

Original Research Article

RISK FACTORS, MANAGEMENT PRACTICES BY NR, AND OUTCOMES OF BIRTH ASPHYXIA: A CROSS-SECTIONAL STUDY AT TERTIARY CARE HOSPITALS IN LAHORE, PAKISTAN

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ABSTRACT

Background: Birth asphyxia is defined as the inability to begin and maintain breathing at birth. Around the globe, approximately four (04) million neonatal deaths are quantified and about one-fourth of all newborn deaths are due to birth asphyxia. It happens when placental blood flow is interrupted. Birth asphyxia is recognized as a major contributor to infant morbidity and mortality. Factors influence the risk of birth asphyxia, including the meconium stain, prolong labor, fetal distress. Neonatal resuscitation practices are well-known to assist newborns in breathing and prevent or manage birth asphyxia. An effective neonatal resuscitation can reduce neonatal fatalities by 30%. The objective is to identify the risk factors, observed the management practices by NR and its outcome and determined the association between factors and outcomes. Study design is observational Cross-sectional study. The study was conducted in the neonatal resuscitation unit of tertiary care hospitals in Lahore. Duration of study March 2024 to August 2024.

Materials and Methods: A total of 1640 births were monitored, and 138 asphyxiated neonates were included in the study. A standardized observational checklist and a review of medical records were used to collect information on maternal and neonatal characteristics, risk factors, and resuscitation practices. After one hour, the neonate's status was documented as alive with oxygen, admitted to the NICU, or deceased. Data were analyzed using SPSS version 26.0, with chi-square tests used to identify relationships between risk factors and outcomes. P-values <0.05 were considered significant.

Results: The majority of mothers (53.6%) were between the ages of 20 and 25, with 65.9% being multigravida. Most of deliveries (47.8%) were performed by caesarean section. A considerable number of asphyxiated neonates were male (58.0%), premature (65.9%), and weighed less than 2.5kg (65.2%). The most common maternal risk factors observed were meconium-stained liquor (18.1%), maternal medical conditions (16.7%), and fetal distress (13.8%). The management of birth asphyxia, initial stages such as drying (95.7%) and warming (100%) were successfully completed, a crucial gap was detected in the timing of bag-and-mask ventilation (BMV), with only 27.9% of neonates receiving it during the "Golden Minute." The total morbidity rate was substantial (76.1%), with 47.1% needing oxygen assistance and 29% being admitted to the NICU. The mortality rate was 7.2%. Prolonged labor was significantly associated with improved initial newborn outcomes ($p=0.010$ for "Baby Well") and decreased NICU admission rates ($p=0.009$). There was a trend toward significance between fetal distress and increased NICU admission ($p=0.058$).

Conclusion: According to the study, preterm birth, low birth weight, meconium stain, and fetal distress are all major risk factors for birth asphyxia. Regardless of adherence to initial resuscitation guidelines, delays in commencing Bag-Mask Ventilation (BMV) during the critical first minute may increase morbidity and death. The findings highlight the critical need for focused healthcare provider training programs to optimize ventilation timing and newborn outcomes.

Keywords: Birth Asphyxia, NR, Newborn, Outcomes

INTRODUCTION

The World Health Organization defines birth asphyxia as the inability to begin and sustain breathing at birth. It occurs when placental blood flow is disrupted, resulting in decreased oxygen saturation and increased blood acidity due to carbon dioxide retention and lactic acid buildup. Hence, birth asphyxia is acknowledged as a significant contributor to infant morbidity and mortality (Techane et al., 2022).^[1]

In addition, one million babies die on the day of their birth, and more than half of all neonatal fatalities happen within the span of the first 24 hours, formally called very early neonatal deaths (VENDS), and almost three-quarters expire within the span of the first week of life. Birth asphyxia (BA) can manifest as fetal heart rate abnormalities, also known as fetal distress. On the other hand, BA may cause generalized organ damage, such as an acute kidney injury, in the first days of life. At the same time, long-term complications may include the infants' neurological disorders or cognitive impairment. (Ayebare et al., 2021).^[2]

Furthermore, approximately two-thirds of the world's ratio of maternal, neonatal, and stillbirth deaths is concentrated in ten large countries in Sub-Saharan Africa and South Asia, with Pakistan being one of them. (Becker et al., 2022).^[3]

The overall Neonatal Mortality Rates (NMR) differ across advanced and underdeveloped nations, ranging from 0.1% to an incredible 5.3%. Every year, 900,000 newborns die as a result of birth asphyxia. The risk of birth asphyxia is determined by several factors, including the mother's age, education, pregnancy history, gestational age, the delivery mode, meconium, labor duration, complications, cord problems, and drugs, and the baby's gender, weight, APGAR score, maturity, and size. (Mergia and Melaku, 2025).^[4]

The causes for newborn mortality differ between developing and developed countries. In developing countries, the leading risk factors are lack of perinatal checkups, maternal malnutrition, and delivery at unsanitary facilities, which can lead to infection. In developed countries, the leading risk factors are tobacco and alcohol use during pregnancy, low birth weight, prematurity, and congenital disabilities. (Dhiloo, 2024).^[5]

The baby was categorized as having asphyxia at birth if their APGAR score was less than 3 for more than 5 minutes, their umbilical cord arterial pH was less than

7, they had neurological symptoms such as convulsions OR increased tone, and they failed multiple organ systems such as cardiovascular, gastrointestinal, hematological, pulmonary, or renal. The major neonatal sequelae found in asphyxiated newborns were hypoxic-ischemic encephalopathy with convulsions, neonatal jaundice, septicemia, transient neonatal tachypnea, hypoglycemia, respiratory distress syndrome, caput succedaneum, and feeding problems. (Tunta et al., 2024).^[6]

As Pakistan is one of the five countries responsible for 49% of all childhood deaths, and Birth Asphyxia has the eighth highest rate of neonatal deaths. Only proper warming, drying, stimulation, and resuscitation can reduce the mortality load in a region where about 500 newborns die every day. (Muzzamil et al., 2022).^[7]

Around the world, 3.3 million stillbirths and 3.7 million neonatal deaths have been reported annually. Approximately, three-quarters of neonatal deaths happen during the lifespan of the first seven days, and seventy-five (75) percent of life loss in children under five years of age occurs during the span of the first 28 days of life. Almost six million newborns require assistance with breathing every year. In high-income nations, resuscitation practices are well-known to assist newborns in breathing and prevent or manage birth asphyxia in hospital settings; in comparison, in low and middle-income nations, it is not a common practice. (Mohamed Ali et al., 2023).^[8]

Therefore, most newborn infants require help to initiate breathing right after birth, and a few require intensive resuscitation measures to restore cardio-respiratory function. (Aziz et al., 2021).^[9]

As a matter of fact, an effective neonatal resuscitation (Aziz et al.) can reduce neonatal fatalities by 30% and may also improve the prognosis for infants who were born asphyxiated (Shikuku et al., 2018).^[10]

Objective:

- To identify the risk factors, observed the management practices by NR and its outcome
- To determine the association between factors and outcomes of NR

MATERIALS AND METHODS

This cross-sectional study was carried out from March to August 2024 at the University of Health Sciences (UHS), Lahore, in collaboration with four tertiary care facilities in Lahore (Jinnah Hospital, Services Hospital, Lahore General Hospital, and

Social Security Hospital). The study's intended population included neonates born with birth asphyxia and their mothers. The current study was an observational study that was ethically approved by the institutional review board and preceded by written permission forms signed by all participants (mothers). The chosen strategy was non-intrusive, with no disruption to the health care professional's activity (treatment of birth asphyxia by resuscitation) by the observer. A total of 1640 deliveries were observed, and 138 asphyxiated newborns were identified.

The sample size was calculated using the Kish-Leslie formula, with 95% confidence, 80% power, and a 5% margin of error. The estimated proportion of mandatory newborn resuscitation (management of asphyxia) was 10%. The study included newborns with birth asphyxia according to the WHO and American Academy of Pediatrics criteria. As a result, any baby who failed to commence spontaneous respiration at birth or within a minute after delivery, with gasp breathing at 30 seconds post-birth. Furthermore, a floppy, bluish, or centrally cyanotic state (blue tongue) was thought to refer to hypoxia. Twin or multiple pregnancies, newborn abnormalities

that impact respiration, and stillbirths were also excluded.

The research areas were located in the gynecological unit's operating theater and labor room. The researcher assigned a numeric code (001, 002, 003, 004, etc.) to individuals who were available for active participation. The researcher/observer carefully positioned herself to obtain a close-up, detailed view of the entire procedure. The data was gathered by observing HCPs' handling of an asphyxiated newborn, as well as reviewing and documenting the mother's medical records. The observer was there every time a delivery happened. The information on how HCPs handle birth asphyxia was captured on a well-structured checklist. A preset checklist was employed for this reason. The neonate's characteristics were documented.

The management steps included drying/stimulation, airway clearance, and advanced bag-and-mask ventilation (ABMV). The key outcome after one hour of newborn status was binary and documented, as well as the newborn's being alive with O₂, admitted to the NICU, and dead. Data were examined using SPSS version 26.0, with multiple variables analyzed with the chi-square test. P-values < 0.05 were deemed significant.

RESULTS

Description of Characteristics of Mothers and Neonates

Table 1: Frequency distribution and percentage of Characteristics of Mothers and Neonates (N=138)

Demographic Variables	Categories	Frequency (f)	Percentage (%)
Maternal Age (years)	20 - 25 Years	74	53.6
	26 - 30 Years	43	31.2
	> 30 Years	21	15.2
Parity	Primigravida	47	34.1
	Multigravida	91	65.9
History of Previous CS	No	115	83.3
	Yes	22	15.9
Mode of Delivery	SVD	37	26.8
	Asst. Delivery	1	.7
	C. Section	66	47.8
	Breach	1	.7
	SVD+Asstd	7	5.1
	Asstd+C.Section	4	2.9
	C.Section+Breach	21	15.2
	Asstd+C.Section+Breach	1	.7
Gender of Neonate	Male	80	58.0
	Female	58	42.0
Gestational Age (in weeks)	< 37	91	65.9
	> 37	47	34.1
Birth Weight	1 - 1.5kg	25	18.1
	1.6 - 2kg	28	20.3
	2.1 - 2.5kg	37	26.8
	>2.5	48	34.8

Maternal Age: The majority of mothers 74 (53.6%) were between 20 and 25 years of age. A substantial portion, 43 (31.2%), were aged 26-30 years, while a smaller group, 21 (15.2%), were over 30 years old. Parity: Most mothers are Multigravida (91; 65.9%), and 47 (34.1%) are Primigravida. History of Previous C-Section: Most mothers 115 (83.3%) had no history of a previous Cesarean section, while 22 (15.9%) had a Cesarean history. Mode of Delivery: The most

common mode of delivery was Cesarean Section (C. Section) (67.3%), whereas 3.7% via SVD.

Neonatal Characteristics

Gender: There was a higher proportion of male neonates (80, 58.0%) compared to females (58, 42.0%). Gestational Age: A majority of the neonates (91, 65.9%) were preterm, born at less than 37 weeks of gestation. The remaining 47 (34.1%) were term newborns (≥ 37 weeks). Birth Weight: The birth

weights were distributed across a range. The largest group of neonates (48, 34.8%) had a birth weight greater than 2.5 kg. This was followed by the 2.1-2.5

kg group (37, 26.8%), the 1.6-2.0 kg group (28, 20.3%), and the 1-1.5 kg group (25, 18.1%).

Table 2: Frequency distribution and percentage of Risk Factors of Birth Asphyxia (N=138)

Maternal Risk Factors			
Placenta Causes	Yes	15	10.9
	No	123	89.1
Meconium Stain Liquor	Yes	25	18.1
	No	113	81.9
HTN	Yes	18	13.0
	No	120	87.0
Prolonged Labour	Yes	15	10.9
	No	123	89.1
H/O PVL	Yes	15	10.9
	No	123	89.1
Fetal Distress	Yes	19	13.8
	No	119	86.2
Decrease Liquor	Yes	13	9.4
	No	125	90.6
Failure to Induction	Yes	4	2.9
	No	134	97.1
Unknown	Yes	12	8.7
	No	126	91.3
Maternal Medical Condition	Yes	23	16.7
	No	115	83.3
	↓FM	5	21.74
	BOH	5	21.74
	Cardiac	5	21.74
	DM	6	26.08
	Thrombopenia	2	8.70

[Table 2] reveals the maternal risk factors of birth asphyxia.

The most common risk factor was Meconium Stain Liquor, present in 25 cases (18.1%), followed by Maternal Medical Condition in 23 cases (16.7%). Fetal Distress was reported in 19 cases (13.8%), and PIH (Pregnancy Induced Hypertension) in 18 cases (13.0%). Placenta Causes, Prolonged Labour, and H/O PVL (History of Per Vaginal Leaking) each occurred in 15 cases (10.9%). Decreased Liquor was

noted in 13 cases (9.4%), and Unknown risk factors in 12 cases (8.7%). The least frequent risk factor was Failure to Induction, present in only 4 cases (2.9%). Among the 23 cases with maternal medical conditions, DM (Diabetes Mellitus) was the most common, affecting 6 cases (26.08%). ↓FM (Decreased Fetal Movement), BOH (Bad Obstetric History), and Cardiac conditions each accounted for 5 cases (21.74%). Thrombocytopenia was reported in 2 cases (8.70%).

Table 3: Management of Birth Asphyxia by NR (n=138)

Did Dry the baby thoroughly? (by gently rubbing the back)	Yes	132	95.7
	No	6	4.3
Was the baby kept warm?	Yes	138	100.0
	No	0	0
Did check newborn airway?	Yes	137	99.3
	No	1	0.7
Did the baby assess for meconium?	Yes	105	76.1
	No	33	23.9
Did the baby's airway clear with a suction bulb?	Yes	133	96.4
	No	5	3.6
Did the baby's head place in a neutral position?	Yes	128	92.8
	No	10	7.2
Did initiate the bag-and-mask ventilation (BMV)? (n=104)	Yes	103	99.0
	No	1	1.0
Did BMV initiate within the Golden minute (60s)?	Yes	29	27.9
	No	75	72.1
Was the chest moved with each ventilation or not? (ABMV) (n=96)	Yes	93	96.9
	No	3	3.1
Did initiate/ instigate 01 effective breath with every 3 compressions for 1 min? (n=58)	Yes	52	89.7
	No	6	10.3
Still, the baby required more support breathing (supportive oxygen) or not? (n=58)	Yes	58	100.0
	No	0	0

[Table 3] shows the management of birth asphyxia. The majority (95.7%) of babies dried thoroughly, and

(100%) neonates were kept warm. Almost all (99.3%) newborns' airways were checked, 76.1%

babies were assessed for meconium. 96.4% baby's airway cleared with a suction bulb, and 92.8% baby's head placed in a neutral position. Nearly all newborns (99%) were given BMV, but 27.9% given BMV in the Golden minute (60s), and (96.9%) observed chest movement with each ventilation. 89.7 of neonates were given effective breathing with every 3 compressions in 1 minute. All (100%) babies were provided with supportive oxygen if they still required it.

[Figure 1] reveals the outcomes of neonates who received resuscitation. 23 (16.7%) neonates recovered well, 65 (47.1%) neonates needed oxygen therapy, 40 (29%) neonates required intensive care,

total morbidity (76.1%), and 10 (7.2%) neonates unfortunately died.

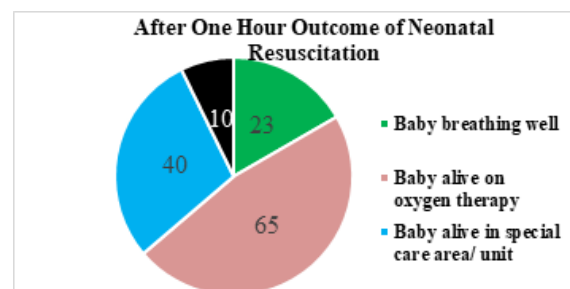


Figure 1: Distribution according to Outcome of Neonatal Resuscitation after One Hour.

Table 4: Association between Risk Factors and Neonatal Outcome

Practices		Baby Well(a) (23)	Oxygen(b) (65)	NICU(c) (40)	Died (d) (10)	X2	P-Value
Unknown	Yes	2 16.7%	7 58.3%	1 8.3%	2 16.7%	a: 0.000 b: 0.665 c: 2.723 d: 1.735	a: 1.000 b: 0.416 c: 0.100 d: 0.189
	No	21 16.7%	58 46.0%	39 31.0%	8 6.3%		
Placenta Causes	Yes	2 13.3%	6 40.0%	5 33.3%	2 13.3%	a: 0.135 b: 0.341 c: 0.155 d: 0.928	a: 0.715 b: 0.561 c: 0.695 d: 0.337
	No	21 17.1%	59 48.0%	35 28.5%	8 6.5%		
Meconium Stain	Yes	3 12.0%	13 52.0%	8 32.0%	1 4.0%	a: 0.479 b: 0.294 c: 0.135 d: 0.479	a: 0.491 b: 0.589 c: 0.715 d: 0.491
	No	20 17.7%	52 46.0%	32 28.3%	9 8.0%		
HTN	Yes	2 11.1%	8 44.4%	6 33.3%	2 11.1%	a: 0.460 b: 0.059 c: 0.190 d: 0.460	a: 0.499 b: 0.809 c: 0.664 d: 0.499
	No	21 17.5%	57 47.5%	34 28.3%	8 6.7%		
Prolong Labour	Yes	6 40.0%	8 53.3%	0 0.0%	1 6.7%	a: 6.597 b: 0.262 c: 6.869 d: 0.008	a: .010 b: 0.610 c: 0.009 d: .0927
	No	17 13.8%	57 46.3%	40 32.5%	9 7.3%		
H/O PVL	Yes	2 13.3%	8 53.3%	4 26.7%	1 6.7%	a: 0.135 b: 0.262 c: 0.044 d: 0.008	a: 0.715 b: 0.610 c: 0.835 d: 0.927
	No	21 17.1%	57 46.3%	36 29.3%	9 7.3%		
Fetal Distress	Yes	4 21.1%	6 31.6%	9 47.4%	0 0.0%	a: 0.305 b: 2.131 c: 3.617 d: 1.721	a: 0.582 b: 0.146 c: 0.058 d: 0.191
	No	19 16.0%	59 49.6% q	31 26.1%	10 8.4%		
Decrease Liquor	Yes	0 0.0%	7 53.8%	5 38.5%	1 7.7%	a: 2.870 b: 0.262 c: 0.626 d: 0.004	a: 0.091 b: 0.610 c: 0.430 d: 0.948
	No	23 18.4%	58 46.4%	35 28.0%	9 7.2%		
Failure to Induction	Yes	1 25.0%	1 25.0%	2 50.0%	0 0.0%	a: 0.206 b: 0.808 c: 0.884 d: 0.322	a: 0.651 b: 0.371 c: 0.349 d: 0.572
	No	22 16.4%	64 47.8%	38 28.4%	10 7.5%		
Maternal Medical Condition	Yes	2 8.7%	10 43.5%	8 34.8%	3 13.0%	a: 1.263 b: 0.145 c: 0.451 d: 1.380	a: 0.263 b: 0.704 c: 0.504 d: 0.242
	No	21 18.3%	55 47.8%	32 27.8%	7 6.1%		
History of Previous CS	Yes	4 18.2%	12 54.5%	5 22.7%	1 4.5%	a: 0.036 b: 0.646 c: 0.531 d: 0.294	a: 0.849 b: 0.423 c: 0.468 d: 0.589
	No	19 16.5%	52 45.2%	35 30.4%	9 7.8%		

[Table 4] shows the association between maternal risk factors and neonatal outcomes, analyzed using chi-square tests. Mothers who experienced Prolonged Labour had significantly different neonatal outcomes. A substantially higher proportion of their neonates were categorized as "Baby Well" (40.0% vs.

13.8%, $p=0.010$). Conversely, none of the neonates in the Prolonged Labour group required NICU admission (0.0% vs. 32.5%, $p=0.009$). A trend towards significance was observed for Fetal Distress and NICU admission. Neonates born after an episode of Fetal Distress had a markedly higher rate of NICU

admission (47.4% vs. 26.1%, $p=0.058$). Furthermore, the presence of Decreased Liquor showed a near-significant association with a lower rate of "Baby Well" outcomes (0.0% vs. 18.4%, $p=0.091$).

DISCUSSION

The study examined the risk factors and management of birth asphyxia and outcomes.

In the current study, the majority of mothers (74; 53.6%) were between 20 and 25 years of age. Most mothers are Multigravida: 91 (65.9%). These findings align with the study by (Amsalu et al., 2023) reported the majority of maternal age 55%, and having a multigravida 58%.^[11]

Gestational Age: the neonates (91, 65.9%) were preterm, born at less than 37 weeks of gestation. And 53.6% of neonates had a birth weight < 2.5kg. Our findings are congruent with (Becker et al., 2022) who reported that 58% of neonates were < 37 weeks and 54.6% were < 2.5 kg. Similarity may be due to both being developing countries. However, (Ghanaie et al., 2021) presented dissimilar findings 37% preterm, and 21% had less than 2.5kg. This discrepancy might be due to differences in prenatal care and healthcare facilities.^[12,13]

In this study, the most common risk factor was Meconium Stain Liquor, present in 25 cases (18.1%). As noted in a study from similar contexts by Ochoga et al. (2021), (22.8%) mothers had meconium-stained amniotic fluid. The respiratory condition after birth may be complicated by intrauterine meconium discharge, which increases the risk of severe hypoxia and BA.^[14]

Interestingly, in the current study, Placental Causes, Prolonged Labour, and H/O PVL (History of Per Vaginal Leaking) were reported in only 10.9%, respectively, while Fetal Distress was reported in 19 cases (13.8%). The findings of the study of (Getachew et al., 2020) revealed placental causes (9.8%), Prolong Labour (15.5%) and Fetal Distress (13.3%), which are congruent with current study. These complications lead to birth asphyxia due to the deprivation of blood flow to the fetus. The findings proclaimed by (Farooq et al., 2025) that APH 22 (18.3%), PIH 26 (21.7%), PROM 30 (25.0%), and Prolonged labor 34 (28.3%) are contrary to the current study.^[15-17]

Current study findings (95.7%) babies dried thoroughly (99.3%), newborn's airway was checked, 76.1% babies were assessed for meconium. 96.4% baby's airway cleared with a suction bulb. The results of (Guta, 2022) revealed that (82.4%) babies were gently dried. 91.7% of babies' airways checked. These results align with the current study.^[18]

In the current study (99%) were given BMV, but 27.9% given BMV in the Golden minute (60s), and (96.9%) contrary findings by (Owusu et al., 2024) revealed only 46.0% of asphyxiated newborns needed "bag and mask" ventilation for resuscitation; this discrepancy could be caused by the mothers'

prenatal care booked cases. The majority of the patients in the current study were un-booked cases, who face a higher risk of complications, so neonates require advanced resuscitation.^[19]

The final outcomes of neonates who received resuscitation, morbidity cases were 76.1%, and 7.2% died. Another study conducted by (Apio et al., 2025) identified 69.4% morbidity and 4.6% fatality, which validates this data. The contrary findings revealed by (Ogunkunle et al., 2020) 14.7% neonates died.^[20,21]

The association between risk factors and outcomes was analyzed, Prolonged Labour had significant outcomes as "Baby Well" ($p=0.010$), "NICU" ($p=0.009$). The results of research done by (Apio et al., 2025) Align with the present study, prolonged labor was significant ($P=0.001$) with the severity of Birth Asphyxia. According to (Alamneh et al., 2022) Neonates delivered to women who experienced extended labor had a 2.69 times higher risk of having birth asphyxia. Obstructed labour might affect the fetus's blood supply, resulting in hypoxic episodes that could lead to birth asphyxia. (Ayebare et al., 2022).^[22,23]

In the current study, neonates born after an episode of Fetal Distress had a markedly higher rate of NICU admission ($p=0.058$). Our findings align with the study of (Wosenu et al., 2018), who reported that fetal distress had 5.7 times the chance of having birth asphyxia than those delivered with a normal fetal heart rate. The probable cause for this is that fetal distress occurs when the fetus does not receive sufficient oxygen during pregnancy or delivery, which can lead to asphyxia (Lemma et al., 2022).

CONCLUSION

This study revealed that birth asphyxia in the study population is a multifaceted issue caused by a combination of maternal, obstetric, and fetal factors. The high risk of preterm births and low birth weight in asphyxiated neonates emphasizes the importance of improved prenatal care and maternal nutrition. While healthcare workers demonstrated proficiency in the basic first steps of newborn resuscitation, the critical failure to commence bag-and-mask breathing within the golden minute shows a significant gap in care quality. The findings provide an essential baseline for the institutions involved, indicating that, while resources are available, practical skills and prompt application of resuscitation protocols require immediate improvement in order to save newborn lives.

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