Evidence-Based Clinical Recommendations for the use of Antenatal Corticosteroids

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ABSTRACT

Antenatal corticosteroid (ACS) therapy is one of the most effective evidence-based interventions for improving neonatal survival and reducing major short-term morbidities associated with prematurity in pregnancies at risk of preterm birth. However, the clinical benefit of ACS largely depends on accurate patient selection, appropriate gestational age, and the reliable prediction of delivery timing. The most pronounced benefit is achieved when delivery occurs within 1-7 days after the initial dose; outside this window, efficacy decreases and the risk of unnecessary fetal exposure increases. Current evidence strongly supports the administration of ACS in pregnancies between 24+0 and 33+6 weeks of gestation with a high risk of preterm birth within the following seven days. Within this gestational window, ACS significantly reduces neonatal mortality as well as major morbidities such as respiratory distress syndrome, intraventricular hemorrhage, and necrotizing enterocolitis. In contrast, the 22+0–23+6 weeks of gestation represent the most sensitive period for the use of ACS, and administration should be considered only in selected cases in which delivery is expected imminently and aggressive neonatal care is planned, within a shared decision-making process. The administration of ACS is not recommended in pregnancies below 22+0 weeks of gestation. The use of ACS in the late preterm period (34+0-36+6 weeks of gestation) remains controversial, and no survival benefit has been demonstrated. Although ACS may modestly reduce the need for respiratory support during this period, it increases the risk of neonatal hypoglycemia, and uncertainties persist regarding long-term neurodevelopmental outcomes. Therefore, ACS should not be used routinely but should be considered only in selected cases where a clear potential benefit is evident. There is insufficient evidence to support the use of prophylactic ACS prior to planned cesarean delivery at ≥37 weeks of gestation. Although repeated courses of ACS may provide short-term respiratory benefits, their use should be carefully limited due to concerns regarding fetal growth and potential long-term effects associated with increased exposure. Overall, ACS should be administered using a targeted, selective, and individualized approach.

Keywords: Antenatal corticosteroids; Neonatal outcomes; Preterm birth

Gynecol Obstet Reprod Med 2026;32(2):131-141

Introduction

Antenatal corticosteroid (ACS) therapy is one of the most powerful evidence-based interventions for improving neonatal prognosis in pregnancies at risk of preterm birth. Current high-level evidence demonstrates that a single course of ACS administration not only accelerates pulmonary maturation in the preterm neonate but also significantly reduces neonatal mortality and major prematurity-related morbidities (1). This effect is considered to be associated not only with a reduction in respiratory distress syndrome but also with a decreased incidence of intraventricular hemorrhage and necrotizing enterocolitis, attributable to improved hemodynamic stability.

The fundamental determinant of the clinical value of ACS therapy is the accurate prediction of delivery timing. Current evidence indicates that the most pronounced benefit is achieved when preterm birth occurs within 1-7 days after the initial dose (2-4). In contrast, in pregnancies with a low likelihood of preterm delivery or when the timing of delivery falls outside this window, the administration of ACS not only fails

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Submitted for Publication: 10.04.2026 Revised for Publication: 12.05.2026
Accepted for Publication: 12.07.2026 Online Published: 23.07.2026

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QR Code	Access this article online
	www.gorm.com.tr • https://mndijital.medicalnetwork.com.tr gorm@medicalnetwork.com.tr
	Doi:10.21613/GORM.2025.1724

How to cite this article: *Akalin M. and Demirci O. Evidence-Based Clinical Recommendations for the use of Antenatal Corticosteroids. Gynecol Obstet Reprod Med. 2026;32(2):131-141*

to provide the expected benefit but may also result in unnecessary fetal exposure and potential long-term effects. In this context, ACS is not recommended as a widespread, reflexive practice; rather, it should be considered a targeted therapy for high-risk, carefully selected cases, with due consideration of the benefit–risk balance. It should be acknowledged that the effectiveness and safety of ACS may vary across different healthcare settings, depending on factors such as the accuracy of patient selection, timing of administration, and the availability of adequate neonatal care.

The Clinical Opinion of the Turkish Society of Maternal-Fetal Medicine and Perinatology aims to evaluate evidence on the use of ACS in pregnancies at risk of preterm birth and to highlight key considerations to prevent excessive and non-indicated use of ACS in clinical decision-making.

Beneficial and Potential Adverse Effects of ACS on the Fetus

Beneficial Effects of ACS on the Fetus: ACS promotes structural and functional maturation of the fetal lung by accelerating the development of type I and type II pneumocytes; this process results in improved lung mechanics, enhanced gas exchange, and facilitated postnatal pulmonary adaptation (5,6). Stimulation of mechanisms involved in surfactant release and alveolar fluid clearance, increased pulmonary defense capacity against oxidative stress, and activation of epithelial transport pathways responsible for lung fluid absorption constitute the principal biological components of this effect (7,8). However, the emergence of this response depends on the fetus having reached a stage of lung development that can respond to corticosteroids; this explains why the lower gestational age threshold is critical for ACS administration.

Experimental data suggest that exposure to ACS may modulate not only pulmonary effects but also central hemodynamic responses. In particular, ACS may be associated with a reduced risk of intraventricular hemorrhage by suppressing hypercapnia-induced increases in cerebral blood flow (9). Studies forming the basis of clinical recommendations demonstrate that the effects of ACS are not limited to reductions in respiratory morbidity but also support the transition to extrauterine life by stimulating concurrent developmental processes across multiple organs and systems (10,11). However, for these benefits to become clinically meaningful, strict adherence to the appropriate gestational age and correct indications is essential.

Subgroup-specific clinical contexts such as multiple gestation, fetal growth restriction, diabetes, preterm premature rupture of membranes, and mode of delivery may influence the balance of risks and benefits of ACS and should be considered in individualized clinical decision-making.

Potential Adverse Effects of ACS on the Fetus: ACS has been shown to exert tissue-specific apoptotic effects at the cellular level (12). This biological effect is considered a potential mechanism that may lead to adverse outcomes on fetal growth and neurodevelopment, particularly when exposure occurs during developmentally sensitive periods. Concerns that supraphysiologic corticosteroid exposure in later gestational ages may negatively affect fetal brain development underscore the need for extreme selectivity in the use of ACS during this period. Therefore, the balance between short-term neonatal benefits and potential long-term developmental effects should be carefully considered when using ACS.

Current evidence regarding the administration of a single course of ACS suggests that most short-term adverse fetal and neonatal outcomes, such as increased infection rates or small-for-gestational-age birth weight, are generally not elevated (13). However, some studies have reported suppression of both basal and stress-responsive cortisol secretion in neonates exposed to ACS, an increased rate of low birth weight among term infants, and a higher risk of serious infections during the first year of life (14-16).

The most consistently reported short-term adverse effect of ACS administration in the late preterm period is an increased incidence of neonatal hypoglycemia (17). Randomized data demonstrate that hypoglycemia occurs more frequently in exposed neonates compared with controls; however, in most cases, this condition is transient, readily detectable, and responsive to standard clinical management, including early feeding and glucose monitoring. Importantly, current evidence suggests that when neonatal hypoglycemia is promptly recognized and appropriately treated, it is generally not associated with significant long-term adverse outcomes. However, evidence suggesting that neonatal hypoglycemia is not merely an acute metabolic disturbance but may also be associated with long-term neurodevelopmental delays confers particular importance to this adverse effect. Even more notably, despite the transient nature of hypoglycemia and appropriate treatment, the associated neurodevelopmental risk may not be eliminated (18).

Nevertheless, these findings should be interpreted with caution, as the available evidence remains heterogeneous and may be influenced by confounding factors, such as underlying perinatal conditions and the severity of hypoglycemia. Concerns appear to be more relevant in recurrent, severe, or unrecognized hypoglycemia cases, underscoring the importance of careful postnatal monitoring and appropriate management strategies in neonates exposed to ACS. Therefore, while neonatal hypoglycemia is a clinically relevant and measurable adverse effect, its clinical significance should be interpreted in light of its generally transient nature, the effectiveness of current management approaches, and the overall balance between potential risks and respiratory benefits.

Findings regarding neonatal mortality vary significantly according to country income level and healthcare system condi-

tions. While ACS has been shown to improve neonatal survival in high-income countries, studies from low- and middle-income countries have reported an increase in neonatal mortality (19). These adverse outcomes are thought to be largely attributable to off-indication and excessive use of ACS, inaccurate prediction of gestational age and delivery timing, and the lack of adequate neonatal care infrastructure. Indeed, studies in which the therapy was applied in appropriately selected cases and under suitable neonatal care conditions have demonstrated that ACS significantly reduces neonatal mortality (20). These data underscore that the safety and efficacy of ACS are closely related not so much to the drug itself, but to appropriate patient selection and the context of ACS administration

In most long-term follow-up studies of children exposed to a single course of ACS before 34 weeks of gestation, no significant adverse cardiovascular, respiratory, or neurodevelopmental outcomes have been demonstrated (21,22). However, experimental data suggest that ACS promotes terminal cellular differentiation rather than cell proliferation during fetal organ development, which may increase susceptibility to metabolic, cardiovascular, and psychiatric disorders in the long term (23).

Large-scale observational data indicate that the neurodevelopmental effects of ACS exposure vary according to gestational age. Exposure to a single course of ACS is associated with a reduced risk of neurodevelopmental disorders in extremely preterm infants; however, in late preterm and especially term-born children, modest but consistent increases in the risk of neurocognitive, mental, and behavioral problems have been reported (24). This phenomenon is thought to be related to neurodevelopmental vulnerability associated with supraphysiologic corticosteroid exposure during the period of accelerated brain development after 34 weeks of gestation. Nevertheless, evidence on long-term outcomes is inconsistent, and studies showing no adverse effects also exist. Recent follow-up studies, including those from the ALPS trial, provide further reassurance regarding neurodevelopmental outcomes at school age following late-preterm exposure. Long-term follow-up studies suggest that exposure to a single course of ACS is not associated with significant harm in most neurodevelopmental outcomes, and that some observed cognitive differences remain of uncertain clinical significance (25,26). These inconsistencies may be explained by underlying pregnancy pathologies leading to ACS administration, the difficulty of selecting appropriate control groups, and the differing neurodevelopmental sensitivities of the developmental window during which exposure occurs. Current data suggest that the clear benefits of ACS in very early preterm births outweigh the potential neurodevelopmental risks reported in the late preterm and term periods; therefore, the use of ACS in later gestation should be highly selective.

Timing, Drug Selection, and Dosing in ACS Therapy

Timing in ACS Therapy: Timing in ACS therapy is the most critical determinant of clinical efficacy. Current evidence indicates that the greatest benefit is achieved when the first dose is administered 1-7 days before delivery; when given within 24 hours before birth, efficacy is limited, and after seven days, it declines thereafter (2-4).

Although the 1-7-day interval between ACS administration and delivery remains the optimal therapeutic window, emerging evidence suggests that biologically meaningful effects may begin much earlier. Experimental and clinical data indicate that corticosteroid-induced changes in fetal lung fluid clearance, surfactant production, and pulmonary compliance may be initiated within hours of the first dose. Observational studies have reported reductions in neonatal mortality and respiratory morbidity even when delivery occurs within 24 hours of ACS administration, although the magnitude of benefit is generally lower than in the optimal window (27,28). These findings suggest that the effect of ACS should not be interpreted as an "all-or-none" phenomenon strictly confined to the 1-7-day interval, but rather as a time-dependent continuum in which partial benefit may still be achieved even with shorter exposure intervals. Observational and experimental data suggest that physiological effects may begin within hours after the initial dose; in some studies, reductions in neonatal mortality have been reported as early as two hours (27,28). However, the consistency and clinical significance of these early effects remain variable across studies, and current evidence does not support modifying established timing recommendations based on these findings alone.

Accurately predicting the timing of preterm delivery remains a major clinical challenge. Despite advances in risk stratification, a substantial proportion of women identified as being at high risk of preterm birth do not deliver within the optimal time window. Studies have shown that more than half of patients diagnosed with preterm labor do not deliver within seven days of diagnosis, and a considerable proportion ultimately deliver at term (29). This is clinically significant, as evidence indicates that early ACS exposure in infants born at term may increase the risk of adverse outcomes compared with those not exposed. Therefore, ACS is not recommended based on broad or early indications, but rather in carefully selected cases in which the timing of delivery can be predicted with high probability, minimizing unnecessary exposure associated with mistimed administration. Importantly, this uncertainty creates a fundamental clinical trade-off, while delaying ACS administration may risk missing the optimal window in cases of imminent delivery, early administration increases the likelihood of overtreatment and exposure in pregnancies that ultimately continue to term. This dilemma underscores the need for a cautious, individualized approach that integrates clinical findings, risk factors, and dynamic reassessment, rather than relying on a single time-point decision. Taken together, these considerations suggest that ACS timing of administration should be viewed as a probabilistic clinical deci-

sion, in which both the potential for early benefit and the risk of mistimed exposure must be carefully balanced.

Drug and Dose Selection: Parenteral (intramuscular) betamethasone and dexamethasone are agents whose efficacy in accelerating fetal lung maturation has been demonstrated in randomized trials and are considered equivalent in ACS therapy (30). Although some clinicians prefer betamethasone for its greater reduction in the risk of intraventricular hemorrhage, no direct head-to-head comparison exists, and meta-analyses have not demonstrated significant differences among ACS types in their effects on intraventricular hemorrhage (1). On the other hand, hydrocortisone, another corticosteroid, has limited transplacental passage due to extensive placental metabolism and is therefore not recommended in routine ACS therapy. However, in exceptional situations where betamethasone and dexamethasone are unavailable, intravenous hydrocortisone (500 mg every 12 hours, for a total of four doses) may be used as a last resort (31). In pregnant women receiving hydrocortisone for another medical indication, if there is an indication for fetal lung maturation, a standard course of betamethasone or dexamethasone is recommended.

Standard dosing regimens for betamethasone and dexamethasone have been defined to provide the most effective and safe acceleration of fetal lung maturation. Betamethasone is administered as two intramuscular doses of 12 mg given 24 hours apart. Dexamethasone, due to its more rapid onset of action and shorter duration of effect, is administered as four intramuscular doses of 6 mg at 12-hour intervals. Current evidence indicates that, at these standard doses, corticosteroid receptors are largely saturated, and a near-maximal biological response is achieved in fetal target tissues (32). In contrast, there is no convincing evidence that non-standard regimens, such as dose increases or decreases, single-dose courses, weight-based dosing, shorter dosing intervals, or intravenous/oral administration, provide any additional benefit in efficacy or safety. Therefore, adherence to evidence-based standard dosing and administration protocols is recommended in ACS therapy.

In pregnant women with diabetes, ACS administration should not be delayed when an obstetric indication is present. However, maternal glucose levels should be closely monitored due to the risk of steroid-induced secondary hyperglycemia. The effect of corticosteroids on maternal glycemic control typically begins approximately 12 hours after the first dose and may persist for up to five days. Therefore, frequent blood glucose monitoring (including capillary glucose measurements at regular intervals, particularly within the first 48-72 hours after administration) is recommended for diabetic pregnant women receiving ACS, particularly those using insulin, and insulin doses should be appropriately adjusted based on glycemic values.

Recommendations for ACS Administration According to Gestational Age

For pregnancies with a high likelihood of delivery within the next 1–7 days, recommendations for ACS administration by gestational age are presented in Figure 1.

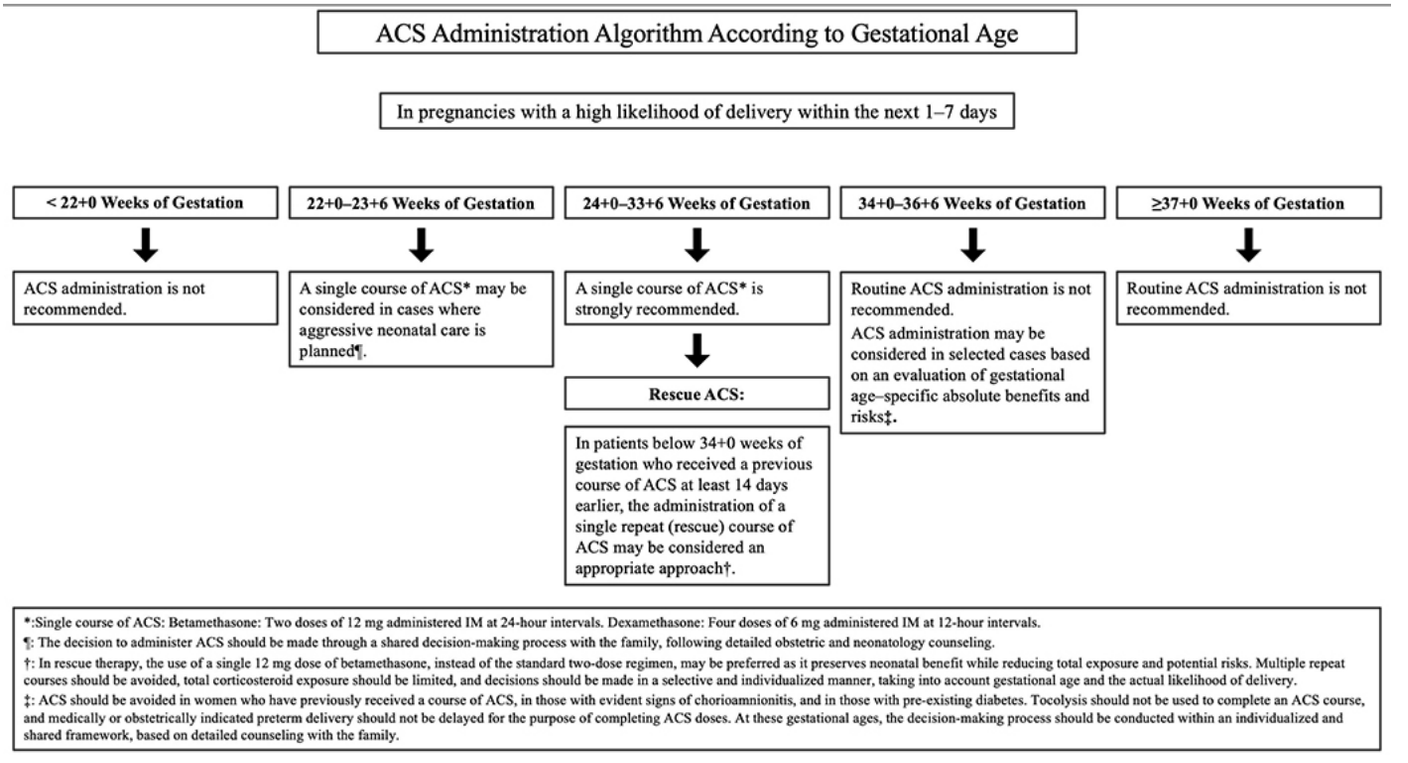

Figure 1: *Recommendations for antenatal corticosteroid administration according to gestational age in pregnancies with a high likelihood of delivery within the next 1-7 days*

<22+0 Weeks of Gestation

In this early gestational period, the fetal lungs have not yet reached the developmental maturity required to mount a meaningful and sustained response to corticosteroids; the number of alveolar structures through which the drug can exert its effect is extremely limited, and the biological targets necessary for pulmonary maturation are insufficiently developed (33). In addition, clinical data evaluating neonatal survival and morbidity outcomes following ACS exposure at 20+0-21+6 weeks of gestation are very limited, and existing studies do not demonstrate a consistent or clinically meaningful benefit. This limited biological response capacity, together with the insufficient evidence base, renders the potential benefit of ACS use in early gestational weeks uncertain, while raising concerns regarding unnecessary fetal exposure and possible adverse effects. Therefore, the administration of ACS is not recommended in pregnancies below 22+0 weeks of gestation.

22+0–23+6 Weeks of Gestation

This gestational age range represents the most complex and ethically sensitive period for the use of ACS. During this stage, a shared decision-making process is critical, as families, obstetricians, and neonatologists must collaboratively balance the probability of survival against the risk of severe lifelong morbidity. The primary potential benefit of ACS at these gestational ages is an increase in survival; however, the high risk of major long-term morbidity among survivors must be explicitly incorporated into the decision-making process.

Evidence regarding the efficacy of ACS at very early gestational ages has been derived from meta-analyses of randomized trials and large observational databases. These data indicate that ACS exposure at 22 and 23 weeks of gestation is associated with a reduction in mortality, and at 23 weeks, with a decreased risk of severe intraventricular hemorrhage or periventricular leukomalacia; however, no consistent reduction has been demonstrated in other major morbidities such as necrotizing enterocolitis or chronic lung disease (34). Large cohort analyses further show that survival rates are significantly higher among infants exposed to ACS, whereas the likelihood of survival without major morbidity remains low in both exposed and unexposed groups. In infants born at 22 weeks of gestation who received postnatal life support, survival was 38.5% among those exposed to ACS, compared with 17.7% among those not exposed; however, survival without major morbidity remained limited in both groups (4.4% and 1.0%, respectively) (35). Similarly, in studies including infants born at 22+0–23+6 weeks of gestation, survival to discharge was 53.9% among those who received a complete course of ACS and 35.5% among those who did not; survival without major morbidity at 36 weeks' postmenstrual age was 26.9% and 10.0%, respectively (36). These data suggest that, when active neonatal care is planned, the use of ACS at very early gestational ages may provide a meaningful survival benefit.

In light of these findings, the administration of ACS may be considered between 22+0 and 23+6 weeks of gestation in cases with a high likelihood of delivery within the next seven days, following detailed maternal-fetal medicine and neonatology counseling, and when aggressive neonatal care is planned. However, an important additional concern in this gestational range is that a substantial proportion of fetuses exposed to ACS do not deliver within seven days and may be exposed to multiple courses of ACS prior to birth. As this may increase exposure-related risks, particularly regarding potential long-term adverse effects, the decision to administer ACS at these gestational ages should be highly selective, individualized, and based on a clearly communicated risk-benefit assessment with the family.

24+0–33+6 Weeks of Gestation

A systematic review of randomized trials has demonstrated that ACS administration at these gestational ages provides substantial benefits in neonatal and perinatal outcomes. ACS significantly reduces neonatal mortality, perinatal death, respiratory distress syndrome, the need for mechanical ventilation or continuous positive airway pressure, intraventricular hemorrhage, and the risk of necrotizing enterocolitis (1). Although a marked reduction has also been observed in moderate-to-severe respiratory distress syndrome, its effect on chronic lung disease remains unclear.

In light of this robust evidence, ACS administration is recommended for all pregnancies between 24+0 and 33+6 weeks of gestation with an increased risk of preterm birth within the next seven days. Within this gestational window, ACS improves neonatal survival and reduces major short-term morbidities; however, potential long-term neurodevelopmental effects should be considered. The identification of appropriate candidates should be based on clinical assessment indicating a high likelihood of delivery in the near term due to obstetric or medical indications or an increased risk of spontaneous preterm birth, such as active preterm labor accompanied by cervical changes.

34+0–36+6 Weeks of Gestation

The use of ACS at these gestational ages remains an area without full consensus among international organizations and requires careful evaluation of the benefit–risk balance. ACS use at ≥34 weeks of gestation remains controversial, as no survival benefit has been demonstrated and the absolute benefit is limited given the relatively low incidence of severe respiratory morbidity at this stage; additionally, uncertainties regarding potential long-term effects persist. Therefore, ACS use at these gestational ages is not recommended as a routine approach, but rather an individualized decision requiring careful assessment of the benefit-risk balance.

In a large randomized trial including pregnant women at high risk of late preterm birth between 34+0 and 36+5 weeks of gestation, the administration of ACS resulted in a modest

but significant reduction in the composite outcome of neonatal respiratory support requirement within the first 72 hours after birth, stillbirth, or neonatal death within the first 72 hours (11.6% vs. 14.4%; RR 0.80) (13). This effect was primarily driven by a reduction in the use of continuous positive airway pressure (CPAP) and high-flow nasal cannula, with no cases of stillbirth or early neonatal death observed. The incidence of transient tachypnea of the newborn was also lower in the treatment group (6.7% vs. 9.9%; RR 0.68). In contrast, no significant differences were found between the groups in respiratory distress syndrome (5.5% vs. 6.4%) or the need for mechanical ventilation (2.4% vs. 3.1%).

A more granular interpretation of the late preterm period reveals substantial heterogeneity in both baseline risk and treatment effect according to gestational age and mode of delivery. Evidence from randomized and secondary analyses indicates that although relative risk reductions may appear consistent, absolute treatment effects vary significantly across clinically relevant subgroups (13,37). Subgroup analyses demonstrate that absolute risk differences vary markedly by gestational week. The baseline risk of respiratory morbidity decreases substantially with advancing gestational age, resulting in diminishing absolute benefit. For example, in patients presenting at 34 weeks of gestation and undergoing planned cesarean delivery, the risk of neonatal respiratory morbidity was 39.4% without ACS and 32.0% with ACS (absolute risk reduction [ARR] 7.4%). In contrast, at 36 weeks of gestation with planned vaginal delivery, the corresponding risks were 6.9% and 5.6%, respectively (ARR 1.3%) (37). These findings highlight that the clinical impact of ACS is substantially greater in the earlier late-preterm weeks and in higher-risk subgroups.

Mode of delivery further modifies the treatment effect. Planned cesarean delivery is associated with a significantly higher baseline risk of respiratory morbidity compared with vaginal birth (adjusted RR 1.90), thereby increasing the absolute benefit derived from ACS in this subgroup (37). Conversely, in pregnancies with anticipated vaginal delivery, particularly at later gestational ages, the baseline risk is low, and the absolute reduction in respiratory morbidity becomes marginal.

In contrast to these modest respiratory benefits, the risk of neonatal hypoglycemia increases significantly with ACS exposure in the late preterm period, occurring in 24.0% of exposed neonates compared with 15.0% in unexposed controls (absolute risk increase 9.0%; RR 1.60) (13). This adverse effect is clinically relevant, particularly given concerns regarding potential neurodevelopmental implications.

Taken together, these data indicate that the benefit–risk balance of ACS in the late preterm period is highly dependent on gestational age, planned mode of delivery, and baseline risk. While clinically meaningful benefit may be observed in earlier gestational weeks and in pregnancies scheduled for cesarean delivery, the absolute benefit becomes progressively smaller toward 36 weeks, whereas exposure-related risks remain constant. Therefore, individualized decision-making based on subgroup-specific absolute risks is essential to optimize clinical outcomes.

The interpretation of short-term benefits associated with ACS in the late preterm period should be considered in the context of available long-term outcome data. Although the ALPS trial demonstrated a reduction in short-term respiratory morbidity (13), follow-up analyses and subsequent cohort studies have not demonstrated consistent evidence of significant long-term neurodevelopmental impairment among children exposed to ACS in this gestational window (24,25). These findings are generally reassuring and suggest that the observed increase in neonatal hypoglycemia does not translate into a clear and measurable long-term neurodevelopmental disadvantage at the population level (25,26).

However, it is important to acknowledge that long-term data in the late preterm population remain limited, and available studies may not be adequately powered to detect subtle neurocognitive or behavioral differences. In addition, observational studies evaluating broader populations have reported modest associations between ACS exposure at later gestational ages and increased risks of neurodevelopmental or behavioral disorders, although causality remains uncertain due to potential confounding factors (24).

Taken together, current evidence suggests that while short-term respiratory benefits are well established and long-term outcomes appear largely reassuring, a degree of uncertainty persists. Therefore, the decision to administer ACS in the late preterm period should consider not only immediate neonatal benefits but also the limited long-term evidence, reinforcing the importance of a cautious and individualized approach.

When international guidelines and expert opinions are considered together, the administration of ACS between 34+0 and 36+6 weeks of gestation should not be regarded as a routine and widespread practice. Rather, it should be considered only in selected cases with a high likelihood of delivery within the next seven days, a clearly established delivery plan, and a clear potential benefit, with decisions based on gestational age-specific absolute benefits and risks (38-43). In particular, ACS is not recommended between 34+0 and 36+5 weeks of gestation in cases with threatened preterm labor without significant cervical change, in women who have previously received a course of ACS, in pregnancies with evident signs of chorioamnionitis, and in those with pre-existing diabetes. Tocolysis is not recommended to complete an ACS course at 34+0–36+5 weeks of gestation, and medically or obstetrically indicated preterm delivery is not recommended to be delayed for the purpose of completing ACS doses. At these gestational ages, the decision-making process should be conducted within an individualized

and shared framework, taking into account the mode of delivery, underlying obstetric pathology, availability of neonatal care, and detailed counseling with the family.

≥37+0 Weeks of Gestation

Current evidence regarding the use of ACS prior to planned cesarean delivery at ≥37+0 weeks of gestation is insufficient to demonstrate a clear clinical benefit in practice. Available data are inconsistent and of low certainty, suggesting a possible reduction in respiratory morbidity (44). In contrast, there are difficult-to-explain clinical findings such as an increased need for mechanical ventilation, as well as significant gaps in knowledge regarding neonatal hypoglycemia and long-term outcomes. Furthermore, methodological limitations and potential bias in existing studies reduce the reliability of these results. For these reasons, there is insufficient high-quality evidence to support the prophylactic use of ACS prior to planned cesarean delivery at ≥37 weeks of gestation, and routine use is not recommended.

Recommendations for Rescue ACS Administration

Current evidence suggests that repeated courses of ACS provide short-term respiratory and neonatal benefits; however, they do not confer additional long-term benefits, and, due to concerns about potential adverse effects on long-term neurodevelopmental outcomes, their use should be cautious, limited, and individualized. The Cochrane systematic review has evaluated the efficacy and safety of repeated courses in women who remain at risk of preterm birth ≥7 days after the initial single ACS course (45). An analysis including ten randomized controlled trials demonstrates that repeated administration of ACS significantly reduces the risk of respiratory distress syndrome (RR 0.83) and serious neonatal outcomes (RR 0.84), thereby providing short-term neonatal benefit. In contrast, repeated courses have been associated with a small reduction in mean birth weight at delivery; however, no significant adverse effects have been identified for growth parameters adjusted for gestational age or for outcomes such as mortality, major neurodevelopmental disability, or growth in early childhood.

Current meta-analyses have not systematically evaluated whether the risk of harm increases with more frequent repeated ACS courses; therefore, caution is warranted regarding the administration of multiple repeat (rescue) courses. Some studies have reported concerning findings suggesting that increased exposure to ACS may be associated with adverse effects. In pregnancies receiving multiple courses, a significant increase in the rate of small-for-gestational-age fetuses has been observed, placental weight has been shown to decrease inversely with the number of courses, and although statistical certainty is limited, there may be a trend toward an increased incidence of cerebral palsy (46-49). Furthermore, secondary analyses from randomized trials support a dose–response relationship between the number of ACS courses and reduced fetal growth. Although no clear increase has been demonstrated in mortality or major neurodevelopmental impairment at five years of age, increasing exposure appears to be associated with a less favorable risk profile. In light of these findings, the administration of multiple repeat courses of ACS should be restricted to highly exceptional circumstances, given the potential for long-term adverse effects.

In line with current evidence and other national guidelines, the administration of a single repeat (rescue) course of ACS may be considered in patients below 34+0 weeks of gestation who have a high likelihood of preterm delivery within the next seven days and who received a previous course of ACS 7-14 days earlier, depending on clinical circumstances. In rescue therapy, a single 12 mg dose of betamethasone, rather than the standard two-dose regimen, may be preferable, as it preserves neonatal benefit while reducing total exposure and potential risks (50). However, regimens consisting of two doses of betamethasone or four doses of dexamethasone are also acceptable. Nevertheless, multiple repeat courses are not recommended; total corticosteroid exposure should be limited, and the decision should be made selectively and individually, taking into account gestational age and the likelihood of delivery.

National Evidence and Context from Türkiye

Available data on ACS use in Türkiye remain limited and largely derive from heterogeneous single-center observational studies. As a result, the national evidence base does not yet allow for robust, population-level conclusions regarding the efficacy and safety of ACS across different clinical contexts.

Several cohort studies from Türkiye focusing on the late-preterm period have demonstrated a reduction in neonatal respiratory morbidity following ACS administration (51,52). One notable contribution from Türkiye is a cohort study by Beksac et al., which evaluated the effects of a single course of antenatal betamethasone in pregnancies between 24 and 34 weeks' gestation. In this study of 493 neonates, ACS exposure was not associated with reduced respiratory morbidity; in contrast, the treatment group had higher rates of respiratory distress syndrome, congenital pneumonia, neonatal sepsis, and bronchopulmonary dysplasia than controls (53). Subgroup analyses further suggested that these adverse associations were more pronounced in earlier gestational age groups, particularly among extremely preterm infants. These findings contrast with the well-established benefits reported in large randomized trials and international meta-analyses, highlighting the complexity of translating global evidence into local clinical practice. Importantly, the results of this study may reflect differences in patient selection, timing of administration, underlying clinical conditions, or healthcare system–related factors, rather than directly contradicting the biological effects of ACS.

Taken together, the limited and heterogeneous data from Türkiye, including studies reporting both beneficial and po-

tentially unfavorable outcomes, underscore the need for cautious interpretation and context-specific clinical decision-making. In the absence of large-scale, high-quality national data, current practice in Türkiye continues to rely predominantly on international evidence. However, these findings also emphasize the importance of appropriate patient selection, optimal timing, and avoidance of non-selective use of ACS, principles that are central to this clinical opinion.

Conclusion

ACS therapy is one of the most powerful evidence-based interventions in obstetric practice, improving neonatal survival and reducing major short-term morbidities associated with prematurity in pregnancies at risk of preterm birth. However, the clinical benefit of ACS is highly dependent on accurate patient selection, appropriate gestational age, and precise prediction of delivery timing. Inappropriate timing and broad, non-selective indications not only fail to provide the expected benefit but may also lead to unnecessary fetal exposure and potential short- and long-term adverse effects. Therefore, ACS is not recommended as a routine, reflexive approach but rather as a targeted, selective therapy.

Timing in ACS therapy is the most critical determinant of clinical effectiveness. The greatest benefit is achieved when the first dose is administered 1-7 days before delivery; when administered outside this window, efficacy decreases markedly. The use of ACS based solely on the presence of preterm contractions without significant cervical change results in a high rate of overtreatment and may increase the risk of potential harm, particularly in infants ultimately born at term. Therefore, the decision to administer ACS should be based on clinical scenarios in which the timing of delivery can be predicted with reasonable reliability.

Based on current evidence, the administration of ACS is strongly recommended in pregnancies between 24+0 and 33+6 weeks of gestation with a high risk of preterm delivery within the next seven days. Within this gestational window, ACS significantly reduces neonatal mortality as well as major morbidities such as respiratory distress syndrome, intraventricular hemorrhage, and necrotizing enterocolitis. In contrast, 22+0–23+6 weeks of gestation represent the most complex and ethically sensitive period for the use of ACS. At these gestational ages, ACS may be considered only in highly selected cases in which delivery is imminent and aggressive neonatal care is planned following detailed maternal–fetal medicine and neonatology counseling, as part of a shared decision-making process. In pregnancies below 22+0 weeks of gestation, the administration of ACS is not recommended based on current biological and clinical evidence. The use of ACS between 34+0 and 36+6 weeks of gestation remains controversial due to the lack of demonstrated survival benefit, the limited absolute respiratory benefit, and uncertainties regarding neonatal hypoglycemia and potential long-term neurodevelopmental effects. During this period, ACS is not recommended for routine use; rather, it may be considered only in selected cases with a high likelihood of delivery within the next seven days, a clearly established delivery plan, and a clear potential benefit, based on a gestational age–specific assessment of absolute benefits and risks. At ≥37 weeks of gestation, particularly prior to planned cesarean delivery, there is insufficient robust evidence to support the prophylactic use of ACS; therefore, routine use is not recommended.

Evidence regarding repeated (rescue) ACS administration indicates that short-term respiratory benefits may be achieved; however, no additional long-term benefit has been demonstrated. Moreover, concerns persist regarding fetal growth restriction and potential neurodevelopmental effects with increasing exposure. Therefore, in selected cases below 34+0 weeks of gestation who received a prior course of ACS at least 14 days earlier and remain at high risk of preterm delivery within the next seven days, the administration of a single rescue course may be considered appropriate. Avoiding multiple repeat courses is one of the key expert-opinion recommendations in this field.

In conclusion, although ACSs hold an indispensable place in modern perinatology practice, they should be used to ensure optimal effect in the right patient, at the right time, and with the least possible exposure. The clinical decision-making process should be conducted within an individualized and shared framework, taking into account gestational age, the actual likelihood of preterm delivery, accompanying obstetric conditions, the availability of neonatal care, and detailed counseling with the family.

Acknowledgments: This study has been published on Maternal Fetal Medicine and Perinatology Society of Türkiye under the category "Clinical Opinion".
Financial and material support: No funds were received in support of this work. No benefits in any form have been or will be received from a commercial party related directly or indirectly to the subject of this manuscript.
Conflict of interests: The authors have no conflicts of interest relevant to this article.
Authors' contributions: MA: Conceived the manuscript, performed the literature review, critically appraised the available evidence, drafted the manuscript, and developed the clinical recommendations and figure. OD: Contributed to the study concept, interpreted the evidence, critically revised the manuscript for important intellectual content, and supervised the preparation of the manuscript.

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