

Design of an Intelligent Appointment System for Blood Donation Based on Two-Step Identity Verification, Clinical Eligibility Screening, and Dynamic Capacity Assessment

Fatemeh Haji Ali Asgari

Iran Blood Transfusion Organization (IBTO)

Ahmad GharehBaghian

Iran Blood Transfusion Organization (IBTO)

Fatemeh MohammadAli

Iran Blood Transfusion Organization (IBTO)

Babak YektaParast

Iran Blood Transfusion Organization (IBTO)

Zahra Nasiri

Iran Blood Transfusion Organization (IBTO)

AmirArio Shokri

Iran Blood Transfusion Organization (IBTO)

Abstract

Introduction and Objective: The increasing demand for blood products and the necessity of safeguarding donors' rights have challenged traditional appointment systems. Manual processes can lead to unnecessary visits, wasted time, and mismatches between appointment demand and center capacity. This study aims to design an intelligent model integrating three key steps: Identity verification, clinical eligibility screening, and real-time capacity assessment.

Methods: The model comprises three layers.

Layer 1: Two-step identity verification. The donor enters their national ID and phone number for initial confirmation. The system then queries the civil registration system for date of birth, father's name, and city of birth to confirm identity authenticity. Age (18–60 years, with extension to 65 years for regular donors, where applicable) is extracted. If the donor meets the permissible age criteria, the process proceeds.

Layer 2: Clinical eligibility screening connects to: (a) the electronic blood donation record, including the required 8-week interval, annual donation frequency (men ≤ 4 , women ≤ 3), and complication history; and (b) the electronic health record, including weight ≥ 50 kg, medical contraindications (such as cardiovascular, pulmonary, renal, and hepatic diseases; epilepsy or seizures; injection drug use; history of blood transfusion or surgery; jaundice; severe allergies; and medication use) and behavioral/environmental risks (such as high-risk sexual contact, tattooing, cupping, and travel to malaria-endemic areas). The system classifies screening outcomes into three categories: permanent contraindications $\rightarrow$ process termination; temporary contraindications (e.g., insufficient donation interval or treatable anemia) $\rightarrow$ alternative date suggestion; and cases requiring clinical assessment $\rightarrow$ physician alert registration. Registered alerts are transmitted to the center physician for review.

Layer 3: Dynamic scheduling queries center capacity, including active beds, available staff, and apheresis machines, and recommends an appropriate appointment time based on available capacity.

Results: The proposed model is designed to reduce identity verification rejections and unnecessary visits, improve bed and equipment utilization through optimized appointment distribution, support preventive intervention through automated clinical alerts, and facilitate informed physician decision-making.

Conclusion: By integrating identity, clinical, and operational data, the intelligent system provides an integrated approach to blood donation appointment management, effectively responding to the growing needs of healthcare centers while safeguarding donor dignity and health and contributing to the digital transformation of the national blood transfusion system.

Keywords

Intelligent Appointment Scheduling, Blood Donation, Clinical Eligibility Screening, Electronic Health Record, Clinical Alert, Dynamic Capacity Assessment.