

Flight Fitness Assessment in a Hajj Pilgrim with Symptomatic Iron-Deficiency Anemia Secondary to Uterine Leiomyoma: A Case Report and Clinical Decision-Making Perspective

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ABSTRACT

Determining flight fitness in Hajj pilgrims with anemia remains challenging because current recommendations largely rely on hemoglobin thresholds while providing limited guidance for integrating laboratory findings with clinical judgement during predeparture screening. Evidence on real-world decision-making in mass gathering medicine remains limited. Case Presentation: A 46-year-old Indonesian woman undergoing final Hajj predeparture screening presented with fatigue, dizziness, pallor, and active menstrual bleeding secondary to uterine leiomyoma. Her hemoglobin decreased from 8.2 g/dL to 7.9 g/dL following intravenous crystalloid administration, likely because of hemodilution. Despite stable hemodynamic status, persistent symptoms, ongoing blood loss, and reduced physiological reserve led to temporary flight deferral and referral for definitive management. Discussion: This case highlights that flight fitness assessment should integrate hemoglobin values with symptom severity, physiological compensation, functional capacity, and travel demands. It also reveals limitations in current screening protocols, including reliance on laboratory thresholds and the lack of standardized clinical decision-support tools. Conclusion: An integrated, patient-centered approach to flight fitness assessment may improve clinical decision-making, patient safety, and Hajj predeparture screening while providing practical insights for travel medicine and mass gathering health.

INTRODUCTION

International travel has experienced a substantial resurgence following the COVID-19 pandemic, accompanied by an increasing proportion of older travellers and individuals living with chronic diseases. This demographic transition has expanded the scope of travel medicine beyond infectious disease prevention toward comprehensive assessment of medical fitness for travel. Among all recurring international mass gatherings, the Hajj pilgrimage represents one of the most medically complex settings because more than two million pilgrims from over 180 countries undertake prolonged air travel followed by physically demanding religious rituals in an environment characterized by extreme heat, overcrowding, and limited opportunities for physiological recovery. Consequently, predeparture medical assessment has become an essential component of Hajj health services, aiming not only to determine travel eligibility but also to reduce preventable morbidity, optimize healthcare resource utilization, and ensure patient safety throughout the pilgrimage (Al-Tawfiq et al., 2022; Memish, 2018).

The importance of comprehensive health assessment has become increasingly evident as the epidemiological profile of Hajj pilgrims continues to change. Improvements in life expectancy and the growing prevalence of non-communicable diseases have resulted in a larger proportion of pilgrims presenting with cardiovascular disease, diabetes mellitus, chronic kidney disease, chronic respiratory disorders, obesity, and hematological abnormalities. These conditions may remain clinically stable under normal circumstances but become clinically significant when combined with prolonged air travel, altered cabin pressure, dehydration, sleep deprivation, and the considerable physical demands of Hajj rituals. Recent evidence in mass gathering medicine emphasizes that pre-travel risk assessment should extend beyond disease identification to include individualized evaluation of physiological reserve, functional capacity, and the anticipated challenges of the pilgrimage journey (Al-Tawfiq et al., 2022; Memish, 2018).

Among these medical conditions, anemia deserves particular attention because it directly affects systemic oxygen delivery and physiological adaptation during flight. The World Health Organization estimates that anemia affects approximately 1.6 billion people globally, with women of reproductive age remaining disproportionately affected because of menstrual blood loss and gynecological disorders (WHO, 2021; Shander et al., 2023). During commercial flights, cabin pressure is typically maintained at the equivalent of an altitude of approximately 6,000–8,000 feet, resulting in reduced ambient oxygen pressure and mild hypobaric hypoxia. Although healthy passengers generally tolerate these physiological changes without difficulty, individuals with moderate or severe anemia possess reduced oxygen-carrying capacity and diminished physiological reserve, increasing their susceptibility to fatigue, dyspnea, cardiovascular stress, impaired functional performance, and delayed recovery during prolonged travel. These risks become even more relevant for Hajj pilgrims, who are expected to perform repetitive physical activities under high

environmental temperatures shortly after arrival in Saudi Arabia (Omoigui & Omoigui, 2010; Silverberg, B. 2023)

To minimize these risks, the International Air Transport Association (IATA) recommends careful evaluation of passengers with anemia and advises that individuals with hemoglobin concentrations below 8.5 g/dL should undergo individualized assessment before being considered fit to fly (IATA, 2020; McNally, S. A. 2023). However, this recommendation should not be interpreted as an absolute laboratory cutoff. Contemporary evidence in aviation medicine suggests that tolerance to anemia varies considerably according to symptom severity, cardiovascular compensation, oxygen saturation, ongoing blood loss, comorbid conditions, functional status, and anticipated travel duration. Consequently, patients with similar hemoglobin concentrations may demonstrate substantially different physiological responses and clinical risks during air travel (Omoigui & Omoigui, 2010; Steffen et al., 2023). Furthermore, interventions commonly performed during emergency assessment, such as intravenous fluid administration, may produce dilutional reductions in measured hemoglobin concentration, complicating interpretation of laboratory findings and potentially influencing decisions regarding travel eligibility (Quispe-Cornejo et al., 2022).

Despite increasing recognition of these complexities, important evidence gaps remain regarding the implementation of fitness-to-fly recommendations in real-world clinical practice. Existing literature has predominantly focused on physiological aspects of anemia during air travel or expert consensus regarding aviation safety, whereas relatively little attention has been given to how clinicians integrate laboratory findings with clinical presentation, active bleeding, therapeutic response, and operational constraints during high-volume predeparture screening programs. In practice, frontline physicians frequently encounter situations in which laboratory values, clinical symptoms, patient expectations, and travel regulations provide conflicting information, creating substantial uncertainty regarding the most appropriate clinical decision. This challenge is particularly relevant in mass gathering medicine, where decisions must often be made within limited timeframes while balancing individual patient safety with broader operational considerations (Bellinghausen et al., 2023).

These challenges are especially pertinent in Indonesia, which annually sends the largest Hajj contingent worldwide. To ensure that pilgrims fulfill the national health *istita'ah* requirements, Indonesia has implemented a structured multistage predeparture medical screening system involving primary healthcare centers, referral hospitals, and embarkation health services. Although this system has substantially strengthened preventive healthcare for pilgrims, considerable variability remains in the implementation of clinical decision-making because of differences in healthcare resources, diagnostic capacity, provider experience, and access to definitive treatment across regions. Moreover, anemia remains highly prevalent among Indonesian women, increasing the likelihood that symptomatic anemia will be encountered during final predeparture assessment (Ministry of Health Republic of Indonesia, 2018). Under these circumstances, strict adherence

to numerical laboratory thresholds without sufficient consideration of clinical context may result in inappropriate travel clearance, unnecessary referral, delayed departure, or potentially avoidable patient harm.

More importantly, a conceptual gap exists in the current literature regarding the assessment of flight fitness among medically vulnerable pilgrims. Existing recommendations primarily emphasize physiological safety during air travel, whereas Hajj predeparture screening requires a broader framework that integrates clinical judgement, healthcare system capacity, operational feasibility, and continuity of care. Flight fitness should therefore be regarded not as a binary decision based solely on hemoglobin concentration but as a multidimensional clinical process requiring synthesis of laboratory findings, physiological compensation, ongoing blood loss, underlying disease, functional capacity, anticipated travel burden, and available treatment options. Although this integrated perspective has important implications for travel medicine and mass gathering health services, it remains insufficiently explored in current evidence.

This case report addresses these clinical and policy gaps by describing the management of a female Hajj pilgrim with symptomatic iron-deficiency anemia secondary to uterine leiomyoma whose hemoglobin concentration decreased below the recommended flight threshold following intravenous fluid administration. Beyond presenting a single clinical case, this report critically examines the interaction between laboratory interpretation, physiological assessment, therapeutic decision-making, aviation medicine recommendations, and Indonesia's Hajj predeparture screening policy. By integrating evidence from travel medicine, aviation medicine, hematology, and mass gathering medicine, this report proposes a more contextual approach to flight fitness assessment that extends beyond numerical hemoglobin thresholds. The findings are expected to provide practical insights for clinicians involved in predeparture screening while informing future refinement of evidence-based screening protocols and clinical decision-support strategies for Hajj pilgrims with anemia.

CASE PRESENTATION

A 46-year-old Indonesian woman from Blitar, East Java, presented to the Hajj Embarkation Health Clinic on 14 May 2025 during the final phase of mandatory predeparture medical screening. She was referred from the embarkation screening unit because of progressive fatigue, dizziness, generalized weakness, and marked pallor that had developed over the preceding two days. These symptoms coincided with active menstruation, during which she reported heavier-than-usual bleeding. The patient expressed a strong desire to continue her pilgrimage and reported increasing anxiety regarding the possibility of being declared unfit to travel.

Her medical history was significant for uterine leiomyoma diagnosed several years earlier, accompanied by recurrent menorrhagia that had been managed conservatively. Three months before departure, she had been hospitalized because of excessive uterine bleeding related to the same condition but had not undergone definitive surgical treatment. She denied a history of hypertension, diabetes mellitus, chronic kidney disease, chronic respiratory disease, cardiovascular disease, malignancy, or previous hematologic disorders.

There was no history of blood transfusion during the current episode before presentation at the embarkation clinic.

On examination, the patient was fully alert and oriented (Glasgow Coma Scale score of 15). She appeared pale and mildly lethargic but remained able to communicate appropriately. Her body weight was 60 kg, height 150 cm, and body mass index was 26.7 kg/m². Vital signs demonstrated blood pressure of 98/65 mmHg, heart rate of 60 beats/minute, respiratory rate of 20 breaths/minute, body temperature of 36.6°C, and peripheral oxygen saturation of 98% while breathing room air. Capillary refill time was less than two seconds, indicating preserved peripheral perfusion. Bilateral conjunctival pallor was observed without scleral icterus. Cardiovascular and respiratory examinations revealed no abnormal findings, while abdominal examination was unremarkable without tenderness or palpable masses. No peripheral edema or clinical evidence of heart failure was identified.

Initial laboratory investigations demonstrated a hemoglobin concentration of 8.2 g/dL, red blood cell count of $4.31 \times 10^6/\mu\text{L}$, white blood cell count of $7.1 \times 10^3/\mu\text{L}$, and platelet count of $341 \times 10^3/\mu\text{L}$. Considering the history of chronic menorrhagia secondary to uterine leiomyoma, active menstrual bleeding, and characteristic clinical manifestations, the working diagnosis was symptomatic iron-deficiency anemia secondary to chronic uterine blood loss. Although iron-deficiency anemia was considered the most likely diagnosis, confirmatory iron studies were unavailable at the embarkation clinic because of operational limitations and the need for rapid clinical decision-making before scheduled departure.

As an initial intervention, the patient received intravenous 0.9% sodium chloride solution together with neurobion (B-complex vitamins), which was intended to provide symptomatic support while further clinical assessment was undertaken. No iron supplementation, intravenous iron therapy, or red blood cell transfusion was initiated at the embarkation clinic because definitive treatment was beyond the available clinical resources at the screening facility. Instead, the immediate objective was to reassess the patient's clinical condition and determine whether she remained eligible for air travel according to existing flight fitness recommendations.

Following intravenous fluid administration, repeat laboratory testing demonstrated a decrease in hemoglobin concentration from 8.2 g/dL to 7.9 g/dL. Although this reduction was considered likely to reflect dilutional effects rather than acute disease progression, the patient continued to experience generalized weakness while active menstrual bleeding persisted. The combination of symptomatic anemia, ongoing blood loss, and a hemoglobin concentration below the minimum level recommended by the International Air Transport Association for consideration of commercial air travel prompted reassessment of her flight fitness.

After multidisciplinary discussion within the embarkation medical team, the patient was classified as temporarily unfit for air travel. This decision was based not solely on the measured hemoglobin concentration but on the integration of several clinical considerations, including persistent symptoms,

ongoing uterine blood loss, the anticipated physiological demands of prolonged international travel, and the potential risks associated with immediate participation in Hajj activities after arrival. The patient was therefore referred to the designated Hajj Referral Hospital for comprehensive evaluation and consideration of blood transfusion together with definitive management of her anemia. Her departure was postponed pending clinical stabilization and reassessment of travel eligibility following appropriate treatment.

This case illustrates the complexity of determining flight fitness in medically vulnerable pilgrims. Rather than representing a simple laboratory-based decision, assessment of travel readiness required integration of clinical presentation, physiological status, underlying disease, treatment availability, and operational constraints within a time-sensitive predeparture screening program. These considerations form the basis for the broader clinical and policy issues discussed in the following section.

Table 1. Patient Characteristics

Variable	Findings
Age	46 years
Sex	Female
Height	150 cm
Weight	60 kg
Body Mass Index	26.7 kg/m ²
Chief complaints	Fatigue, dizziness, generalized weakness
Underlying condition	Uterine leiomyoma with chronic menorrhagia
Initial hemoglobin	8.2 g/dL
Repeat hemoglobin	7.9 g/dL
SpO ₂	98% (room air)
Blood pressure	98/65 mmHg
Heart rate	60 beats/min
Respiratory rate	20 breaths/min
Flight fitness decision	Temporarily unfit to fly; referred to Hajj Referral Hospital

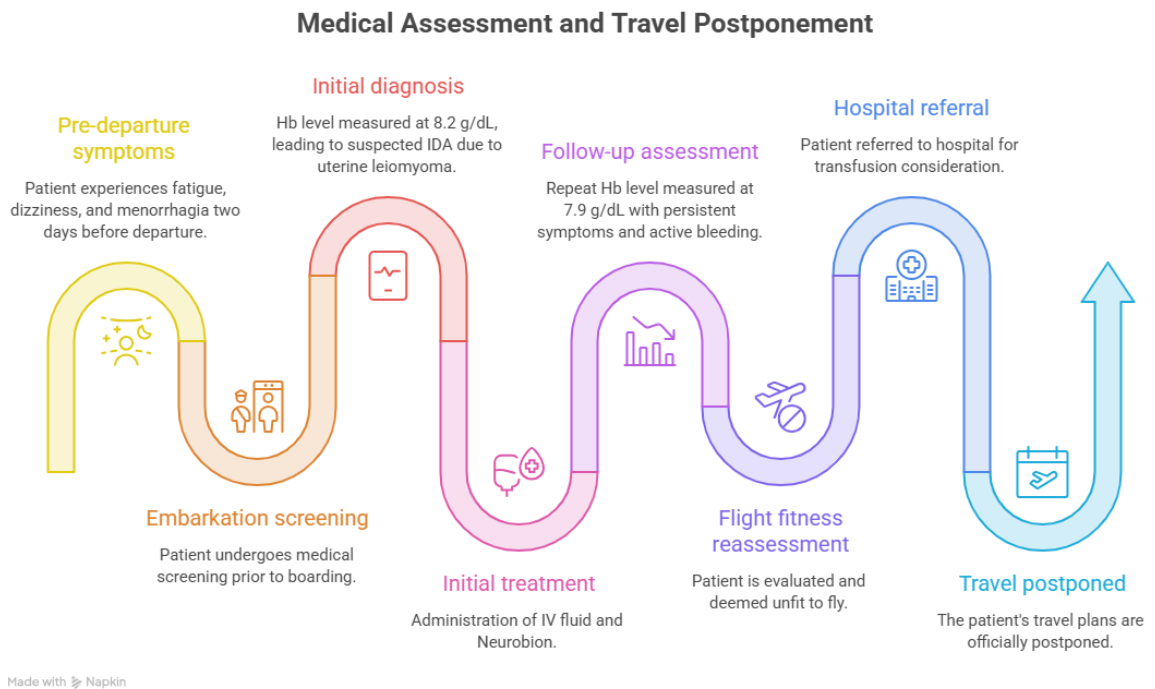


Figure 1. Clinical timeline illustrating the patient's presentation, diagnostic evaluation, therapeutic interventions, and flight fitness decision during Hajj predeparture screening.

DISCUSSION

This case illustrates that determining flight fitness in medically vulnerable Hajj pilgrims is considerably more complex than applying a predefined hemoglobin threshold. Although the patient's hemoglobin concentration ultimately fell below the International Air Transport Association (IATA) recommendation of 8.5 g/dL, the clinical decision to defer travel was based on a comprehensive assessment rather than laboratory findings alone. Persistent fatigue, ongoing uterine bleeding, symptomatic iron-deficiency anemia, and the anticipated physiological demands of prolonged international travel collectively indicated a substantially reduced physiological reserve. This case therefore demonstrates that flight fitness should be viewed as a multidimensional clinical judgement integrating physiological status, disease trajectory, and travel-related risk rather than as a binary laboratory-based decision.

The physiological consequences of anemia during air travel extend beyond reduced hemoglobin concentration. Commercial aircraft cabins are pressurized to the equivalent of approximately 6,000–8,000 feet above sea level, where ambient oxygen tension is lower than at sea level. In healthy passengers, compensatory mechanisms generally maintain adequate tissue oxygenation. However, patients with symptomatic anemia have diminished oxygen-carrying capacity and may be unable to adequately compensate for the combined effects of hypobaric hypoxia, prolonged immobility, dehydration, circadian disruption, and psychological stress associated with long-haul travel. These physiological challenges are amplified during Hajj because pilgrims are expected to perform

prolonged walking, remain outdoors under extreme temperatures, and tolerate considerable physical exertion shortly after arrival. Consequently, the clinical significance of anemia during Hajj extends beyond flight safety alone and directly influences a pilgrim's ability to safely complete the pilgrimage (Omoigui & Omoigui, 2010; Memish, 2018).

An important observation in this case was the decline in hemoglobin concentration following intravenous crystalloid administration. The decrease from 8.2 g/dL to 7.9 g/dL most likely reflected hemodilution rather than accelerated blood loss, consistent with findings from the systematic review by Quispe-Cornejo et al. (2022). This observation has practical implications because repeat laboratory measurements obtained immediately after fluid resuscitation may underestimate true red cell concentration and inadvertently influence flight fitness decisions. Clinicians should therefore interpret post-infusion hemoglobin values within the context of recent therapeutic interventions rather than regarding them as isolated indicators of disease progression. Failure to recognize dilutional effects may result in unnecessary travel restrictions or inappropriate escalation of care.

The initial therapeutic approach also deserves careful consideration. Administration of isotonic intravenous fluids and vitamin B complex provided symptomatic support but did not address the underlying pathophysiology of chronic iron-deficiency anemia secondary to uterine blood loss. Current hematology guidelines recommend that management of symptomatic iron-deficiency anemia should prioritize correction of iron deficiency and control of the bleeding source, while red blood cell transfusion should be reserved for selected patients according to symptom severity, hemodynamic status, and anticipated physiological stress. In the present case, referral for hospital-based evaluation was clinically appropriate because definitive treatment, including blood transfusion or parenteral iron therapy if indicated, was unavailable within the operational scope of the embarkation clinic. This finding highlights an important distinction between supportive stabilization and definitive management during time-critical predeparture assessment.

Beyond the individual patient, this case exposes broader challenges within Hajj predeparture health services. Indonesia has established one of the world's most comprehensive Hajj health screening systems, yet frontline clinicians frequently work within environments characterized by high patient throughput, limited diagnostic resources, and strict operational timelines. Under these circumstances, physicians must balance adherence to standardized protocols with individualized clinical judgement. While standardized laboratory thresholds improve consistency and transparency, excessive reliance on numerical criteria may oversimplify complex clinical situations. Conversely, unrestricted clinical discretion may introduce variability and reduce equity in decision-making. The optimal approach therefore lies in structured clinical decision support that integrates objective laboratory findings with standardized assessment of symptoms, ongoing bleeding, physiological compensation, functional capacity, and anticipated travel demands.

This case also highlights an important conceptual issue within travel medicine. Existing fitness-to-fly recommendations have largely been developed from aviation medicine, where the primary objective is prevention of in-flight medical emergencies. Hajj predeparture screening, however, requires a broader perspective that encompasses not only flight safety but also the ability of pilgrims to safely perform prolonged religious activities after arrival, maintain functional independence throughout the pilgrimage, and access appropriate medical care if deterioration occurs. Consequently, assessment of travel fitness should evolve from a narrow aviation-oriented model toward a comprehensive travel medicine framework that incorporates pre-travel health optimization, continuity of care, destination-specific health risks, and patient-centered decision-making.

From a policy perspective, this case supports refinement of current Hajj screening protocols. Rather than relying exclusively on hemoglobin thresholds, future screening algorithms should incorporate multiple clinical domains, including symptom severity, active bleeding, hemodynamic stability, oxygen saturation, functional capacity, anticipated flight duration, and availability of definitive treatment before departure. Integration of these variables into structured decision-support tools may improve consistency among clinicians while preserving appropriate clinical flexibility. In addition, wider availability of point-of-care hemoglobin testing, iron studies where feasible, standardized referral pathways, and targeted training in aviation medicine could further strengthen predeparture screening programs, particularly in resource-limited settings.

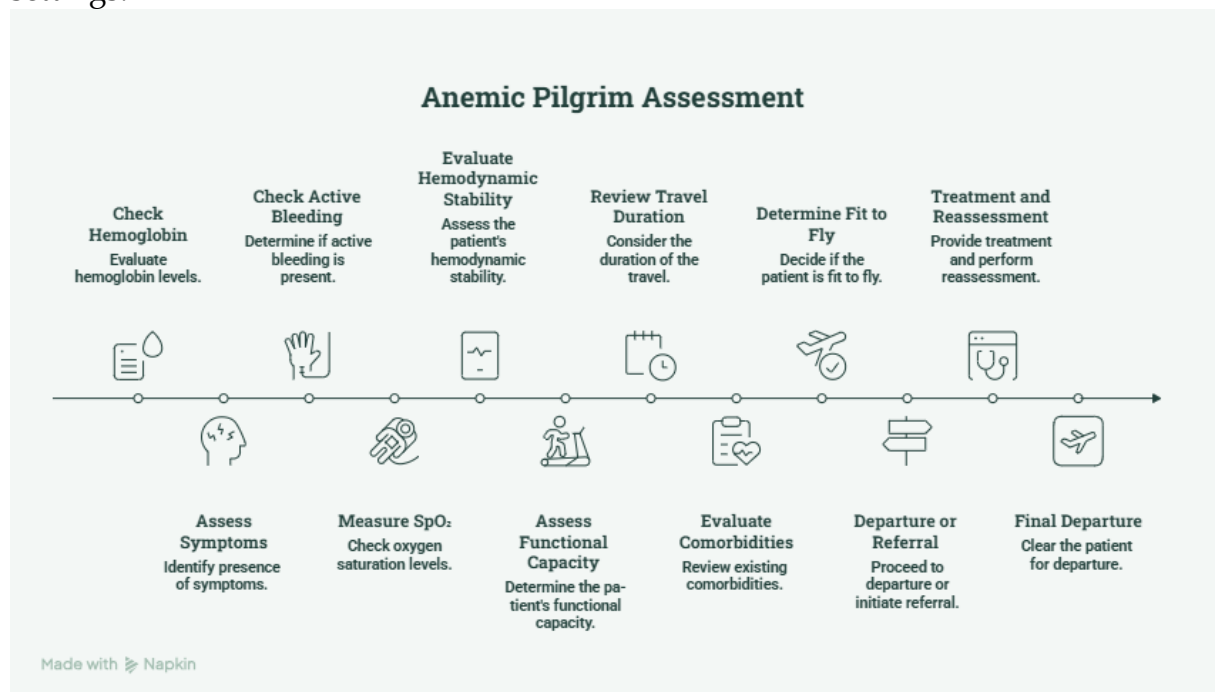


Figure 2. Proposed clinical decision algorithm for assessing flight fitness in Hajj pilgrims with anemia. The algorithm integrates laboratory findings with clinical symptoms, physiological status, ongoing bleeding, and travel-related factors to support individualized decision-making.

Although this report describes a single patient, its implications extend beyond individual clinical management. Case reports remain an important source of hypothesis generation, particularly when they reveal gaps between published recommendations and real-world clinical practice. The present case illustrates how interactions between physiological adaptation, laboratory interpretation, treatment availability, and health system constraints can influence flight fitness decisions in ways that are not fully addressed by existing guidelines. Future multicenter observational studies evaluating outcomes among anemic Hajj pilgrims are needed to determine whether integrated clinical assessment models outperform laboratory-based approaches in predicting travel safety and pilgrimage-related health outcomes.

Overall, this case reinforces the principle that flight fitness assessment should move beyond isolated laboratory thresholds toward individualized, evidence-informed clinical decision-making. Such an approach has the potential to improve patient safety, optimize healthcare resource utilization, and strengthen the quality of Hajj health services while contributing to the broader development of travel medicine and mass gathering medicine.

Table 2. Comparison Between Existing Flight Fitness Recommendations and the Present Case

Assessment Domain	General Recommendation	Present Case
Hemoglobin	Individual assessment if Hb <8.5 g/dL	Hb decreased to 7.9 g/dL
Symptoms	Assess clinical symptoms	Persistent fatigue, dizziness, weakness
Active bleeding	Consider underlying cause	Ongoing menstrual bleeding due to uterine leiomyoma
Hemodynamic status	Must be clinically stable	Stable vital signs
Oxygenation	Adequate oxygen saturation	SpO ₂ 98% on room air
Functional capacity	Assess travel tolerance	Reduced physiological reserve
Clinical decision	Individualized fitness-to-fly assessment	Travel deferred and hospital referral

CLINICAL IMPLICATIONS

This case has several important implications for clinical practice, particularly in the context of travel medicine, aviation medicine, and mass gathering health services. First, assessment of flight fitness in patients with anemia should not rely exclusively on hemoglobin concentration. Although laboratory thresholds provide an essential safety reference, they should always be interpreted alongside symptom severity, hemodynamic stability, ongoing blood loss, functional capacity, underlying comorbidities, and the anticipated physiological demands of travel. Individualized risk assessment is therefore more appropriate than applying fixed laboratory cutoffs in isolation, particularly for medically vulnerable travelers (Omoigui & Omoigui, 2010).

Second, clinicians should recognize that therapeutic interventions performed during predeparture evaluation may influence laboratory interpretation. Intravenous crystalloid administration can produce transient hemodilution and lower measured hemoglobin concentrations without representing true clinical deterioration. Awareness of this physiological effect may reduce unnecessary travel restrictions and improve interpretation of repeat laboratory testing during time-sensitive clinical assessment (Quispe-Cornejo et al., 2022).

Third, management of symptomatic iron-deficiency anemia should prioritize identification and treatment of the underlying cause rather than symptomatic supportive therapy alone. Contemporary international recommendations emphasize early diagnosis of iron deficiency, timely iron replacement, and appropriate patient blood management strategies before considering transfusion, with treatment individualized according to symptom burden, physiological status, and anticipated clinical stress.

Finally, this case highlights the need for structured clinical decision-support tools within Hajj predeparture screening programs. Future screening protocols may benefit from integrating laboratory findings with standardized evaluation of active bleeding, physiological compensation, functional status, expected travel demands, and healthcare resource availability. Such an approach has the potential to improve consistency among clinicians while preserving individualized patient-centered decision-making. As travel medicine continues to evolve toward comprehensive pre-travel risk assessment, multidimensional fitness-to-fly evaluation is likely to become increasingly important for older travelers and individuals with chronic medical conditions undertaking long-haul international travel.

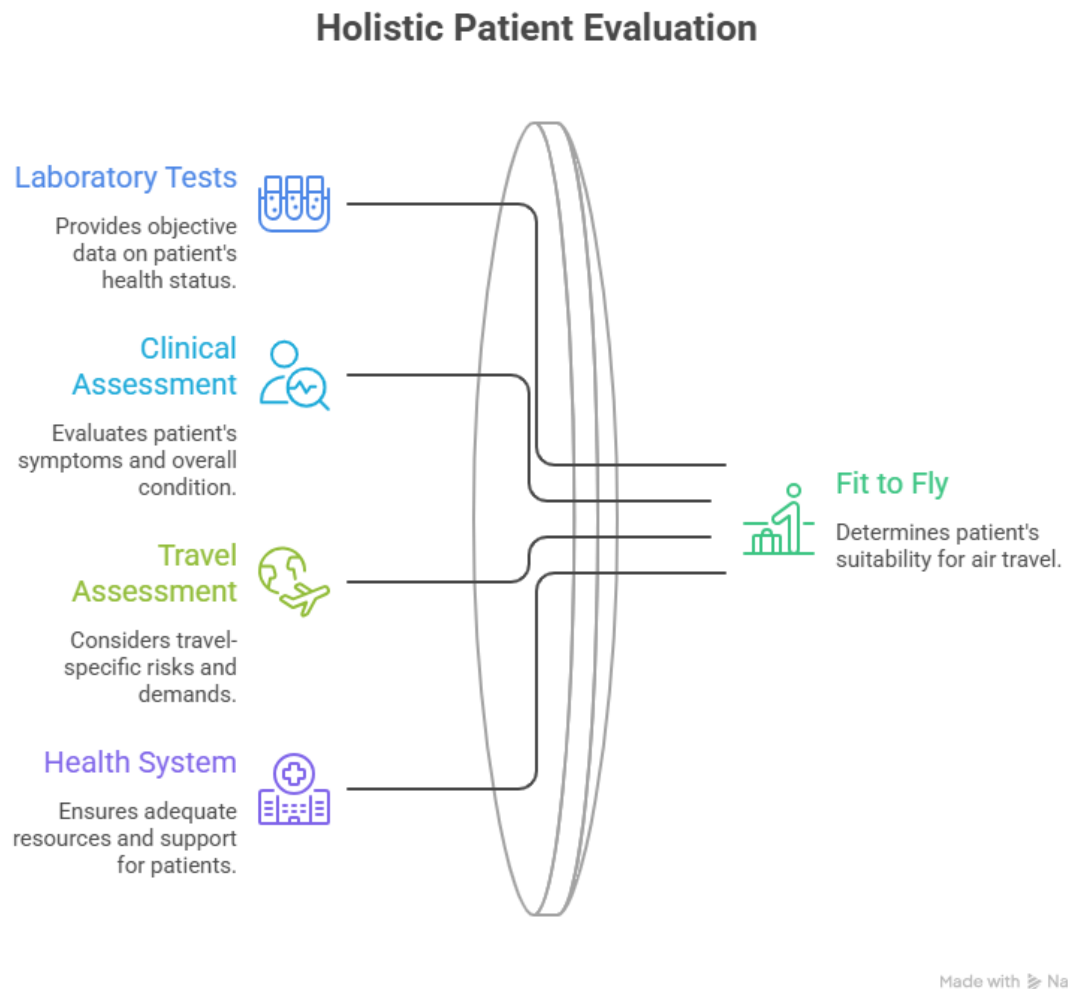


Figure 3. Proposed integrated framework for flight fitness assessment during Hajj predeparture screening. The framework incorporates laboratory evaluation, clinical assessment, travel-related risks, and health system capacity to support evidence-based clinical decision-making.

CONCLUSION

Assessment of flight fitness in Hajj pilgrims with anemia should extend beyond hemoglobin concentration alone. Although laboratory thresholds provide an important safety reference, clinical decision-making must also consider symptom severity, ongoing blood loss, physiological compensation, functional capacity, underlying comorbidities, and the anticipated demands of prolonged air travel and Hajj activities. An individualized, patient-centered approach is therefore essential to ensure both travel safety and appropriate clinical management.

This case highlights important clinical and policy challenges in Indonesia's predeparture Hajj health screening system. The findings support the development of integrated flight fitness assessment algorithms that combine laboratory findings with comprehensive clinical evaluation and standardized referral pathways. Strengthening evidence-based clinical decision support and

conducting prospective multicenter studies will be essential to optimize predeparture screening, improve patient safety, and enhance the quality of Hajj health services.

LEARNING POINTS

- Flight fitness assessment in anemic Hajj pilgrims should not rely solely on hemoglobin concentration but should integrate symptom severity, ongoing blood loss, physiological compensation, functional capacity, and anticipated travel demands.
- Hemoglobin measurements obtained after intravenous crystalloid administration should be interpreted cautiously because dilutional effects may underestimate true red blood cell concentration and influence travel eligibility decisions.
- Symptomatic iron-deficiency anemia caused by chronic gynecological bleeding requires definitive treatment rather than supportive therapy alone. Early referral for appropriate management is essential when definitive treatment cannot be provided during predeparture screening.
- Hajj predeparture health assessment differs from conventional aviation medicine because clinicians must evaluate not only in-flight safety but also the pilgrim's ability to safely complete physically demanding religious activities after arrival.
- Development of standardized, evidence-based clinical decision-support tools may improve consistency, transparency, and patient-centered decision-making during large-scale Hajj predeparture screening programs.

HIGHLIGHTS

- Flight fitness assessment should extend beyond hemoglobin thresholds alone.
- Clinical judgement remains essential during Hajj predeparture screening.
- Active bleeding and physiological reserve influence travel readiness.
- Hemodilution may alter interpretation of repeat hemoglobin measurements.
- Integrated screening algorithms may improve safety and policy implementation.

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