Open Access Library Journal
2025, Volume 12, e14216
ISSN Online: 2333-9721
ISSN Print: 2333-9705

Neonatal Infection in Hospitals: Management Strategy and Follow-Up of Newborns in Low-Resource Settings in the Democratic Republic of Congo

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How to cite this paper: Pululu, A.M., N'sinabau, R.E., Lubaki, F.N., Ngangu, D.B., Ndongosi, F.N., Lumbanzila, S.B., Nkunku, C.M., Mayiza, G.M., Nsingi, A.K., Nkodila, A.N. and Magoga, M.K. (2025) Neonatal Infection in Hospitals: Management Strategy and Follow-Up of Newborns in Low-Resource Settings in the Democratic Republic of Congo. *Open Access Library Journal*, **12**: e14216.
https://doi.org/10.4236/oalib.1114216

Received: September 3, 2025
Accepted: October 20, 2025
Published: October 23, 2025

Abstract

Background: A neonatal infection is an infection occurring in a newborn during the first 28 days of life. It can be caused by various pathogens such as bacteria, viruses, or fungi. **Methods:** We conducted a historical cohort study at the N'djili General Reference Hospital. Our study included newborns who had been diagnosed with a neonatal infection based on maternal medical history and clinical criteria in the newborn. **Results:** In terms of gender, our study counted 1.14 boys for every girl. From a clinical and biological perspective, fever was present in 30.3% of newborns. On the maternal side, peripartum fever accounted for 42.3%. CRP was abnormally high in 74.3%. Newborns with an APGAR score ≥ 7 had better cumulative survival than those with a score < 7, with a statistically significant difference (Log-rank, $p = 0.008$). **Conclusion:** Neonatal infection remains a major public health issue in Kinshasa, with high morbidity and mortality despite diagnostic and therapeutic efforts.

Subject Areas

Environmental Sciences, Microbiology, Parasitology

Keywords

Infection, Neonatal, CRP, Child Survival, N'djili

1. Introduction

Neonatal infections contracted in hospitals pose a major threat to the survival of newborns, especially in resource-limited settings such as the Democratic Republic of Congo (DRC) [1]. According to recent UNICEF data, approximately 96,000 newborns die each year in the DRC before reaching one month of age, with infections such as sepsis and pneumonia among the leading causes, alongside prematurity and asphyxia [1]. Several studies conducted in various provinces reveal a high prevalence of neonatal infections. In Uvira (South Kivu), a 2012 survey found a 15.5% incidence of neonatal infections, with a mortality rate of 17%, and identified major risk factors such as prematurity, hypotrophy, maternal fever during the peripartum period, mechanical ventilation, and nasogastric tube feeding [2]. In Lubumbashi (Haut-Katanga), neonatal sepsis affected more than 31% of newborns admitted to neonatal intensive care, with a mortality rate of 21%, where the majority of cases were early and associated with low birth weight, prolonged rupture of membranes, and maternal urogenital infections [3]. Furthermore, in Kamina, neonatal infections accounted for 22.4% of causes of early neonatal mortality [4].

These data illustrate the epidemiological challenge posed by neonatal infections in Congolese hospitals. Management strategies must be based on rigorous hygiene measures (including hand washing, surface disinfection, and single-use medical equipment), limiting invasive procedures, closely monitoring at-risk newborns, training staff, and improving the hospital environment [5].

Follow-up care for children in these contexts requires an integrated approach that includes the establishment of regular postnatal follow-up, including simple clinical examinations and growth assessments; strengthening community care, in particular by training mothers in basic umbilical cord care (such as cleaning and monitoring for signs of infection), practices that are sometimes compromised by risky traditional customs [6]; as well as coordination with local health facilities to ensure continuity of care, particularly in rural or isolated areas where access to health facilities is limited. In this context, this study was conducted to evaluate strategies for the care and monitoring of children in low-resource settings in the Democratic Republic of Congo.

2. Materials and Methods

This was a historical cohort study conducted at the N'djili General Reference Hospital in Kinshasa, Democratic Republic of Congo, between January 1 and June 30, 2025. The study population consisted of all children hospitalized in the pediatric ward of this hospital. Sampling was exhaustive and convenience-based. The sample size was 109 newborns whose records met the inclusion criteria. The inclusion criteria were any newborn with clinical and biological signs of confirmed neonatal infection. The exclusion criteria included newborns whose records were incomplete and those whose infection was confirmed in the registry but whose records could not be found.

This study was conducted in five stages. The first stage consisted of obtaining verbal authorization from the administrative authorities of the Head of the Pediatrics Department at the N'djili General Reference Hospital to conduct our research. The second stage was devoted to consulting the records of patients treated with a diagnosis of neonatal infection during the period required for the study. The third stage involved consulting the archives of the Pediatrics Department of the N'djili General Reference Hospital to retrieve the files and records. The fourth stage involved transcribing the information obtained from the various medical records onto a pre-established data collection form. Finally, the fifth stage involved analyzing the various data in relation to the research parameters. The variables of interest collected in this study were the sociodemographic, clinical, biological, and evolutionary characteristics of the patients, as well as their prognosis after treatment.

Operational definition:

- Neonatal infection: a history of maternal risk of infection or clinical signs in the newborn such as fever, jaundice, or perinatal asphyxia and/or CRP greater than 6 mg/dL were sufficient to make the diagnosis.

3. Statistical Analysis

The data were entered into an Excel 2013 file, checked, coded, and exported to SPSS 26.0 for analysis. Qualitative variables were expressed in terms of frequencies and percentages. Quantitative variables were expressed as means, medians, and standard deviations. Comparisons of means were performed using Student's t-test. Comparisons of percentages on independent series were performed using Pearson's chi-square test, and in cases where this test was not valid, we used Fisher's exact two-tailed test. A p-value of less than 0.05 was considered statistically significant. The principles of confidentiality and anonymity were respected in accordance with the Helsinki Convention.

4. Results

Of the 498 newborns admitted to the Pediatrics Department of the N'djili General Reference Hospital, 109 had a neonatal infection (NI), representing a frequency of 21.9%. The results are presented by frequency reported on the size of 109 newborns who had an NI.

From this table, we can see that the majority of newborns were in the 36.5 to 39 week age range, accounting for 46.8% with an average of 38.3 weeks. Males predominated, accounting for 53.2% with a sex ratio of 1M/1F. 30.3% of newborns weighed between 2,050 g and 2,500 g, with an average weight of 2785.1 g. The APGAR score was good in 55.1% of cases, while two out of three deliveries were vaginal, representing 66.1% (See **Table 1**).

From a clinical and biological perspective, fever was present in 30.3% of newborns and CRP was elevated in 74.3% of cases. On the maternal side, we mainly noted that urogenital infections at least two weeks before delivery peaked at 60.6%. Premature rupture of membranes (PRM) had occurred at least 24 hours earlier in 69.7% of mothers and between 12 and 24 hours earlier in 30.3% of women. In addition, 42.3% of women had fever during the postpartum period (**Table 2**).

Table 1. Information on newborns.

Information about the newborn	Effective (n = 109)	Percentage
Gestational age		
33 - 36 weeks	22	20.2
36.5 - 39 weeks	51	46.7
39.5 - 43 weeks	36	33
Sex		
Male	58	53.2
Female	51	46.8
Weight		
1.500 g - 2.000 g	14	12.8
2.050 g - 2.500 g	33	30.3
2.550 g - 2.950 g	18	16.5
3.000 g - 3.500 g	32	29.4
3.550 g - 3.950 g	2	1.8
4.000 g - 4.600 g	10	9.2
APGAR		
<7 (collapsed)	49	44.9
≥7	60	55.1
Mode of delivery		
Vaginal	72	66.1
Cesarean section	37	33.9

Table 2. Clinical and biological criteria for neonatal infection.

Defining factors	Effective (n = 109)	Percentage
In newborns		
CRP ≥ 6 mg/L	81	74.3
Fever	33	30.3
In the mother		
Premature rupture of membranes ≥ 24 hours	76	69.7
Urogenital infection within 2 weeks prior to delivery	66	60.6
Puerperal fever with negative thick smear	46	42.3
Premature rupture of membranes ≥ 12 hours but <24 hours	33	30.3
Purulent or foul-smelling amniotic fluid	11	10.1
No information available on prenatal consultations	8	7.3

We note that jaundice was the main symptom in the complication phase (17.4% of cases). In the majority of cases (40.4%), the hospital stay was between 7 and 10 days (Table 3).

Table 3. Clinical presentation of the newborn.

Newborn data	Effective (n = 109)	Percentage
Clinical		
Jaundice	19	17.4
Hypothermia	12	11
Lethargy	9	8.3
Refusal to feed	9	8.3
Respiratory distress	6	5.5
Convulsions	6	5.5
Moaning	4	3.7
Hospital stay		
1 - 3 days	21	19.3
4 - 6 days	38	34.9
7 - 10 days	44	40.4
≥10 days	6	5.5

Our survey shows that triple combination therapy was the main treatment regimen, used in 73.3% of cases, and that the outcome was favorable for two out of three newborns, or 66% (Table 4).

Table 4. Treatment data.

Therapeutic data	Effective (n = 109)	Percentage
Therapeutic modality		
First line	96	88.1
Triple therapy (Cefotaxime + Amoxicillin + Amikacin)	80	73.3
Dual therapy (Cefotaxime + Amikacin)	16	14.7
Second line (Ciprofloxacin)	13	11.9
Evolution		
Improvement	72	66.1
Stagnation	20	18.3
Death	17	15.6

Analysis of clinical variables based on patient outcome (alive vs. deceased) revealed several factors significantly associated with mortality. C-reactive protein (CRP) ≥ 6 mg/dL was observed in 64.7% of deceased patients, compared with 40.2% of survivors ($p = 0.035$). This significant elevation in CRP in deceased patients suggests a more pronounced inflammatory response that may be correlated with an unfavorable outcome. The presence of fever was also more frequent in patients who died (47.1% vs. 32.6%; $p = 0.004$), reinforcing the hypothesis of an association between severe infectious syndrome and mortality. Parity also showed a statistically significant difference between the two groups (p = 0.020). In particular, women with few births (two to four deliveries) accounted for 76.5% of patients who died, compared with 39.1% of survivors. Conversely, primiparas and multiparas were underrepresented in the group of patients who died. This atypical distribution warrants further exploration to determine whether certain parity categories are associated with an increased risk of serious maternal complications (Table 5).

Table 5. General characteristics of newborns and mothers according to vital outcome.

Variable	Survival (n = 92)	No-survival (n = 17)	p
Age, mean and SD, (years)	23.9 ± 5.6	25.7 ± 5.2	0.238
CRP ≥ 6 mg/dL	37 (40.2)	11 (64.7)	**0.035**
Fever	30 (32.6)	8 (47.1)	**0.004**
Parity			**0.020**
Primiparous	31 (33.7)	2 (11.8)	
Paucipara	36 (39.1)	13 (76.5)	
Multipara	25 (27.2)	2 (11.8)	
Urogenital infection	78 (84.8)	16 (94.1)	0.211
Premature rupture of membranes ≥24 hours	65 (70.7)	11 (64.7)	0.411

Factors contributing to death among newborns with NI

Figure 1 shows that the Apgar score at birth is an important prognostic factor for short-term neonatal survival. Newborns with an APGAR ≥ 7 had better cumulative survival than those with a score < 7, with a statistically significant difference (Log-rank, p = 0.008). The red curve (APGAR < 7) shows a more rapid decline in survival over time, suggesting a higher risk of mortality in this group.

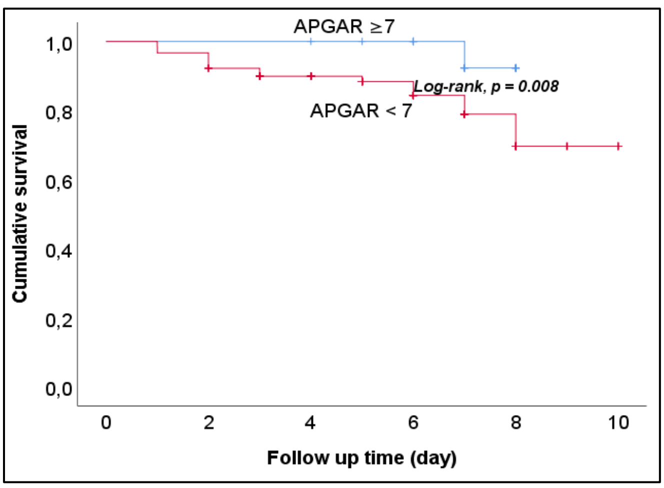

Figure 1. Survival of children according to APGAR score.

5. Discussion

The frequency of neonatal infections (NI) observed in this study, *i.e.*, 21.9% among the 498 hospitalized newborns, is concerning and reflects the high burden of neonatal infections in health facilities in resource-limited settings. This rate is within the range reported in several African studies, although it varies according to the local context, quality of care, and prevention practices. For example, a study conducted in Lubumbashi (DRC) found a prevalence of 31% of neonatal sepsis among newborns admitted to intensive care, with a mortality rate of 21% (3). This higher rate could be explained by the nature of the cases admitted to neonatal intensive care, which are often more serious and at higher risk. In Uganda, Tongo *et al.* [7] reported a prevalence of neonatal infection of 19.2%, while in Niger, a hospital study revealed an incidence of 16.8% [8], showing that the frequency remains high in sub-Saharan Africa. This high frequency highlights the need to strengthen preventive measures, including compliance with hygiene rules, rigorous monitoring in delivery rooms, staff training, and improved care for at-risk newborns [9]. The majority of newborns (46.8%) were born between 36.5 and 39 weeks, with a mean gestational age of 38.3 weeks, indicating a predominance of full-term or near-term births. Although neonatal infections are often associated with prematurity, several studies show that they can also occur in full-term infants, particularly in the presence of obstetric or environmental risk factors [10]. The predominance of male newborns (53.2%) with a sex ratio of 1M/1F is a constant finding in many studies on neonatal infections. It has been suggested that male newborns have a more pronounced immunological vulnerability, which could explain this overrepresentation [11]. An average weight of 2785.1 g was observed, with 30.3% of infants weighing between 2,050 and 2,500 g, which corresponds to hypotrophy or low birth weight. Low birth weight is a well-known risk factor for neonatal infection, as it is often associated with immaturity of the immune system and prolonged exposure to invasive care [12]. An APGAR score considered good in 55.1% of cases indicates that nearly half of newborns had mild to moderate neonatal distress. A low APGAR score, particularly at 5 minutes, is a predictor of neonatal hypoxia, often associated with increased infectious morbidity [13]. Finally, vaginal delivery was predominant in 66.1% of cases, which is consistent with obstetric practices in several African countries. However, this mode of delivery may be associated with an increased risk of infection, particularly in cases of prolonged rupture of membranes or suboptimal hygiene in the delivery room [9].

Fever was observed in 30.3% of newborns, making it one of the most common symptoms associated with neonatal infections, although its absence does not rule out infection, particularly in premature or hypothermic infants [14]. The presence of elevated CRP in 74.3% of cases confirms the importance of this acute phase protein as a biomarker of inflammation and bacterial infection. Although non-specific, CRP is widely used in neonatology as a diagnostic and therapeutic monitoring tool [15]. These results highlight the importance of strengthening clinical and biological monitoring of pregnant women with signs of infection, particularly fever and elevated CRP. In low-resource hospital settings, where diagnostic resources are limited, systematic consideration of these two simple and inexpensive indicators can enable early risk stratification and more effective triage. In addition, training staff to detect early signs of maternal sepsis and implementing standardized protocols for empirical antibiotic therapy can help reduce maternal and neonatal morbidity and mortality. The monitoring of women with few previous births, identified here as a potentially at-risk group, could also be strengthened by targeted prenatal consultations, even in the absence of known previous pathologies. Finally, the establishment of intermediate maternity care units with minimal monitoring (temperature, respiratory rate, rapid CRP) may represent an accessible strategy for improving maternal and neonatal outcomes in facilities with limited resources.

Maternal urogenital infections in the two weeks prior to delivery were reported in 60.6% of mothers. These infections are well known for their role in vertical transmission of pathogens, particularly when they are not detected or adequately treated during pregnancy [16]. They can promote ascending colonization of the genital tract, increasing the risk of chorioamnionitis and neonatal infection. Premature rupture of membranes (PROM) is also a major risk factor. In this study, it occurred at least 24 hours before delivery in 69.7% of cases, and between 12 and 24 hours in 30.3%. The longer the time between membrane rupture and delivery, the greater the risk of fetal-maternal infection. This link is well documented in the literature: the risk of neonatal infection increases significantly when the delay exceeds 18 hours [17]. Finally, postpartum maternal fever, observed in 42.3% of women, may indicate an obstetric infection (endometritis, wound infection, undiagnosed chorioamnionitis), which is itself correlated with an increased risk of neonatal infection. This highlights the importance of monitoring the mother's clinical condition even after delivery to prevent neonatal complications [18]. The results of this study clearly show that the Apgar score at birth is a key prognostic factor for early neonatal survival. Newborns with an Apgar score ≥ 7 have a significantly higher cumulative survival rate than those with a score < 7 (Log-rank, $p = 0.008$). This difference highlights the immediate impact of neonatal distress at birth on mortality during the first days of life. These observations are consistent with data in the literature, particularly in resource-limited settings. A study conducted in Lubumbashi, Democratic Republic of Congo, showed that children with low Apgar scores were at greater risk of developing serious neonatal complications, including neonatal sepsis, which remains one of the leading causes of death [4]. Furthermore, in the same region, neonatal infections accounted for more than 31% of admissions to neonatal intensive care, with a mortality rate of around 21%, often linked to low Apgar scores and other vulnerability factors [5]. In addition, in Uvira (South Kivu), a similar study reported a high frequency of neonatal infections (15.5%) and a mortality rate of 17%, with similar risk factors, including prematurity, hypotrophy, and respiratory distress at birth all situations associated with low Apgar scores [3]. These results confirm that the Apgar score, although a simple and rapid assessment at birth, strongly reflects the clinical condition of the newborn and can serve as an early warning signal to identify children requiring immediate intensive care, especially in low-resource settings where diagnostic tools are often limited. In addition, the high neonatal mortality rate in the DRC (approximately 96,000 deaths per year) is largely attributable to infections, perinatal asphyxia, and prematurity—conditions that are often associated with a low Apgar score [1]. Thus, promoting the Apgar score as a clinical triage tool in the delivery room could help improve neonatal care strategies in the country's health facilities.

6. Conclusion

Neonatal infection remains a major public health issue in Kinshasa, with high morbidity and mortality rates despite diagnostic and therapeutic efforts. Our study highlights the high frequency of these infections, which are often facilitated by preventable risk factors such as prolonged rupture of membranes, out-of-hospital delivery, and poor perinatal hygiene.

Conflicts of Interest

The authors declare no conflicts of interest.

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