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Design and Implementation of Hemophilia Smart Assistant Mini Program

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Abstract: Hemophilia is a lifelong hereditary coagulation disorder. Patients require long-term bleeding prevention and therapeutic management, which brings great management difficulties. Existing chronic disease-oriented tools lack vertical intelligent services for hemophilia. Accordingly, based on the WeChat mini program ecosystem and combined with large model AI capabilities, this paper designs and implements an intelligent auxiliary management system for hemophilia patients. It integrates modules including personal health file management, health recording, intelligent Q&A, medication management, pharmacokinetics-based coagulation factor injection suggestions and reminders, automatic generation of periodic reports, and multidimensional statistical analysis. By adopting this system, hemophilia patients can be effectively assisted in completing daily disease management, standardizing infusion records, and improving the efficiency of home-based self-management.

Keywords: Hemophilia; WeChat mini program; Chronic disease management; Smart assistant

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1. Introduction

Hemophilia is a lifelong hereditary hemorrhagic chronic coagulation disorder, mainly divided into hemophilia A (Factor VIII deficiency) and hemophilia B (Factor IX deficiency) [1]. Due to the lack of corresponding coagulation factors in their bodies, patients often suffer from spontaneous or post-minor trauma bleeding. In severe cases, bleeding may involve joints, muscles, and even internal organs, triggering joint deformities, dysfunction, and even life-threatening conditions [2]. Currently, there is no radical cure for hemophilia, and replacement therapy serves as an effective therapeutic measure [3]. Treatments fall into two categories: on-demand therapy and prophylactic therapy. Individualized prophylactic therapy has become the mainstream for hemophilia treatment [4]. Prophylactic therapy requires regular coagulation factor infusion to maintain the minimum protective trough concentration of in vivo coagulation factors above 1%, which can significantly reduce bleeding episodes and joint damage [5]. Hemophilia features a high risk of sudden onset and stringent

specialized nursing criteria, with highly specialized demands [6]. Patients need lifelong standardized replacement therapy and home-based health management [7]. Nevertheless, most patients encounter numerous problems including delayed treatment, insufficient professional home care competence, poor treatment compliance, untimely emergency bleeding disposal, and non-standardized health data recording. These problems may easily induce severe complications such as joint deformities and internal organ hemorrhage, and severely impair patients' physical and mental health and prognosis [8].

In recent years, with the rapid development of digital health technologies, "Internet + Medical Health" has become a major driving force for the transformation of medical service modes [9]. Featuring unique merits such as no installation requirement, lightweight access, convenient dissemination, and strong user adaptability, WeChat mini programs have become core lightweight carriers for chronic disease home-based management, out-of-hospital patient follow-up, and health knowledge popularization. They are widely applied in medical scenarios including chronic disease data monitoring, health file management, and online consultation services [10–11].

2. Architecture design of the hemophilia smart assistant mini program

Adopting a distributed front-end and back-end separation architecture, the Hemophilia Smart Assistant is divided from top to bottom into five layers: User Layer, Presentation Layer, Business Logic Layer, Data Layer, and External Service Layer, as shown in **Figure 1**.

The User Layer consists of the WeChat mini program and the Web management terminal, targeting ordinary users and system administrators, respectively. Both front-end sides invoke unified back-end RESTful APIs via the HTTPS protocol. The Presentation Layer is a routing layer implemented by the FastAPI framework. The Business Logic Layer encapsulates core services including authentication, record management, medication management, message service, content management, questionnaire, AI service, and WeChat service. The Data Layer includes the MongoDB database and local file storage for structured business data as well as user-uploaded pictures and report files, respectively. The External Service Layer connects to Alibaba Cloud Qwen Large Model and WeChat Open API, providing the system with capabilities of intelligent Q&A, report generation, and subscription message push. Each layer follows sequential dependency rules and interacts through unified interfaces, facilitating system modularization, iterative revision, and later-stage maintenance.

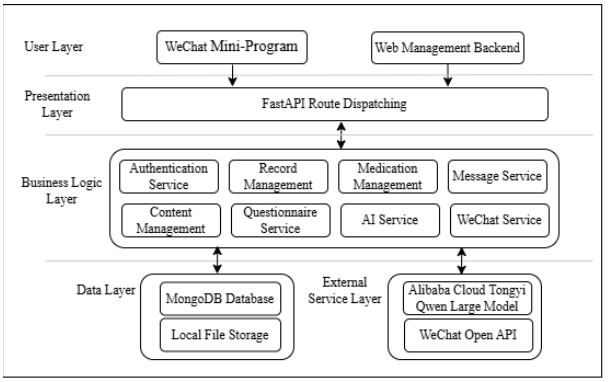


Figure 1. Mini program architecture diagram

3. Functional module and data design of the hemophilia smart assistant mini program

3.1. Functional module design

According to user requirements, the Hemophilia Smart Assistant Mini Program is divided into the WeChat mini program client for end users and the web-based administrator background terminal.

3.1.1. Functional modules of the Hemophilia Smart Assistant WeChat Mini Program client

The mini program client mainly includes seven modules: registration and login, record management, medication management, first aid management, questionnaire survey management, information management, and periodic report management, as shown in **Figure 2**.

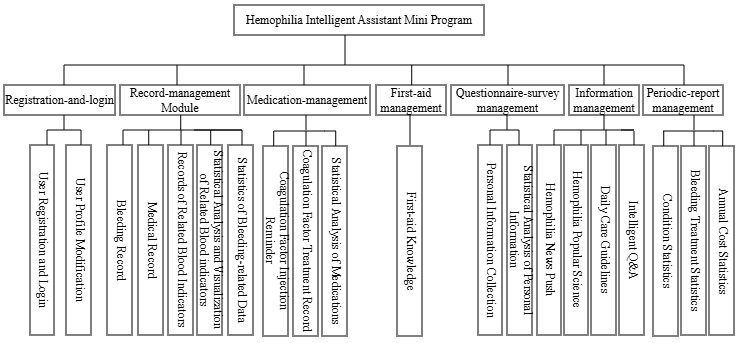


Figure 2. Functional module diagram of the Hemophilia Smart Assistant WeChat Mini Program

(1) Registration and login: Supports user registration and login with WeChat accounts, and provides functions for personal information management.

(2) Record management Module: Supports entry of bleeding events, medical visit information, and blood index data, and enables visual analysis of bleeding frequency, temporal sequence factor activity data, and APTT fluctuation comparison.

(3) Medication management: Records coagulation factor injection information; supports timed reminders and dosage setting; provides individualized schemes based on pharmacokinetic models; and enables visual statistical analysis of dosage and frequency.

(4) First aid management: Popularizes emergency hemophilia disposal workflows, operating essentials, and precautions via texts, images, and videos.

(5) Questionnaire survey management: Collects users' personal information via questionnaires and implements summary, classified statistics, correlation analysis, and visual display of collected data to support hemophilia-related medical research.

(6) Information management: Pushes hemophilia-related news and science popularization content, and leverages an AI agent to answer disease-related questions online.

(7) Periodic report management: Integrates bleeding records and indicator data via charts; counts the distribution of bleeding frequency and severity; analyzes changing trends of coagulation factors; and summarizes medical expenditures for medicines, medical visits, and rehabilitation.

3.1.2. Functional modules of the hemophilia smart assistant administrator terminal

Targeted at system administrators, the management terminal offers background operation and management

functions covering four major modules: management dashboard, user management, content management, and system configuration, as illustrated in **Figure 3**.

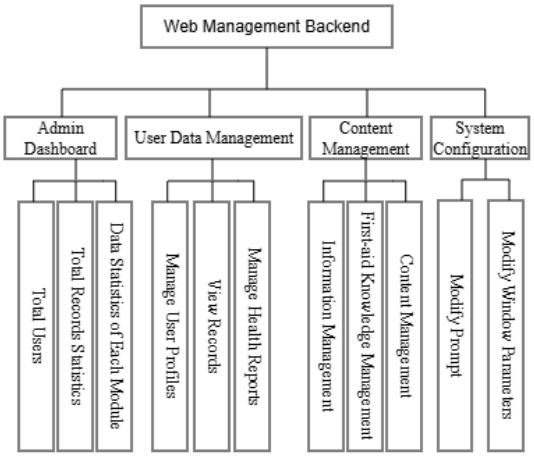


Figure 3. Functional module diagram of the Hemophilia Smart Assistant web management terminal

(1) Management dashboard: Concentrically displays core operational data such as total user volume, total volume of business records (bleeding/medical visit/test/injection), quantity of contents (information/first aid/questionnaires), and number of AI-generated reports, enabling administrators to grasp the overall platform operation status quickly.

(2) User management: Supports viewing of user lists, personal files, and full records; allows editing and deletion operations on users; provides statistical dashboards grouped by dimensions such as hemophilia classification and geographic region.

(3) Content management: Covers background operation and maintenance for three content categories: information, first aid knowledge, and questionnaires. Information management supports article publication, editing, deletion, category and tag management. First aid knowledge management enables adjustment of content display order. Questionnaire management supports questionnaire creation, activation, and viewing of statistics for submitted responses.

(4) System configuration: Configures parameters including large model prompt words and dialogue window length.

3.2. Database design

In accordance with the overall design requirements of the Hemophilia Smart Assistant Mini Program, and to adapt to lightweight deployment of WeChat mini programs, high-frequency AI model interaction, and incremental storage demands for dynamic chronic disease data, the MongoDB non-relational database is adopted for data storage architecture construction. Conceptual database design is completed based on system business data requirements, and an Entity Relationship (ER) diagram of the system is constructed as shown in **Figure 4**, clarifying relationships and data interaction logic among all entities.

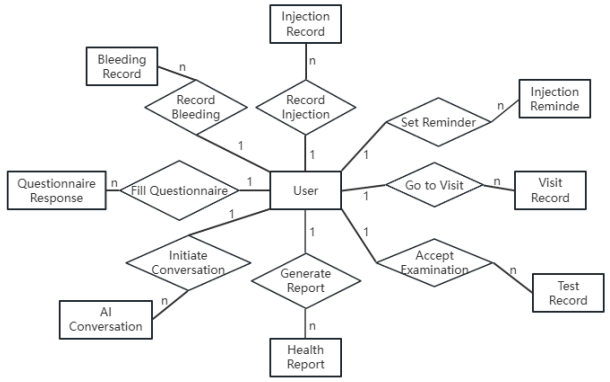


Figure 4. ER diagram of the Hemophilia Smart Assistant database

Taking advantage of MongoDB's document-oriented storage features, various types of business data are stored in separate collections. Cross-collection data association is realized through unique user identifiers to adapt to storage scenarios for fragmented health records and dynamic diagnosis and treatment data. Data indexes are configured to improve retrieval efficiency. Leveraging the expandable merits of document structures, the system adapts to model iteration and function upgrades. Medical privacy data is stored in encrypted form to guarantee data security, furnishing efficient and stable data support for system functions such as intelligent reminders, data analysis, and report generation.

Multiple MongoDB collections are divided according to business functions. For brevity, only the core field design of the coagulation factor injection record collection, carrying key diagnosis and treatment monitoring data, is presented in **Table 1**.

Table 1. Structure of the coagulation factor injection record collection

Field Name	Type	Required	Default Value	Description
_id	ObjectId	Yes	Auto generated	MongoDB document primary key
record_id	string	Yes	UUID hex	Business ID of the record
user_id	string	Yes	Empty string	Associated user ID
inject_time	datetime	Yes	Current UTC time	Injection time
dose	string / null	No	null	Injection dosage
brand	string / null	No	null	Drug brand
reason	string / null	No	null	Reason for injection
remark	string / null	No	null	Remarks
cost	float / null	No	null	Expense

4. Key technologies

4.1. WeChat mini program development technology

The mini program front end adopts the Skyline rendering engine. Relying on heterogeneous rendering pipelines, it reduces memory overhead and improves page rendering and interactive performance [12]. The mini program back end is built as high-performance RESTful APIs based on the FastAPI framework. FastAPI is a modern, fast (high-performance) Web framework for building APIs [13]. The back end is divided into multiple business function modules. The MongoDB document-oriented database stores business data,

and the Beanie asynchronous Object Document Mapper (ODM) simplifies data interaction operations with MongoDB [14].

4.2. Web management terminal technology

The Web management terminal is developed with Vue3 + Vuetify. Pinia implements global state management for unified maintenance of core data such as logged-in user information and operation permissions. The ECharts visualization library is introduced to intuitively display statistical data, including patients' bleeding trends, medication proportion distribution, and changes in test indicators via various charts. The project is built with the Vite tool, effectively improving back-end development and operational efficiency.

4.3. Construction of intelligent service scenarios based on Tongyi Qwen

By integrating the Tongyi Qwen Large Model provided by the Alibaba Cloud DashScope platform and adopting professional Prompt enhancement strategies, the Hemophilia Smart Assistant realizes intelligent services for three business scenarios:

(1) Intelligent Q&A Scenario: When users consult hemophilia-related questions, the system inputs both historical dialogue context and current questions into the large model and returns answers word by word to enhance the interactive experience.

(2) AI Injection Suggestion Scenario: Based on users' hemophilia type, historical injection records, and input coagulation factor drug brands, the large model outputs structured injection reminder plans, which users can add as reminders with one click.

(3) Periodic Report Generation Scenario: The system aggregates statistical data such as users' bleeding events, expenses, and test indicators, constructs prompt words containing data summaries, and drives the large model to generate easy-to-understand health reports.

4.4. Intelligent injection guidance based on pharmacokinetics

Pharmacokinetics is a discipline studying the processes and rules of drug absorption, distribution, metabolism, and excretion within human bodies [15]. In hemophilia coagulation factor replacement therapy, pharmacokinetics mainly describes the dynamic concentration-changing rules of exogenous infused coagulation factor VIII or IX inside patients' bodies. Core parameters include half-life ($t_{1/2}$), recovery rate, clearance rate, and area under the curve. With these core pharmacokinetic parameters, individualized prophylactic therapy dosages and administration intervals for hemophilia patients can be calculated. Standardized interventions maintain patients' in vivo coagulation factor trough concentrations above 1 % so as to lower the risk of bleeding episodes. In the Hemophilia Smart Assistant Mini Program, the injection guidance function built on pharmacokinetic principles integrates patients' historical injection records and coagulation factor activity data, dynamically simulates changing trends of in vivo factor concentrations, and accordingly provides individualized suggestions on administration time and injection dosage, realizing intelligent and standardized guidance for home-based hemophilia prophylactic therapy.

5. System implementation

Developed and deployed based on the WeChat mini program and Web management terminal, the system completes the development of functional interfaces and the implementation of business logic. Core functions

include record management, pharmacokinetics-based medication guidance, large model-driven individualized health analysis, and intelligent Q&A. It delivers full-cycle auxiliary management services for hemophilia patients. Partial functional interfaces are shown in **Figures 5–7**.

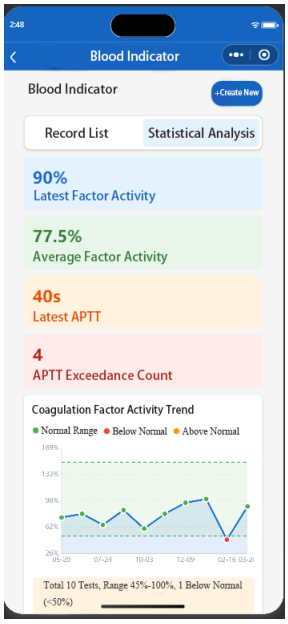


Figure 5. Blood indicator visualization interface

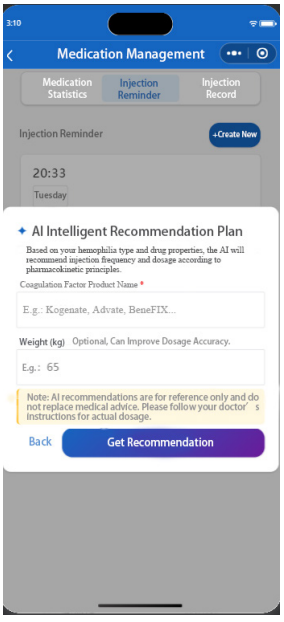


Figure 6. AI intelligent recommendation scheme interface

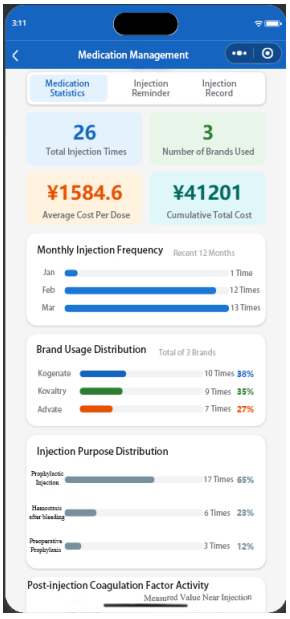


Figure 7. Injection record statistical analysis interface

Record management serves as the fundamental core module of the mini program. Leveraging the ECharts chart library, the system adopts line charts to visualize changing trends of coagulation factor activity and clearly distinguishes measured data from normal reference intervals, facilitating patients and medical staff to dynamically grasp changes in coagulation function and disease status.

The medication management module provides tracking and periodic reminders for coagulation factor injections. It integrates the AI intelligent recommendation function. Combined with patients' hemophilia classification, body weight, and historical injection records, the large model outputs individualized suggestions for injection dosage and frequency.

The injection record module automatically archives information for each injection, including time, dosage, brand, purpose, and expenses, and conducts visual statistical analysis of medication data via charts. The system supports generation of periodic health reports: it automatically aggregates users' bleeding conditions, test indicators, and medication expense data, and leverages the large model to generate easy-to-understand individualized health analysis reports.

Built upon the Qwen large model, the intelligent Q&A module optimizes Q&A performance with prompt-enhanced knowledge retrieval mechanisms. It delivers real-time, professional intelligent consultation and emergency guidance services for questions concerning hemophilia-related knowledge, medication schemes, emergency disposal for trauma and joint bleeding, and daily nursing.

6. Conclusion

Targeting practical demands in hemophilia patients' daily health management, this paper designs and implements the Hemophilia Smart Assistant WeChat Mini Program as well as its supporting Web management terminal. The system integrates hemophilia patients' bleeding record management, medication tracking, knowledge acquisition, and intelligent auxiliary decision-making, forming a complete closed loop ranging from data collection to health report output. It provides patients with a convenient, professional, and sustainable digital management tool.

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Disclosure statement

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References

[1] Lim YM, Ardila J, Castaman G, et al., 2026, Diagnosis and Management of Hemophilia A and B. Journal of Thrombosis and Haemostasis, 2026(24) 2341–2354. https://doi.org/10.1016/J.JTHA.2026.04.005

[2] Lei XR, 2025, Hemophilia: A Hereditary Coagulation Disorder Disease. Health for All, 2025(31): 82–83. https://doi.org/10.20252/j.cnki.rrjk.2025.31.031

[3] Li YJ, Zhong XH, Sun J, 2007, Development Status of Comprehensive Care Mode for Hemophilia. Chinese Journal of Nursing, 42(8): 732–734.

[4] Chen BB, Xia AD, Yu K, 2019, Determination of Pharmacokinetic Parameters and Curative Effect of Individualized Prophylactic Therapy in Adult Severe Hemophilia A Patients. Journal of Mathematical Medicine, 2019(32): 11.

[5] Gao X, Xu P, Luo X, et al., 2025, The Impact of Individualized Prophylactic Treatment Based on Pharmacokinetic Parameters on the Prognosis of Patients with Severe Hemophilia A. Expert Review of Hematology, 19(2): 213–218. https://doi.org/10.1080/17474086.2025.2597370

[6] Xue F, Dai J, Chen LX, et al., 2023, China Hemophilia Diagnosis and Treatment Report 2023. Theory and Practice of Diagnostic Medicine, 22(2): 89–115.

[7] Yang RC, 2024, Chinese Guidelines for Hemophilia Management (2024 Edition). Peking Union Medical College Press, Beijing.

[8] Beijing Hemophilia Home Rare Disease Care Center, Tianjin University, 2024, Research Report on Treatment Patterns and Disease Burden of Hemophilia Patients in China.

[9] Luo HF, Deng Y, 2025, Exploration on Practice and Development Trend of "Internet +" in Chronic Disease Management. Internet Weekly, 2025(24): 55–57.

[10] Tang LW, Chen DD, Shao J, et al., 2022, Design and Development of an Intelligent Health Management Platform for Metabolic Syndrome Patients Based on WeChat Mini Program. Journal of Zhejiang University (Medical Sciences), 51(1): 115–121.

[11] Ma JX, Cai J, 2022, Design and Implementation of Chronic Disease Self-Management Support Platform Based on WeChat Mini Program. Software, 2022(4): 149–152.

[12] WeChat Open Source Community, 2026, Introduction to Skyline Rendering Engine. https://developers.weixin.qq.com/miniprogram/dev/framework/runtime/skyline/introduction.html

[13] FastAPI Official Documentation, 2026, Overview of the FastAPI Framework. https://fastapi.tiangolo.com/zh/

[14] Beanie Official Documentation, 2026, Documentation Beanie ODM. https://beanieodm.dev/

[15] Yang BF, Chen JG (Chief Editors jointly), 2024, Pharmacology (10th Edition). People's Medical Publishing House, Beijing.

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