HeXEHRS: FHIR-Based Cloud EHR Services to Support Healthcare in Depopulated Areas Driven by Digital Twin

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Abstract. HeXEHRS is a FHIR-based cloud EHR service designed to support healthcare in depopulated areas, powered by digital twin technology. Its core functionalities encompass standard EHR tasks including data exchange for healthcare processes. In the first year of this national project, we present the design and define the functionalities of the system.

Keywords. EHR systems, HL7 FHIR, digital twin

1. Introduction

The Japanese government has launched a five-year project promoting science and engineering in sectors such as energy, mobility, and healthcare [1]. The healthcare focus is on 'digital twin' technology [2], aiming to automate and streamline the entire data-to-point-of-care process.

2. Healthcare in Depopulated Areas

One focal topic of the government's project addresses healthcare in depopulated areas. Developed countries face challenges with aging populations; in Japan, 29.1% of the population was 65 or older in 2022. Furthermore, regions without physicians are on the rise as local populations decline. More than 1,100 clinics have been designated as "clinics in depopulated areas" in Japan. Medical practices in these areas require specific functions such as sharing medical information between central and mobile clinics, telemedicine support with major hospitals, and integration with home nursing systems [3].

Doctors need to handle non-specialty areas, requiring continuous learning to improve healthcare quality and safety. Contracting for feature-rich EHR can be costly and strain local government finances [4]. The national project aims to address these issues including good cost-effectiveness and rich functional extensibility through

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innovative EHR systems. We investigated the characteristics of clinics in depopulated areas and reflected them in the functional requirements.

3. HeXEHRS: FHIR-based cloud EHR services

We have designed a FHIR-based cloud EHR service, named "HeXEHRS," to support healthcare in depopulated areas. Its core functionalities encompass standard EHR tasks, such as patient administration and record-keeping, as well as data exchange for healthcare processes. HeXEHRS is equipped with APIs that enable integration with complementary cloud services, including remote video consultations, PHRs, and AI-assisted documentation. Notably, the system leverages a "digital twin" engine developed by other national projects.

3.1. Research and Development Items of HeXEHRS

- Definition and specification of core functions of electronic medical records
- Design and Implementation of HeXEHRS; a FHIR based EHR platform using newly developed FHIR server supporting multi-institutions
- Specification and development of extensible APIs to peripheral auxiliary systems including insurance claiming, laboratories, and digital twin systems for secondary data usage
- Integration with LLM-based AI for powerful clinical decision support

4. Conclusions

Our aim was to design and develop a FHIR-based cloud EHR services targeted at supporting clinics in depopulated areas at low cost. In the first year of the project, we researched the requirements of clinics in depopulated areas and defined the core functionalities of the FHIR-based cloud EHR services. We will showcase the design and system requirements definition of HeXEHRS integrated with FHIR resource data model, highlighting our progress in the first year of the national projects.

References

[1]   Progress of the next Cross-ministerial Strategic Innovation Promotion Program. https://www8.cao.go.jp/cstp/english/sipoverview.pdf
[2]   Machado TM, Berssaneti FT. Literature review of digital twin in healthcare. Heliyon. 2023 Aug 24;9(9):e19390.
[3]   Murphy P, Burge F, Wong ST. Measurement and rural primary health care: a scoping review. Rural Remote Health. 2019 Aug;19(3):4911.
[4]   Kawaguchi H, Koike S, Ohe K. Regional differences in electronic medical record adoption in Japan: A nationwide longitudinal ecological study. Int J Med Inform. 2018 Jul;115:114-119.