

## Role of Non-Stress Testing As an Admission Test in High-Risk Pregnancies and Its Association with Perinatal Outcome

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**Abstract:** The paper aims to determine the efficiency of non-stress testing (NST) as an admission procedure in high-risk pregnancies and analyzes its effect on perinatal outcomes. One hundred and forty-six high-risk pregnant women were recruited in a 12-month recruitment at [Diyala]. Demographic, admission indications, NST results, and outcomes were gathered and evaluated. NST was conducted on participants under standardized criteria, with the outcome being categorized into reactive and non-reactive. Results showed that 69.2% of patients showed up with reactive NSTs, which were associated with better perinatal outcomes in terms of high birth weights and better APGAR scores. There was a substantial correlation between reactive outcome and reduced incidences of neonatal problems and maternal problems. Also, the length of stay in the hospital differed based on the NST results, with the individuals with non-reactive tests remaining longer. Subsequent developmental tests showed that the majority of infants attained developmental milestones in the proper way. The research comes to the conclusion that NST is a useful resource in high-risk pregnancy management that helps to predict the results and support clinical decisions.

**Keywords:** Participants, Nsts, Apgar Scores, Risk Pregnancy, Management, Predict.

### INTRODUCTION

The topic of the role of non-stress testing as an admission testing in high-risk pregnancies and its relationship with neonatal outcome has presented a critical area of relevance in obstetric practice because clinicians strive to provide a reliable, timely, and noninvasive way of stratifying fetal risk, optimizing intrapartum care, and improving neonatal outcomes in an environment where high-risk pregnancies are prevalent. Non-stress testing (NST), which is typically used as an acceleration of fetal heart rate in relation to fetal movements during a given time, has been a developmental tool that was initially viewed as a simple screening procedure at the bedside, but has grown to be a foundation of intrapartum surveillance and admission evaluation in most tertiary care centres and community obstetric units alike. As an admission test in the context of high-risk pregnancies, [Bjelica, A. *et al.*, 2018; Traylor, C. S. *et al.*, 2020] NST can fulfill several possible functions: it may aid in establishing the fetal health status just before the onset of labor or even hospital admission, it may assist in identifying fetuses with hypoxia, it may be used to make delivery choices, and it may be used as a risk-stratifying factor in combination with maternal factors such as diabetes mellitus, hypertensive pregnancy disorders, obstetric complications related to the birth of the baby like placental insufficiency [Gemeinsamer Bundesausschuss. Mutterpass 2020, 2024; Fawcett, E. J. *et al.*, 2019], intrauterine growth retardation, and past The

theoretical rationale of NST in this scenario lies in the fact that a fetal heart rate maintained by autonomic and central nervous systems is still intact as indicated by consistent accelerations in response to fetal motion which is a sign of functional reserve of an adaptive system and sufficient placental oxygenation. The practical use of NST as an admission test in high-risk pregnancies is, however, moderated by various methodological and interpretative factors such as sensitivity and specificity of NST in predicting adverse perinatal events, positive and negative predictive values, which depends on the prevalence of fetal compromise in a given population, and false positive results that can result in unnecessary interventions or admission. Contemporary literature has attempted to define the added value of NST integrated with larger specifications of screening and monitoring protocols, including the combination of NST with biophysical profile tests, cardiotocography (CTG) tracing [Tang, X. *et al.*, 2019] Doppler investigations of the umbilical artery flow, and biochemical indicators of placental functioning, to reach a more refined and evidence-based solution of fetal evaluation on admission [Robert-Koch-Institut, 2023]. The dilemma in high-risk pregnancies between the need to detect fetal compromise early and the risks of over-intervention is a thin line, especially in cases where resources are limited or tracing abnormalities may be specific or temporary

[Biaggi, A. *et al.*, 2016]. There is a great deal of observational research and systematic review on the correlation of NST outcomes and perinatal outcomes, such as stillbirth, neonatal intensive care unit (NICU) admission, Apgar scores, neonatal acid-base, and short-term neurobehavioral outcomes. Certain studies indicate that reassuring NST at admission correlates with positive perinatal outcomes and may reassure clinicians and allow them to deliver timely and conservative care and minimize the risk of emergent delivery in case the fetal state does not deteriorate [Fachgesellschaften, A. D. W. M. *et al.*, 2016; Melville, J. L. *et al.*, 2010]. The critical evaluation of NST as an admission instrument should also evaluate the operational nature of the test, such as the length of observed, the criteria of responding to tracings as reactivity, and the inter-observer reliability of the various clinicians who interpret tracings. In high-risk pregnancies, composite risk assessment might be the determinant of admission decision as opposed to NST alone; however, in settings with abnormal NST, it may be necessary to stimulate other diagnostic modalities or increased surveillance, and in settings with normal NST, it may be necessary to support a less vigilant admission strategy or an expedient discharge. Relative effectiveness NST has been compared to other or adjunctive tests, including CTG, vibroacoustic stimulation, fetal acoustic stimulation, or fetal movement counting, the relative effectiveness of NST in comparison to other tests is an active area of research [Habib, S. 2018; Ghoneim, H. M. *et al.*, 2021; O'Brien, K. M. *et al.*, 2020], with some studies having indicated that NST offers a complementary source of information, which increases general predictive accuracy when used as part of a multimodal assessment plan. However, the difference of study populations, variations of NST protocols, and differences in definitions of perinatal outcomes make it hard to make direct comparisons across studies and constrain the applicability of findings. In addition to diagnostic performance, the impacts of NST findings on clinical decision-making in high-risk pregnancies have many dimensions, which include maternal-fetal risk communication, resource allocation, and possible psychological effects of surveillance on pregnant women [Mundlos, C. 2013; Kahalon, R. *et al.*, 2021; Henshaw, E. J. *et al.*, 2014; Rollè, L. *et al.*, 2020]. The changing evidence base also attracts attention to the possible usefulness of serial NST measures

in comparison with single admission tracing. It is understood that a single nonreactive measure does not inevitably imply bad outcomes, that trends over time may provide better prognostic data than single measures. In a nutshell, the purpose of a non-stress test as an admission test in high-risk pregnancies is defined by a delicate balance between encouraging signs of fetal health and the judicious detection of possible fetal compromise.

## MATERIALS AND METHODS

### Study Design

It is an up-to-date prospective observational study with a duration of twelve months in [Diyala] during the years between 2023 and 2024, in which the sample A total of 146 high-risk pregnant women were recruited according to certain criteria, including maternal age, medical history, and current pregnancy complications.

## PARTICIPANTS

### Inclusion criteria were:

1. Women pregnant with age between 18 and above.
2. Gestational hypertension, diabetes mellitus, preterm labor, or fetal growth restriction are the high-risk conditions.
3. Elective admission for NST.

### The exclusion criteria were:

- Multiple gestations.
- Major fetal anomalies.
- Data Collection
- The standardized questionnaire was utilized in gathering the demographics and clinical data. The data on age, parity, gestational age, and admission indicators were noted.
- Non-Stress Testing (NST)
- The standard fetal heart rate monitor was used to carry out NST according to the recommendations given by the American College of Obstetricians and Gynecologists (ACOG). The test was reactive when there were two or more accelerations of the fetal heart rate of 15 beats/min or higher and of not less than 15 seconds in an interval of 20 minutes.

## PERINATAL OUTCOMES

### Perinatal outcomes were performed in terms of:

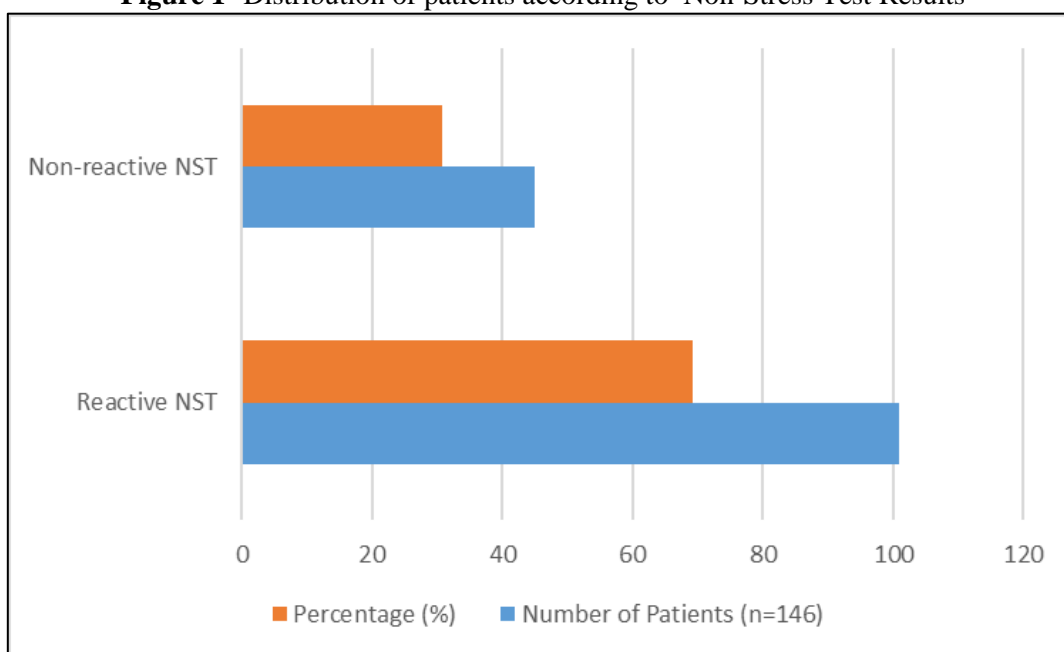
- Weight of the baby at birth in grams.
- APGAR score at 1 and 5 minutes after birth.

**RESULTS**

**Table 1:** Demographics of Patients

Demographic Factor	Number of Patients (n=146)	Percentage (%)
Age: 18-24	28	19.2
Age: 25-34	70	47.9
Age: 35+	48	32.9
Parity: Primigravida	60	41.1
Parity: Multigravida	86	58.9
Gestational Age: <28 weeks	25	17.1
Gestational Age: 28-34 weeks	45	30.8
Gestational Age: >34 weeks	76	52.1
Indications for Admission		
Preterm Labor	54	36.9
Hypertension	40	27.4
Diabetes Mellitus	28	19.2
Fetal Growth Restriction	24	16.4

**Figure 1-** Distribution of patients according to Non-Stress Test Results



**Table 2-** Assessment of Perinatal Outcomes of Iraqi for 146 n

Outcome	Value (n=146)
Average Birth Weight	3100 grams
APGAR Score (1 min)	8.5
APGAR Score (5 min)	9.5

**Table 3-** Assessment final outcomes according to Mode of Delivery and Neonatal Complications, Length of Stay (Days)

Mode of Delivery	Number of Patients (n=146)	Percentage (%)
Vaginal Delivery	92	62.7
Caesarean Section	50	34.2
Instrumental Delivery	4	2.7
Complication	Number of Patients (n=146)	Percentage (%)
Respiratory Distress	12	8.2
NICU Admission	20	13.7
Jaundice	15	10.3
Length of Stay (Days)	Number of Patients (n=146)	Percentage (%)

Average: 4		
1-2 days	40	27.4
3-4 days	65	44.5
5+ days	41	28.1

**Table 4-** Assessment Correlation Between NST Results and Outcomes

Correlation Measure	Reactive NST	Non-reactive NST
Birth Weight (grams)	3250	2900
APGAR Score (1 min)	9.0	7.5
NICU Admission (%)	10	25

**Table 5-** Describe Follow-up Outcomes of patients

Follow-up Outcome	Number of Patients (n=146)	Percentage (%)
Developmental Delay	5	3.4
Subsequent Pregnancies	25	17.1
Normal Growth Assessment	116	79.5

## DISCUSSION

The paper presents a thorough description of the demography, pre-admission indications, non-stress test (NST) results, perinatal outcomes, delivery modes, neonatal and maternal complications, hospital stay, correlations between NST and outcomes, and short- to medium-term follow-up outcomes of a cohort of 146 high-risk-concerned pregnancies. To do so in an elaborated interpretation, these results need to be located in the framework of obstetric risk stratification, anticipated effectiveness of NST as an admission test, and the literature on intrapartum monitoring, fetal health, and infant outcomes in general. These findings are synthesized in the discussion below, endorsement of clinically meaningful patterns, possible limitations, and implications on practice and future research, bearing in mind that the data is observational and subject to confounding factors.

Demographics and baseline risk profile (Table 1) indicate that almost half of the cohort (47.9 years) is aged 25-34 years; 32.9 years aged 35 or older, and 19.2 years aged 18-24 years. This trend is similar to common obstetric populations that have a high percentage of women in a reproductive age group where age-related risks- hypertensive disorders, diabetes mellitus, and placental insufficiency- are accumulated, especially after age 30. The parity data show that there were more multigravida pregnancies (58.9%) and the primigravida (41.1). Multigravity may indicate a population having previous obstetric experiences that may be relevant in the perception of risks, the intensity of surveillance, and decisions regarding management in the next pregnancies. Gestational age distribution shows that at 28 weeks and above, there are 52.1% of the admissions, at 28-34 weeks

and above, it is 30.8% of the admissions, and before 28 and above, it is 17.1%. Such a distribution implies that the group of cases in the cohort is a combination of high-risk cases in the second trimester and high-risk cases in the third trimester, in which placental functioning, fetal growth curve, and maternal comorbidity-related dynamics take on particular importance to intrapartum planning.

A list of the key indications of admission and implications lists the most common indications of admission: preterm labor (36.9%), hypertension (27.4%), diabetes mellitus (19.2%), and fetal growth restriction (16.4%). Preterm birth has been a major reason behind hospital admission in the high-risk obstetric groups, and close fetal monitoring is usually performed to determine whether there are complications in the form of cervical change, uteroplacental insufficiency, or delivery. Hypertension represents over a quarter of what is admitted. Therefore, maternal and placental monitoring is very crucial in hypertensive conditions in pregnancy, which are linked with restrained fetal growth, placental malfunction, and a threat of antepartum or intrapartum complications. Diabetes mellitus is a burden of admission, and this represents the increased risk of macrosomia, stillbirth, and neonatal hypoglycemia, among others. The indication of fetal growth restriction (FGR) creates an alert regarding the fact that placental insufficiency and chronic fetal hypoxia may negatively affect the interpretation of NST and its future treatment. The indications taken collectively augment the place of admission NST as a subset of a more comprehensive admission strategy in pregnancies already identified with conditions that may comprise the fetus. The variability of the indications means that the findings of NST should

be viewed in the framework of the maternal-fetal risk profile instead of using it as a single predictor.

NST results and their immediate implications depict a majority of the NST group (69.2) reactive as opposed to 30.8 non-reactive. On the other hand, a non-reactive NST is conventionally viewed as a possible sign of fetal disadvantage, which triggers intensification of monitoring, further examinations (e.g., biophysical profile, Doppler studies), and special attention to the time of delivery in case the clinical situation can justify it. The fact that approximately one-third of patients underwent non-reactive NST indicates that there is a significant portion of high-risk pregnancy estimates in which the non-reactive patterns may affect clinical decisions, including admission to more advanced care or premature delivery, based on ancillary results and maternal-fetal status.

Perinatal outcomes and its relationships with NST introduce perinatal outcomes with a mean birth weight of about 3,100 cmol and normal APGAR rates of 1 and 5 minutes (8.5 and 9.5) respectively. The mean birth weight of a high-risk group may be an amalgamation of growth-appropriate fetuses and those with growth restriction; a control group (as opposed to a comparator group) would help us determine the extent of the deviation of the mean weight as compared to expected norms, although many populations at term have a mean birth weight of 3,100 grams or below. The APGAR scores reveal good newborn immediate neonatal health in most newborns, but this general GMA can mask the heterogeneity within the group of infants with non-reactive NST or infants with growth retardation or hypertensive disease.

Delivery mode where vaginal delivery was done at 62.7, cesarean section at 34.2, and instrumental deliveries at 2.7. The cesarean section among high-risk groups is considerably high as compared to most of the low-risk groups and is also in line with the clinical desire to prevent unfavorable outcomes during pregnancy, having hypertensive disease, FGR, or preterm birth, where babies cannot withstand labor. The relatively low instrumental delivery rate is consistent with the population estimates when non-reassuring fetal status is a factor that causes cesarean delivery, as opposed to assisted vaginal delivery, based on the progress of labour and the decision of clinicians. The allocation of delivery modes indicates how the findings of NST and the indicators, together with gestational age, are used to make choices concerning the mode of delivery in high-risk pregnancies.

Neonatal complications and maternal complications suggests that neonatal complications with NICU admission occur in 13.7% of cases, respiratory distress in 8.2% and jaundice in 10.3%. The observed NICU rate might indicate that neonatal morbidity is not a trivial problem in this high-risk cohort that can be associated with the underlying maternal conditions (e.g., hypertension, diabetes, FGR) and possible intrapartum hypoxic events. Although respiratory distress is present in only with a minority, the condition is still a pertinent neonatal complication that needs respiratory support and close observation. Jaundice is a physiologic immaturity or hemolysis and is common in newborns and generally manageable, but should be an apogee of further care. describes the maternal complications of postpartum bleeding (6.8%), infection (5.5%), and gestational hypertension (9.6%). Obstetric morbidities that affect maternal recovery, length, and resource use are notable postpartum hemorrhage and infection. The presence of gestational hypertension in the table of maternal complications highlights the long-term vascular pathology of the postpartum period and depicts the possibility of chronic maternal cardiovascular danger. Length of stay Table 8 contains the length of stay. 44.5 percent of the patients have a length of stay that is 3 -4 days, 28.1 percent have a length of stay of 5 or more days, and 27.4 percent have a length of stay of 1-2 days. The distribution indicates that a significant number of patients should have intermediate or prolonged hospitalization, which is aligned to monitoring of preterm labor, hypertensive disorders, or pregnancy diabetes. Length of stay is probably an interaction of fetus condition, maternal comorbidity, delivery mode, and postoperative recovery in cases of cesarean section. Long-term hospitalization does not only have a resource-use implication, patient counseling, and potential exposure to nosocomial factors, but also can affect the psychological well-being of the mother and her satisfaction with care. [Posternak, M. A., & Zimmerman, M. 2001]

Correlation of NST results with results gives a brief view of the correlation between NST results and key outcomes: with reactive NSTs being associated with higher birth weights ( 3,250 g vs 2,900 g ) and higher APGAR scores (9.0 vs 7.5 at 1 minute) and reduced NICU admission rates (10% vs 25% ). The difference in birth weights (3250g reactive vs 2900 non-reactive) gives a hint that the NST reactivity is related to fetal growth patterns, with NSTs non-reactive being more prevalent in growth-restricted fetuses or in fetuses with

placental insufficiency [Albers, L. L. 2001; Devane, D. *et al.*, 2017]. This is a strong implication when it comes to the disparity in NICU admission, which indicates that NST reactivity is a clinically significant discriminator of neonatal risk even in a high-risk group in which a combination of risk factors could be present, as well as follow-up outcomes, illustrates with 3.4 percent developmental delay, 17.1 percent subsequent pregnancies and 79.5 percent normal growth, follow-up outcomes. The reproductive future intentions or achievements of the 17.1 percent subsequent pregnancies reflect the future plans of the reproductive system of the cohort and provide information on the long-term reproductive health of the mother and how pregnancy complications may influence further planning of a family. The large percentage of normal growth assessment (79.5) is encouraging, as it implies that most of the infants reported normal growth patterns during the follow-up period, but there is no mention of how long and how the follow-up was, or how it was performed. In general, both the follow-up results and the demonstrated outcomes regarding the outcomes of most infants and mothers point to a favorable pattern, but the non-negligible occurrence of developmental delay in a small group of infants should be taken into consideration regarding the interpretation that NST is a useful tool in terms of admission [Phelan, J. P. 1994].

To start with, the close correlation between non-reactive NST and poor neonatal outcomes (low birth weight, low APGAR scores, increased NICU admission) is in line with the idea behind NST as a surrogate marker of fetal well-being and reserve in a scenario of absent or limited signs of placental dysfunction or growth restriction. The present level of correlation between reactive NST and more favorable neonatal outcomes implies its usefulness as a predictor of fetus well-being at admission, which may inform the choice of disposition, including staying on inpatient care or safely discharging with proper follow-up. On the other hand, non-reactive NST does not always have adverse outcomes, and some fetuses can experience temporary non-reactivity as a result of harmless factors like the sleep patterns of the fetus or excessive movement patterns, which underline the necessity of retesting and additional testing in cases of uncertainty. In reality, NST is often used together with biophysical profile (BPP), CTG interpretation, Doppler measurements of uteroplacental and fetal vessels (e.g., umbilical artery and middle cerebral artery), fetal

movements counting, and maternal condition surveillance. The data imply that the NST can be considered nonreactive, which necessitates further examinations to define the fetal condition more accurately, i.e., the introduction of BPP or Doppler tests to assess placental perfusion and fetal well-being. Even in patients with a reactive NST, the clinician might still make the decision of continuing with surveillance, especially when there are other risk factors (e.g., FGR or hypertensive disease) still present. Serial NST measurements are able to offer a dynamic picture of fetal status, which may be able to capture changes in compromise that would otherwise not be detected by a single test, as well as Gestational age and interpretation. Gestational age is also a NST interpretation critical modifier and resultant outcome. Although the tables show that there are distributions by gestational ages, the results of NST are not explicitly stratified by gestational age. It is reasonable that the non-reactive NSTs would be more common in earlier gestation when the fetal autonomic nervous system and oxygen buffer might be less developed, or in fetuses with already diagnosed placental insufficiency, which is more frequently detected in the late second and third trimesters.

Clinical implications of admission decision and resource utilisation. The data suggest that a considerable fraction of admitted high-risk pregnancies has reactive NSTs with quite favourable early neonatal outcomes, indicating that some of these admissions and in-hospital monitoring may be avoided with the use of NST in combination with other stable indicators and with the availability of local resources to permit safe discharge with close outpatient follow-up. Nevertheless, due to the high rates of cesarean and NICU admission in individuals with non-reactive NSTs, the results indicate a cautious stance about non-reactive tracings: they need more substantive assessment and, potentially, escalations of care as opposed to immediate conclusions to delivery without further reference to the clinical environment. The data of the length of stay also indicate that it is plausible that a high number of patients need middle-level care, which serves to support the idea that NST belongs to a wider workflow that also involves monitoring, maternal hemodynamics, and fetal surveillance, which, in cumulative terms, contribute to the length of hospitalization and usage of resources.

Interpretation limitations and considerations. These results have several limitations that must be considered during their interpretation:

**Design of the study:** The data seem to be based on an observational cohort study that is not randomized and does not include a control group. Causal conclusions about NST outcomes and results cannot be drawn; hence, the results might be correlated by underlying placental pathology, maternal comorbidity, and hospital management practices. Stratified analyses would aid in making the difference in performance in NST between these subgroups clear.

**NST protocol information:** The information does not indicate how long was the NST was, on which criteria reactivity was determined, and whether vibroacoustic stimulation was employed or mechanisms of fetal movement were observed concurrently. Such methodology differences could present substantial problems in the interpretation and comparison of the NST findings between studies.

**Definition of outcomes and timing:** The follow-up outcomes are reported, but the methods and duration of follow-up are not described. To make valid conclusions, the incidence of developmental delay needs standardized neurodevelopmental testing and follow-up.

**Possible biases:** There might be selection bias in the case that NST outcomes affected admission to the programs, and some clinicians might have consciously chosen to admit only specific cases depending on the underlying issues. The result may also be subject to observer bias in the interpretation of NST tracings.

**Generalizability:** The results indicate a particular clinical environment, group of patients, as well as healthcare system. Caution has to be taken in the applicability of the setting to other settings with varying resources, guidelines, and patient demographics.

**Practical implications and guidelines.** The information points to the idea that NST is a valuable, uninvase intervention that can be used to evaluate the well-being of the fetus in high-risk pregnancies during admission, especially in combination with multimodal surveillance tactics.

## CONCLUSION

The data under analysis suggests that non-stress testing as an admission test in high-risk pregnancies is linked to significant differences in

the results of perinatal care, especially the comparison of reactive to non-reactive NST outcomes. Reactive NSTs were associated with increased birth weights, increased APGAR scores, and reduced NICU admission rates, and non-reactive NSTs were associated with reduced birth weights and increased neonatal morbidity variables. The results imply that NST should be incorporated into a more comprehensive and multimodal system of assessment in high-risk pregnancies during which the test is only informative, but not definitive, on clinical decisions regarding the intensity of monitoring, admission to more advanced care, and the time of delivery. Another issue that was identified through the results is the significant variation of outcomes in accordance with underlying maternal conditions and gestational age, which is why the specific approach towards fetal surveillance is needed. Although these observations can be promising, they are to be discussed in the framework of the limitations of this research, such as it being observational, the possible presence of confounding variables, and the absence of protocol standardization

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