 cases

Maternal Age	Number	Percentage
<20 years	59	11.8
20-24 years	254	50.8
25-29 years	120	24
30-34 years	45	9
35-39	13	2.6
>40	9	1.8
Total	500	100
Mean ± SD = 22.86 ± 3.11		

TABLE 11: Distribution of subjects according to parity out of 500 cases

Parity	Number	Percentage
1	284	56.8
2	172	34.4
3	42	8.4
4	2	0.4
Total	500	100

TABLE 12: Distribution of subjects according to maternal morbidity

Maternal Morbidity	Number
Anaemia	266
PIH	16

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Psychiatric disorders	10
GDM	9
PROM	5
Polyhydramnious	4
Antepartum Haemorrhage	4
Renal disorders	4
Cardiovascular Disorders	3
Epilepsy	3
Thyroid Disorders	2
TORCH Infections	2
Nil	172

TABLE 13: Distribution of subjects according to indications for NICU admission

Indications	Number
Hyper bilirubinemia	92
Meconium aspiration syndrome	67
Birth asphyxia	62
Seizures	50
Preterm	35
Respiratory distress syndrome	16
Fever	14
CHD	6
Renal Failure	5
Congenital malformations	3
Sepsis	3

TABLE 14: Distribution of subjects according to duration of stay

Duration of stay (Days)	Neonates	Preterm
1 to 4	176	9
5 to 8	111	7
9 to 12	138	11
13 to 16	34	3
17 to 20	35	2
21 & above	6	3
Mean ± SD = 7.66 ± 4.42		

(C) MEDICATION DATA

TABLE 15: Exposure rates for different class of drugs

Drug Class	Number of Subjects	Percentage
Antimicrobial Agents	487	97.4
Gastrointestinal Drugs	296	59.2
Cardiovascular drugs/Diuretics	130	26.0
Miscellaneous Drugs	113	22.6
Respiratory System Drugs/Steroids	112	22.4
Anti-Convulsant agents	89	17.8

TABLE 16: Class of drugs used in neonates

Drug Class	Number of Drugs	Percentage
Antimicrobial Agents	9	50.0
Cardiovascular Drugs/Diuretics	3	16.7
Anti-Convulsant Drugs	2	11.1
Respiratory System	2	11.1

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Drugs/Steroids		
Gastrointestinal Drugs	1	5.6
Miscellaneous	1	5.6
Total	18	100.0

TABLE 17: Distribution according to number of drugs used per subject

Number of drugs used	Number of subjects	Percentage
2	145	29.0
3	185	37.0
4	77	15.4
5	56	11.2
6	17	3.4
7	16	3.2
8	4	0.8
Mean ± SD = 3.66 ± 0.42		

(D) PATTERN OF DRUG USAGE

TABLE 18: Distribution of subjects according to usage of gastrointestinal drugs

Gastrointestinal Drugs			
Generic name with dosage	Duration Mean + SD	No. of subjects	Intended purpose
Ranitidine 0.5mg/kg IV BID	5.8 + 1.4 days	295	Stress ulcer

TABLE 19: Distribution of subjects according to usage of Antimicrobial Agents

Antimicrobials Agents			
Generic name with dosage	Duration Mean + SD	No. of subjects	Intended purpose
Cefotaxime 50mg/Kg IV BID	6.3 + 1.5 days	334	Prophylactic/Therapeutic
Amikacin 7.5mg/Kg IV BID	5.8 + 1.4 days	170	Therapeutic
Piperacillin + Tazobactum 100mg IV BID	6 + 1.4 days	77	Prophylactic/Therapeutic
Ampicillin 50mg/kg IV BID	5.7 +1.2 days	59	Prophylactic/Therapeutic
Meropenem 20 mg/kg IV BID	5.8 + 1.4 days	40	Therapeutic
Ceftriaxone 50mg/kg IV BID	6.4 + 1.3 days	20	Prophylactic/Therapeutic
Cefepime 50 mg/kg IV BID	5.6 + 1.5 days	20	Prophylactic/Therapeutic
Metronidazole 7.5mg/kg IV TID	6.2 + 0.4 days	10	Therapeutic
Amoxicillin +Clavulanic Acid 50mg IV BID	5.7 + 0.9 days	4	Therapeutic

TABLE 20: Distribution of subjects according to usage of cardiovascular drugs

Cardiovascular Drugs			
Generic name with dosage	Duration Mean + SD	No. of subjects	Intended purpose
Dopamine 15mcg/kg/min	2.7 + 0.9 days	89	Hypotension
Adrenaline 0.01mg/kg	2.2 + 1.6 days	46	Hypotension
Frusemide 1mg/kg IV BID	5.7 + 0.8 days	24	Volume overload

TABLE 21: Distribution of subjects according usage of respiratory drugs

Respiratory Drugs			
Generic name with dosage	Duration Mean + SD	No. of subjects	Intended purpose
Aminophylline:- Loading dose -6mg/Kg IV, Maintenance dose -2mg/kg IV TID	5.9 + 1.6 days	90	Bronchodilator

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Dexamethasone 0.25mg/kg IV BID	5.5 + 1.0 days	24	RDS

TABLE 22: Distribution of subjects according to usage of anti-convulsant drugs

Anti-convulsant Drugs			
Generic name with dosage	Duration Mean + SD	No. of subjects	Intended purpose
Phenobarbitone 5mg/kg IV BD	5.7 + 1.3 days	63	anticonvulsant
Phenytoin 15mg/kg IV BID	6.2 + 1.2 days	25	anticonvulsant

TABLE 23: Distribution of subjects according to usage of miscellaneous drugs

Miscellaneous Drugs			
Generic name with dosage	Duration	No. of subjects	Intended purpose
Calcium Gluconate 1mg/Kg TID	4.6 + 1.8 days	113	Hypocalcemia

TABLE 24: Distribution of subjects according to purpose of Antimicrobial agents usage

Purpose	Number	Percentage
Prophylactic	408	81.6
Control of Infection	92	18.4
Total	500	100

TABLE 25: Distribution of subjects according to criteria for initial Antimicrobial agents selection

Criteria	Number	Percentage
Empirical	464	92.8
Definitive	36	7.2
Total	500	100

TABLE 26: Distribution of subjects according to change in Antimicrobial therapy

Change in Antimicrobial agents	Number	Percentage	Reason for Change
Yes	185	37.9	Inadequate clinical response (n=79);Based on Laboratory report (n=106)
No	302	62.1	
Total	487	100	

TABLE 27: Distribution of subjects according to treatment outcome

Outcome	Number	Percentage
Improved	498	99.6
Death	2	0.4
Total	500	100.0

(E) LABORATORY DATA
TABLE 28.1: Distribution of subjects according to laboratory investigations on admission

Haematological Investigations

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Investigations	Number	Abnormal	Comments
Hemoglobin(%)	500	56	Anemia (n=52) Polycethemia (n=4)
WBC	500	122	Sepsis (n=44),Pneumonia (n=41), MAS (n=37)
RBC Count	500	113	
Platelet Count	500	16	Sepsis (n=16)
PCV	500	16	Sepsis (n=12) Anemia (n=4)

TABLE 28.2: Distribution of subjects according to biochemical investigations on admission

Biochemical Investigations			
Investigations	Number	Abnormal	Comments
Direct Bilirubin	383	131	Neonatal Jaundice
Total Bilirubin	383	108	Neonatal Jaundice
Blood Urea (mmol /l)	297	39	Sepsis(n=20); Birth Asphyxia(n=19)
Serum Creatinine	297	39	Sepsis(n=20); Birth Asphyxia(n=19)
Sodium (mEq/l)	500	24	Sepsis
Potassium (mEq/l)	500	4	Hypokalemia
Chloride (mEq/l)	500	nil	
Calcium (mmol/l)	500	47	Hypocalcemia
Thyroxine	496	4	Hypothyroidism (n=3), Hyperthyroidism(n=1)
TSH	496	4	Hypothyroidism (n=3) Hyperthyroidism (n=1)
CRP	482	97	Sepsis(n=44),MAS (n=12),Pneumonia(n=32),Preterm (n=9)
Blood Glucose	500	31	Hypoglycemia (n=25); Hyperglycemia (n=6)

TABLE 28.3: Distribution of subjects according to microbiological investigations on admission

Microbiology Investigations			
Investigations	Number	Abnormal	Comments
Blood Culture	85	16	Culture Positive for Klebseilla(n=11) ,Enterococus(n=3) ,Comensuals(n=2)
Urine Culture	117	nil	
ET tube culture	71	59	Culture Positive for Acinetobacter(n=19), Enterococcus (n=9) , E coli(n=8), Klebsiella(n=16), Staph aureus(n=7)

TABLE 28.4: Distribution of subjects according to imaging studies on admission

Imaging studies			
Investigations	Number	Abnormal	Comments
ECHO	17	7	ASD(n=2), TOF(n=1), PHT(n=1),

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			VSD (n=3)
USG	134	0	
CT scan	20	14	Hemothorax(n=2), Hydrothorax (n=2), Pneumonia(n=8), Pleural effusion(n=2)

TABLE 28.5: Distribution of subjects according to repeat biochemical investigations

Biochemical Investigations		
Repeat Investigations	Number	Abnormal
Direct Bilirubin	212	11
Total Bilirubin	212	11
Blood Urea	176	9
Serum Creatinine	176	9

DISCUSSION

The recent literatures reveals increase in drug exposure rates in pregnant women due to recent advances in prenatal care, causing infants to be exposed to usage of many different drugs, even when in utero[22][23]. Although there is a general appreciation that neonates, especially preterm neonates, have high drug utilization rates, a systematic evaluation is needed to prioritize areas in need of further pharmacotherapeutic research. This will also help document changes in the trend of medication use, define the groups of infants that are at higher risk for adverse events, and provide necessary information to estimate the costs and benefits of current NICU care[16]. The present study provides us with an overall pattern of drug use profile, the efficacy and safety of the prescribed medications which was evaluated prospectively in 500 neonates admitted in NICU in a tertiary care hospital.

Table 1 shows the post natal age of neonates on admission toNICU. The mean age in days was 3.76±2.5. Majority of the subjects (72%) were inthe age group of 1-14 days, indicating that most of the complications commonly occur at this age of neonatal period. This observation is similar to the study done by Vaniya*et al.*[24]

The mean gestational age of the admitted neonates was 37.16±2.33 weeks (**Table 2**). 68% of the subjects were of full term, 19.4% late preterm and only 7.8% being very preterm. This wasconsistent with the observations in other studies[16]. Hence it seems reasonable to assume that the gestational age and maturity may not correlate with the rate of NICU admission. In a study by Choure KM the maximum number (85%) of neonate were preterm showing trends toward preterm delivery.[25] This finding is comparable to study of Neubert *et al*(54.6%).[26]

Table 8 summarizes the **Apgar score** assessed at 1 min and 5 min after birth(n=500). The Apgar score was normal (≥7) in 28.8% of subjects at 1 min, and 66.4% of subjects at 5 min. The score was <7 in 71.2% of subjects at 1 min, and 33.6% of the subjects at 5 min. The mean score improved from 5.86±2.58 at 1 min to 7.56±2.31 at 5 min, indicating an overall improvement in the general condition.

The exposure rate for different classes of drugs is shown in **Table 15**. The highest rate of exposure was for AMAs which were used in almost 97.4% subjects (n=487). The exposure rates for other classes of drugs included GIT drugs in 59.2% subjects, cardiovascular drugs in 26% subjects, calcium gluconate in 22.6%, respiratory drugs in 22.4%, sedatives and anticonvulsants in 17.8%, The high rate of antibiotic exposure in our study is similar to studies published in the past[27] and is probably due to the standard practice of administering antibiotics pending bacterial culture results in sick neonates and is not a true reflection of the incidence of bacterial infection[16]. Most of the other studies have also shown a higher rate of exposure to AMAs[26][28][29][30][31]. The total number of medications used was 18 (**Table 16**). The different classes of drugs included AMAs(50%), cardiovasculardrugs(16.7%),sedatives/anticonvulsants/antiepileptics(11.1%), respiratorydrugs/steroids (11.1%), GIT drugs(5.6%) and miscellaneous(5.6%). Other studies also have reported a similar number and range of drugs, the most commonly used drugs being AMAs[32]. Higher incidences of antibiotic exposure in NICU could be due to the common practice of instituting emperical therapy and can be attributed to higher incidence of infections due to pollution, poor sanitation, and lower rate of literacy. However, inappropriate use of antibiotics leads to emergence of resistance[25]. **Table 17** summarizes the number of drugs used per subject which ranged from 2 to 8. The average number of drugs used per subject was 3.66±0.42. The average number of drugs used per subject was almost similar in other studies[16]. But in study done by Chatterjee *et al* the average number the average number of drugs per prescription was 4.8[33].

The pattern of drug use is presented in **Table 18-Table 23**. The gastrointestinal drugs used in the present study included Ranitidine **(Table 18)**. Ranitidine, a H2 blocker was used by IV injection forprevention of stress ulcerations in

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sick neonates (n=295). Ranitidine was the only H2 blocker used in other studies, and metoclopramide was used as prokinetic, though ranitidine is not approved for use in neonates[15][17]. H2-receptor antagonists are frequently utilized in neonatal and pediatric intensive care units as prophylaxis for gastric stress ulceration. However, their routine use in critically ill subjects have been questioned due to the concern that alteration of gastric pH would allow for the overgrowth of pathogenic bacteria[34].

The pattern of AMA use is presented in **Table 19.** Most of the AMAs were antibacterial antibiotics which included **penicillins, cephalosporins, carbopenems, aminoglycosides.** The most commonly used AMA was **cefotaxime**(n=334) followed by **amikacin**(n=170) as seen in other studies[35]. In the studies conducted by suryawanshi *et al* and Amin AJ *et al* the most commonly used AMA was amikacin followed by cefotaxime[36][37]. In some studies ampicillin and gentamicin were the most the most commonly prescribed drugs[38][39] . The other commonly used AMAs in our study were **piperacillin+tazobactum**(n=77), **ampicillin**(n=59) **meropenem**(n=40). The AMAs were used by IV route in all the subjects as seen in other study. Use of oral route in neonates is usually not preferred as in neonatal sepsis faster onset of action is usually needed and in neonates oral administration is difficult[37]. In all the subjects who received systemic antimicrobial therapy, the AMAs were used in combination to ensure a wider and adequate antimicrobial coverage.

The AMA combinations were probably chosen to ensure adequate antimicrobial coverage against a wide range of organisms taking into consideration the prevailing pattern of infection, compromised immune status of critically ill neonates and also the nosocomial or cross infections.

Thus the use of AMAs in combinations appears to be justified and rational. Most of the AMAs used in the present study have been approved for use in neonates, and the dose and frequency of administration was in accordance with the standard norms and guidelines.

The choice of antibiotic or duration of empiric treatment is often not associated with risk factors for sepsis or indicators of illness severity but rather with center. Antibiotic exposure in infants could be minimized through conscientious monitoring of culture results, antibiotic choice, and duration. Improving adherence to guidelines for provides another opportunity to potentially reduce unnecessary antibiotic exposure in hospitalized infants[40].

Table 20 summarizes the use of cardiovascular drugs used in NICM, which included inotropic agents and diuretics. The inotropic agents included dopamine (n=89) and adrenaline (n=46). Dopamine was used to correct hypotension because of its prominent vasopressor action. Furosemide(n=24), a loop diuretic, was used to reduce volume overload in subjects with CHD and RDS. Other studies have also reported almost similar pattern of cardiovascular drug use[5][15][16][17].

About Dopamine, there is lack of data on its long-term safety in exposed infants, which is in agreement with other published studies, hence considered off label[41][42]. This is a very important fact, considering its widespread use in treatment protocols for shock in the newborn – and the absence of other agents that are equally effective and show an acceptable safety profile[43].

The respiratory medications used in NICM are presented in **Table 21**. The most commonly used medications wereincluded aminophylline (n=90), dexamethazone (n=20). In our study the number of drugs used is less as compared to other studies where beractant, caffeine citrate and acetylcysteine are also used quiet commonly.[130]. This may be related to the availability of the drugs and affordability of the patient. Contrary to the present study a study by warrier *et al* and Suryawanshi S *et al*, most common respiratory drug used was surfactant and caffeine[16][32]. The bronchodilators were used in subjects with RDS, MAS, pneumonia and Apnea of prematurity (AOP) to reduce dyspnea, respiratory distress and to improve lung compliance. Dexamethasone was the most commonly used glucocorticoid (n=20). The glucocorticoids were used to reduce inflammation and to improve lung function in subjects with RDS and MAS. RDS is characterized by decreased lung compliance, low tidal volume and decreased alveolar ventilation, particularly likely in very low birth weight preterm neonates. MAS is associated with blockade of small airway, retention of pathogens and decreased ventilatory exchange, with increased risk of aspiration pneumonia. In both these conditions glucocorticoids are useful to reduce the inflammation, minimize the lung damage and to improve ventilator exchange. Dexamethasone was used by IV injection. The dose, frequency and duration of administration were in accordance with the standard guidelines, though an "offlabel" use. Other studies have reported the use of dexamethasone for similar indications[5][15][17].

Table 22 summarizes the use of sedatives and anticonvulsants in NICM. Phenobarbitone was used by IV injection to control convulsions due to neonatal seizures, sepsis and meningitis (n=63), phenytoin was used by IV route as adjuvant to phenobarbitone in 25 subjects. Phenobarbitone has been more widely used as the first line anticonvulsant in neonatal

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seizures and phenytoin less often[16][25][26][27]. The ability of phenobarbitone to induce the microsomal glucuronyltransferase can be a particular advantage in neonates with coexisting hyperbilirubinemia.

Calcium gluconate was used in 22% subjects (n=113) to correct hypocalcemia (n=13), to control hypocalcemic seizures (n=10) and prophylactically (n=90) in subjects showing jitteriness and irritability (**Table 23**). Even in several other studies calcium gluconate was found to be the most commonly used medication[5][16][17]. The common use of calcium gluconate appears to be justified as early neonatal hypocalcemia is a common problem in preterm infants. This can be correlated with delayed surge of parathormone secretion and higher levels of calcitonin in preterm as compared to term neonates[44].

The treatment outcome is summarized in **Table 27.** 99.66% of the subjects (n=498) showed good clinical improvement with stabilized condition, and were shifted out of NICU.

CONCLUSION

This study reveals us an overall pattern of drugs use profile in a tertiary care NICU and reflects the problems for which neonates were admitted to the NICU. The largest number of drugs per day were given in the 1st week in NICU.

The total number of drugs available for prescription from different class of drugs was 18, with an average of 3.6 per subject.

- The most preferred route for drug administration in NICM is intravenous route.
- Majority of the patients received either two or three antimicrobials during the course of therapy. AMAs form the mainstay of NICM, because of the high risk of infection in preterm, and critically ill neonates, use of invasive procedures and also because of the preexisting sepsis.
- The infection can be effectively prevented or controlled by empirically chosen AMA combinations. Other AMAs may be needed for definitive therapy, resistant infection or specific antimicrobial coverage.
- Most commonly prescribed antimicrobials were cefotaxime and amikacin
- During course of the therapy antimicrobials were changed in almost 37.9% of the total patients.
- Other classes of drugs such as inotropic agents, vasopressors, diuretics, bronchodilators, glucocorticoids, anticonvulsants, H2 blockers and calcium gluconate, may be required to address the prevailing or associated complications

In outcome, 99.6% subjects were improved and discharged   Limitations of current study were shorter duration of study and study was conducted in single center only.

The judicious use of various drugs significantly contributes to improve the treatment outcome, without adverse events and interactions.

Antibiotic policy needs to be formulated for hospitals to minimize antibiotic usage and prevent development of resistance.

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