

Original Article

Impact of discontinuing routine corticosteroid premedication on contrast reaction rates in high-risk patients: A clinical audit

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Abstract

Background: Recent guidelines question the efficacy of routine corticosteroid premedication for patients with asthma or multiple drug allergies undergoing contrast-enhanced computed tomography (CECT), citing limited evidence of its effectiveness.

Objective: To evaluate the incidence of documented contrast reactions following the cessation of routine corticosteroid premedication in high-risk patients.

Materials and Methods: A retrospective single-centre audit was conducted from September 2021 to April 2022, including 527 patients undergoing CECT. Routine corticosteroid premedication was discontinued for high-risk patients (those with known asthma or multiple drug allergies, defined as allergies to three or more drug classes), except for individuals with confirmed contrast media allergies. Demographic and clinical data, including reaction severity, were collected using REDCap. Reaction rates between premedicated and non-premedicated groups were compared using appropriate statistical tests for categorical and continuous variables.

Results: Of 527 patients, 82 received premedication and 445 did not. Reaction rates were 1.2% (1/82) in the premedicated group and 0.4% (2/445) in the non-premedicated group ($p = 0.4$). All observed reactions were mild (grade 1–2), consisting mainly of urticaria, with no severe reactions recorded in either group. Demographics were comparable between groups.

Conclusion: Discontinuing routine corticosteroid premedication for high-risk patients was not associated with a statistically significant increase in contrast reactions in this audit and aligns with current guideline recommendations from professional bodies. However, due to the small number of events and the retrospective design, these findings should be interpreted with caution. Further studies are needed to confirm the safety of this approach in broader patient populations.

Keywords: Allergies, Contrast media, Contrast reactions, Corticosteroid premedication, High-risk patients.

Introduction

Each year, approximately 300 million computed tomography (CT) procedures are performed worldwide, with an annual increase of 4% [1]. The majority of these are contrast-enhanced CT (CECT) scans, which are widely used for diagnosing and monitoring a range of medical conditions [2]. Iodinated contrast media (ICM) are among the most commonly administered drugs globally, used in about 75 million examinations annually, with adverse reactions occurring in 1% to 3% of cases [3]. While most reactions are mild and self-limiting, severe or life-threatening events can still occur [4].

Adverse effects of ICM, often referred to as contrast allergies, are classified by reaction type, severity, or mechanism [5]. Reactions are categorized by onset as acute (within 60 minutes), delayed (1 hour to 1 week), or late (more than a week) [6]. Acute reactions are further classified as mild, moderate, or severe [4]. Delayed reactions affect about 2% of patients, and are typically mild cutaneous hypersensitivity reactions occurring hours to days after contrast exposure [4,5]. Both delayed and late reactions are generally self-limiting and typically require only symptomatic treatment [7].

ICM, introduced in the 1920s, initially consisted of ionic, high-osmolar contrast materials, which carried higher risks of acute reactions [7]. Risk factors for contrast reactions include multiple drug allergies (MDA defined as allergies to three or more drug classes [8]), asthma, and comorbidities such as heart disease or diabetes.

Premedication with corticosteroids was strongly advised in the 1980s and 1990s, reflecting the higher risk associated with earlier contrast agents. However, the efficacy of corticosteroid premedication in high-risk patients remains controversial, with limited scientific evidence supporting its effectiveness [9]. Studies show that adverse reactions can still occur despite premedication, and corticosteroid use may also be associated with potential adverse effects such as transient hyperglycaemia, leukocytosis, and increased susceptibility to infection in certain patients [10]. These findings have prompted increasing scrutiny of routine corticosteroid prophylaxis and contributed to evolving guideline recommendations regarding its use.

The introduction of low-osmolar contrast media (LOCM) significantly reduced adverse event rates, leading to updated guidelines from the American College of Radiology (ACR) [4] and the European Society for Urogenital Radiology (ESUR) [11], which recommend premedication only for patients with a known history of contrast media reactions. Our institution previously administered routine corticosteroid prophylaxis to premedication to high-risk patients, including those with asthma or multiple drug allergies, following a regimen similar to that used for patients with known ICM allergies. To align with recommendations from professional bodies such as the ACR and ESUR, we adopted a policy of discontinuing premedication for these patients. We conducted a clinical audit to evaluate the incidence of acute contrast reactions following the discontinuation of routine corticosteroid premedication in high-risk patients without a prior contrast media allergy during the implementation of this protocol change.

Materials and methods

This audit was conducted at a single tertiary academic institution and reflects real-world implementation within this centre. Ethics approval and consent were waived by the local institution, given its observational, retrospective, and non-interventional nature. Patient records were de-identified prior to analysis.

From September 2021 to April 2022, our institution implemented a change in the corticosteroid premedication protocol for contrast-enhanced CT (CECT) scans. Previously, high-risk patients - including those with asthma and multiple drug allergies - routinely received premedication, and scans were postponed if the regimen was incomplete. This protocol reflected earlier institutional practice derived from historical literature and prior contrast safety recommendations, when prophylactic corticosteroids were more widely used for patients considered at increased risk of contrast reactions [12]. Under the new protocol, premedication is reserved only for patients with documented

contrast media allergies. Other high-risk groups no longer receive routine premedication, although referring clinicians may still prescribe premedication at their discretion. Because premedication could therefore be prescribed according to clinician judgement rather than random allocation, the premedicated group may have included patients perceived to be at higher risk of contrast reactions, introducing potential selection bias. This change aimed to reduce unnecessary steroid use while maintaining safety for patients with documented contrast allergies.

Premedication cessation for patients with multiple drug allergies (MDA), excluding those with contrast media allergies, was implemented simultaneously across all patient settings—including emergency, inpatient, and outpatient—from September 13, 2021, onwards.

For asthmatic patients, the process was implemented in two phases: Phase 1 (November 30–December 31, 2021): Premedication was discontinued for emergency and inpatient asthmatic patients, with intravenous contrast administered as needed under constant medical supervision. Phase 2 (January 1–March 31, 2022): Premedication was discontinued for outpatients with asthma. Intravenous contrast was administered only after screening for asthma control using a simple questionnaire detailed in Appendix 1. Only patients with well-controlled or partly-controlled asthma proceeded without premedication. Patients with uncontrolled asthma identified through the screening questionnaire were required to be rescheduled unless premedication had already been prescribed by the referring clinician and taken by the patient prior to the scheduled CT scan. This screening method, coupled with a new 30-minute post-injection observation period, was well-suited to busy outpatient environments and addressed patients' limited access to immediate medical care after leaving the facility.

Our institution uses three low-osmolar iodinated contrast media (LOCM): Iohexol 350 mgI/mL (Omnipaque, GE Healthcare), Iopromide 370 mgI/mL (Ultravist, Bayer), and Iopamidol 370 mgI/mL (Iopamiro, Bracco). The choice and use of these agents reflect procurement and supply considerations, as well as radiologist preference. Contrast volume and administration rate are determined by protocol, with boluses of 50–90 mL administered at 1–5 mL/second using a power injector.

Data were collected using the Research Electronic Data Capture (REDCap) system and included patient demographics (age, sex, ethnicity), medical history (asthma, drug allergies), risk factors, premedication status, and contrast media type. Only acute contrast reactions occurring before patients left the radiology department were included; delayed and late reactions were excluded.

Adverse reaction severity was classified according to the ACR Manual on Contrast Media Version 2024, with patients categorized as having mild, moderate, or severe reactions (Table 1). Patients with multiple symptoms were assigned the highest severity grade. Physiologic reactions such as nausea, vomiting, altered taste, perspiration, warmth, flushing, and anxiety were classified as side effects and did not require documentation or intervention by radiologists.

Table 1. *Classification of adverse reactions in response to contrast media.*

Severity Level	Signs and Symptoms
Mild	Mild urticaria, rashes, skin edema, itchiness, nasal congestion, slight throat irritation, mild swelling of eyes and face
Moderate	Diffuse urticaria, erythema, wheezing, bronchospasm (mild or without hypoxia), dyspnea, mild hypotension, chest pain, hypertension, facial edema, laryngeal edema, tachycardia or bradycardia, prolonged nausea or vomiting
Severe	Generalized edema, facial edema with dyspnea, arrhythmia, profound hypotension, anaphylactic shock, unresponsiveness, convulsions or seizures

Continuous variables are reported as means $\pm$ standard deviations or medians where appropriate. Categorical variables were compared using Pearson's chi-squared test or Fisher's exact test when expected cell counts were small. Continuous variables were compared using the Wilcoxon rank-sum test. A two-tailed p-value of <0.05 was considered statistically significant. Statistical analyses were performed using R (version 3.4.1+) and SAS (version 9.4+). Multivariable regression analysis was not performed because the very low number of adverse events limited the statistical power for reliable model estimation.

Results

During the implementation phase, data were collected from 527 consecutive patients: 82 received premedication (as prescribed by referring clinicians), and 445 underwent contrast-enhanced CT scans without premedication under the updated protocol. The characteristics of the study cohort are summarized in Table 2.

The mean patient age was 64.8 years (SD = 16.6) in the premedication group and 63.6 years (SD = 17.7) in the non-premedication group, with no significant difference ($p = 0.75$, Wilcoxon rank-sum test). The premedication group had a higher proportion of female patients (61%, $n=50$) compared to the non-premedication group (51%, $n=229$), but this difference was not statistically significant ($p = 0.11$, Pearson's Chi-squared test).

Table 2. Baseline characteristics of patients.

Variables	With premedication, N = 82 ¹	Without premedication, N = 445 ¹	p-value
Age	64.82 (16.62)	63.62 (17.70)	0.75 ²
Gender			0.11 ³
Female	50 (61%)	229 (51%)	
Male	32 (39%)	216 (49%)	
Ethnicity			0.019 ⁴
Chinese	50 (61%)	262 (59%)	
Indian	5 (6.1%)	77 (17%)	
Malay	25 (30%)	90 (20%)	
Others	2 (2.4%)	16 (3.6%)	
Patient type			<0.001 ³
Emergency	3 (3.7%)	39 (8.8%)	
Inpatient	71 (87%)	293 (66%)	
Outpatient	8 (9.8%)	113 (25%)	
Patient history			0.88 ³
Asthma	52 (63%)	288 (65%)	
Asthma & Multiple drug allergy	22 (27%)	121 (27%)	
Multiple drug allergy	8 (9.8%)	36 (8.1%)	
Allergic reaction	1 (1.2%)	2 (0.4%)	0.40 ⁴

¹Mean (SD); n (%). ²Wilcoxon rank sum test. ³Pearson's Chi-squared test. ⁴Fisher's exact test.

Both groups were predominantly Chinese, with Malays and Indians also represented. The premedication group comprised 61% Chinese (n=50), 30% Malay (n=25), 6.1% Indian (n=5), and 2.4% others (n=2). The non-premedication group included 59% Chinese (n=262), 20% Malay (n=90), 17% Indian (n=77), and 3.6% Others (n=16). While the proportion of Chinese patients was similar between groups, the premedication group had a higher proportion of Malay patients and a lower proportion of Indian patients. A statistically significant difference in ethnic distribution was observed between groups (p=0.019). However, the study was not designed or powered to evaluate ethnicity as an independent risk factor for contrast reactions, and therefore this finding should be interpreted with caution.

Patient distribution across imaging centres differed between groups ($p < 0.001$). Emergency service patients were under-represented in the premedication group (3.7% vs 8.8% in the non-premedication group), while inpatient service patients were over-represented (87% vs 66% in the non-premedication group). Conversely, a higher proportion of outpatient cases was observed in the non-premedication group (25% vs 9.8%). Patient histories of asthma and MDA were similar between groups, with no statistically significant difference ($p = 0.88$, Pearson's Chi-squared test). Approximately 63% of the premedication group ($n = 52$) and 65% of the non-premedication group ($n = 288$) had asthma without MDA. Patients with both asthma and MDA comprised 27% in both groups ($n = 22$ in the premedication, $n = 121$ non-premedication group). The smallest subgroup, those with MDA but no asthma, accounted for 9.8% ($n = 8$) in the premedication group and 8.1% ($n = 36$) in the non-premedication group.

Table 3. *Distribution of asthma control status among patients with asthma in the outpatient setting.*

Variables	With premedication, N = 8 ¹	Without premedication, N = 113 ¹	<i>p-value</i>
Asthma control status			<0.0012
Uncontrolled	3 (37.5%)	9 (8%)	
Partly-controlled	4 (50%)	0 (0%)	
Well-controlled	1 (12.5%)	104 (92%)	

¹*n (%)*. ²*Fisher's exact test.*

During Phase 2 implementation, asthma control among outpatients was assessed using a structured screening questionnaire (Appendix 1). Asthma control status differed significantly between the premedication and non-premedication groups ($p = 0.0014$). Most patients in the non-premedication group had well-controlled asthma (104 patients, 23.0%), whereas only one patient (1.2%) in the premedication group was classified as well-controlled. In contrast, partly controlled asthma was observed in four patients (4.9%) in the premedication group compared with nine patients (2.0%) in the non-premedication group, and three patients (3.7%) in the premedication group were classified as having uncontrolled asthma, while none were recorded in the non-premedication group (Table 3).

Of the three patients who experienced acute allergic reactions, two had both asthma and multiple drug allergies, and one had asthma alone. The overall reaction rate was 0.6% (3/527), with 1.2% (1/82) in the premedication group and 0.4% (2/445) in the non-premedication group. Two patients (one from each group) experienced mild reactions presenting with pruritus, localized urticaria, and nausea. One patient in the non-premedicated group developed a severe reaction characterized by facial edema with dyspnea and arrhythmia. All reactions occurred shortly after contrast administration and were managed conservatively within the radiology department with antihistamines and supportive care. Symptoms resolved following treatment, and no escalation of care or advanced resuscitative intervention was required. There was no statistically significant difference in allergic reaction rates between groups (Fisher's exact test, $p = 0.40$). While the observed rate was slightly higher than the 0.3% reported by the ACR for low-osmolar contrast media [4], the small number of events limits meaningful comparison and interpretation of these rates.

Discussion

Our audit of discontinuing steroid premedication for contrast-enhanced CT scans in patients with asthma or multiple drug allergies found no statistically significant difference in acute allergic reaction rates between the premedication (1.2%) and non-premedication (0.4%) groups. While the overall reaction rate (0.6%) was slightly higher than the 0.3% reported by the ACR for low-osmolar iodinated contrast media [4], the small number of events and unbalanced group sizes limit meaningful comparison. Our findings are consistent with recent literature and suggest that routine premedication may not be necessary for patients with asthma or multiple drug allergies, provided they have no known contrast media allergy [13]. However, due to methodological limitations, these results should be interpreted with caution.

Previous studies, such as Katayama et al. (1990) [12], reported higher adverse reaction frequencies in premedicated patients receiving non-ionic contrast media, regardless of risk level. Our study showed a similar trend, but the small number of events and substantial disparity in group sizes preclude definitive conclusions. The lack of statistical significance suggests that this observed difference could be due to chance. This likely reflects that premedication was predominantly used for patients perceived to be at higher risk, even if these patients were not always accurately identified. It is also possible that the higher reaction rate observed in the premedicated group reflects selection bias, as premedication was more likely to be prescribed for patients perceived by clinicians to be at greater risk of contrast reactions. This limitation reflects the real-world nature of the audit, where treatment decisions were determined by clinical judgement rather than randomized allocation.

The observed trend therefore likely reflects clinicians preferentially prescribing premedication to patients perceived to be at higher risk, rather than a direct effect of the premedication itself. These findings align with recent literature questioning the efficacy of routine corticosteroid prophylaxis and support results reported by Mervak et al. (2015) [9] and Schrijvers et al. (2019) [14], which found no significant reduction in moderate-to-severe adverse reactions.

Demographic analysis revealed some patterns, but the study was not powered to draw meaningful statistical inferences regarding age, sex, or ethnicity. While we found no significant age differences between groups, previous studies have shown that elderly subjects experience higher rates of severe reactions and reaction-related deaths [15]. The higher proportion of females in the premedication group was noted; whether this reflects a greater predisposition to contrast media reactions among females or other factors cannot be determined from this study. Racial distribution varied, with more Malay patients in the premedication group, but our study cannot determine whether ethnicity is a significant risk factor. These observations may warrant further investigation in larger studies.

The higher proportion of inpatients in the premedication group may reflect a more cautious approach by requesting clinicians. While there is no solid evidence to support the use of rapid prophylaxis regimens, these are often administered in urgent and emergent situations due to their perceived safety and potential to reduce reaction risk [16]. The higher proportion of outpatients in the non-premedication group likely reflects updated CT scan instructions, which now specify that premedication is not required unless patients have confirmed contrast allergies. (Appendices 2 and 3 show the comparison of the old and new instructions).

In addition, asthma control among outpatients differed significantly between the premedication and non-premedication groups. Most patients undergoing CT without premedication had well-controlled asthma, whereas patients receiving premedication were more likely to have partly controlled or uncontrolled asthma. This likely reflects clinician decision-making during the implementation phase, where patients perceived to have poorer asthma control may have been preferentially prescribed premedication despite the revised protocol. These findings highlight the pragmatic nature of the audit and suggest that treatment decisions were influenced by clinical judgement rather than strict protocol adherence, introducing the possibility of selection bias between groups. While premedication may reduce the incidence of mild adverse reactions, it does not lower the incidence of moderate-to-severe reactions or reaction-related deaths [7]. Current evidence does not support the use of premedication to reduce immediate ad-

verse reactions in high-risk patients, including those with a history of severe reactions [14]. Conversely, the side effects of steroid premedication are well-documented and include transient leucocytosis and hyperglycaemia, the latter being particularly concerning for diabetic patients [4,9,17].

The same study by Mervak et al. (2015) [9] found that the number needed to treat (NNT) to prevent one adverse reaction of any severity is 69 (95% CI, 39–304). Most strikingly, the NNT increases substantially for more severe outcomes: to prevent one severe reaction, 569 patients must be treated (95% CI, 389–1083), and to prevent one lethal reaction, 50,000 patients must be treated [18]. These findings suggest that premedication has limited effectiveness, particularly in preventing severe or fatal reactions.

From a practical standpoint, the requirement for premedication can lead to logistical challenges and potential delays in care. Davenport et al. (2016) [18] demonstrated that premedication was associated with increased hospital stays, longer wait times for CT scans, and a higher incidence of hospital-acquired infections compared to non-premedicated controls.

Several limitations warrant consideration. The main limitation is the significant size disparity between the premedicated and non-premedicated groups, reflecting the real-world implementation of the new protocol. The low number of adverse events limits statistical power and definitive conclusions about premedication and reaction rates. Our analysis was also limited by incomplete data on potential confounders such as contrast media volume, injection rate, and individual patient risk factors. While some studies have explored these factors, there is insufficient evidence to establish a clear link between contrast volume or flow rate and the risk of acute allergic reactions. The single-centre, retrospective design introduces potential selection bias, as group allocation was determined by protocol implementation rather than randomization. Our focus on acute reactions may have overlooked delayed and late reactions occurring after discharge. Although the data were collected between September 2021 and April 2022, institutional protocols for contrast administration and premedication have remained unchanged since that time, and the findings remain consistent with current ACR and ESUR guideline recommendations regarding selective corticosteroid premedication. These limitations underscore the need for larger, prospective, multi-centre studies to validate our findings and provide more robust evidence for clinical practice guidelines.

Conclusion

In this retrospective study with significant methodological limitations, the discontinuation of routine premedication with corticosteroid was not associated with a detectable increase in acute contrast reactions. These findings are consistent with recent literature questioning the efficacy of routine premedication and support current guideline recommendations from professional bodies such as the American College of Radiology (ACR) and the European Society of Urogenital Radiology (ESUR), which advocate a more selective approach to corticosteroid premedication. However, due to the small number of events, unbalanced group sizes, and other methodological limitations, these results should be interpreted with caution. Eliminating unnecessary premedication may improve operational efficiency within radiology departments by streamlining CT scheduling and reducing delays in care. Nevertheless, further research, ideally prospective, randomized, and multi-center is needed to confirm the safety of this approach and to identify more precise risk factors for contrast reactions. Such research could help develop more nuanced and personalized premedication guidelines, further refining patient care in radiology.

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Availability of data

Anonymized data required for this study may be made available by the author(s) upon reasonable request.

Supplementary Documents

Appendix 1. Asthma screening questionnaire.

Assessment for Asthma Control					
Asthma symptom control			Level of Asthma Control		
In the past 4 weeks, has the patient had:	Yes	No	Well Controlled	Partly Controlled	Uncontrolled
Daytime asthma symptoms more than twice/week?					
Any night waking due to asthma?					
SABA reliever for symptoms more than twice/week?			None of these	1-2 of these	3-4 of these
Any activity limitation due to asthma?					

Appendix 2. Outpatient preparation instructions for CT scan used BEFORE the implementation period.

GUIDE TO COMPUTED TOMOGRAPHY (CT) FOR OUT-PATIENT

General Preparation for all CT examinations with Intravenous contrast medium administration.

1. Please **inform the doctor / staff** attend to you if you:
 - a) are a **diabetic** and are taking the medicine called **METFORMIN (Glucophage)**.
The doctor or staff will advise you to discontinue the drug for **2 days after** the scan. (The use of iodine-based contrast media may result in a transient impairment of renal function, which may precipitate lactic acidosis in diabetics who are taking **METFORMIN**). If you are on diabetic medicine **other than METFORMIN**, you will be advised to omit the anti-diabetic drug on the day of the examination. This is because you need to fast for four hours prior to your scan.
 - b) are **asthmatic** (or have a **history of asthma**) or have **multiple drug allergies** (more than two). The doctor will have to prescribe **prednisolone 30 mg tablets**. These need to be taken **12 hours (1st dose) at _____ and 2 hours (2nd dose) at _____** before your scan.
 - c) are **pregnant** or **likely to be pregnant**.
2. Please fast for 4 hours before the scan. You may continue to take all prescribed medications (**except** for diabetic medicine – please refer to Note 1a.)
3. Depending on the type of scan, we may have to give you an injection of contrast medium for this examination. The nurse will insert a needle into your vein so that we can administer contrast during the scan.
4. If you are **below 21 years old**, please bring your parent or guardian with you. We need someone to sign the consent form if an injection is required for your scan.
5. On the day of your appointment, please report to **the respective appointment counter** for registration **20 minutes before** your appointment time.
6. Please submit the original request form on the appointment day and make payment for the scan. You may pay by cash, NETS, Medisave, and other major Credit Cards.
7. Please bring along all **X-rays, ultrasound, MRI films** and any previous **CT images** if they were not performed at SGH.

The actual scan will take about 20 to 30 minutes depending on the area being scanned. However, we might not be able to stick to the appointment time strictly due to emergency cases that may arise. We seek your understanding should you encounter any delays as priority is given to emergency cases.

Appendix 3. Outpatient preparation instructions for CT scan used DURING the implementation period.

GUIDE TO COMPUTED TOMOGRAPHY (CT) FOR OUT-PATIENT

BEFORE THE EXAM

1. If you are **pregnant** or **likely to be pregnant**, please inform us so we can reschedule your appointment.
2. If you have had a previous **allergic reaction** to **CT contrast media**, a doctor should have prescribed you **prednisolone 30mg tablets** to take **12 hours (1st dose)** and **2 hours (2nd dose)** before your scan.

Please inform us if you are **allergic** and have **not** been prescribed prednisolone.

Examples of CT contrast media include: Iohexol (Omnipaque), Iopamidol (Isovue), Iopromide (Ultravist), Ioversol (Optiray), Ioxilan (Oxilan), and Iodixanol (Visipaque).

3. Please **fast for 4 hours** before the scan. You may continue to take all prescribed medications (*except* for diabetic medication).
4. Please **drink** 250mL of water at **2 hours** and **1 hour** before your CT exam (before coming to the department).
5. If possible, please **try not to empty your bladder** after the second drink. For patients with a urinary bag, please clamp the bag.

AT OUR DEPARTMENT

1. On the day of your appointment, please report to the respective appointment counter for registration 20 minutes before your appointment time.
2. Please inform the staff attending to you if you:
 - a) are **diabetic** and are taking the medicine called **METFORMIN (Glucophage)**.
 - b) are on **blood thinning** medications.
 - c) are **asthmatic** or have a **history of asthma**. Please bring along your prescribed rescue inhaler into the CT room on the day of the scan.
 - d) have had a previous **allergic reaction** to **CT contrast media**.
 - e) are **pregnant** or **likely to be pregnant**.
3. Depending on the type of scan, we may have to give you an injection. The nurse will insert a needle into your vein so that we can administer contrast media during the scan.

Depending on the indication for the scan, you *may* be asked to drink oral contrast 2 hours before the CT scan **in our department**. Oral contrast solution can only be prepared in our department. Please allow for a potential additional **2-hour wait** and plan accordingly.

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