INFOKES : Jurnal Ilmiah Rekam Medis dan Informatika Kesehatan E-ISSN : 2745 – 5629
Volume 16 Issue 2 2026 page : 213-221

Requirements for an EMR-Based Virtual Reality Application for PROLANIS Education: A Literature and Process-Mapping Synthesis

Setya Wijayanta[1]*, Adhani Windari[1], Mochammad Arief Darmawan[1], Sylvia Anjani[2], Faik Agiwahyuanto[2]

[1]Medical Records and Health Information Study Program, Poltekkes Kemenkes Semarang, Indonesia
[2]Medical Records and Health Information Study Program, Dian Nuswantoro University, Indonesia

Email: setyawijayanta@poltekkes-smg.ac.id*

Submitted: 23 June 2026 Reviewed: 28 July 2026 Accepted: 11 August 2026

ABSTRACT

Background: PROLANIS participants require repeatable chronic-disease education, while electronic medical records (EMRs) and virtual reality (VR) offer opportunities for personalized and interactive delivery. Before prototype development, requirements must reflect health literacy, workflow, privacy, and VR safety. **Methods:** This descriptive initial Research and Development stage used a literature- and document-informed requirements synthesis, a proposed PROLANIS process map, and minimum EMR data-element mapping for Sidorejo Lor and Sidorejo Kidul Community Health Centers, Salatiga City. No interviews, focus-group discussions, participant surveys, direct observations, or patient-level EMR extraction were conducted at this stage. Candidate requirements were organized into domains and provisionally prioritized using MoSCoW as design input requiring later stakeholder validation. **Results:** Five preliminary requirement groups were identified: concise chronic-disease education, EMR-based personalization, adult- and older-user accessibility, data security and confidentiality, and operational support for health workers. Proposed must-have functions include a patient education profile, simple visualization of examination results, and hypertension and diabetes modules. Non-functional requirements include simple navigation, large text, audio narration, seated mode, short sessions, stop/pause options, and role-based data access. **Conclusion:** The study provides an initial, literature- and process-mapping-based requirements model rather than empirically validated local user needs. Participatory co-design, stakeholder validation, usability testing, VR-safety assessment, data-governance review, and evaluation of patient understanding are required before implementation claims can be made.

Keywords: Chronic Disease; Electronic Health Records; Health Education; Needs Assessment; Virtual Reality

INTRODUCTION

Indonesia's 2023 Health Survey reported a hypertension prevalence of 30.8% among adults aged 18 years and older based on blood-pressure measurement and a diabetes prevalence of 11.7% among people aged 15 years and older based on blood-glucose examination (1). Community Health Centers play a key role in primary health care. These services emphasize promotive and preventive activities, including health education for patients with chronic diseases. PROLANIS is a crucial program because it integrates participants, health facilities, and BPJS Kesehatan (Indonesian Health Insurance) to maintain the health of chronic patients and an optimal quality of life (2,3).

PROLANIS participants at the Sidorejo Lor and Sidorejo Kidul Community Health Centers generally require repeated education on hypertension, diabetes mellitus, physical activity, medication, diet, danger signs, and check-up schedules. Conventional education may face constraints such as waiting time, limited consultation duration, variable health literacy, and difficulty attending regularly. Sidorejo Lor and Sidorejo Kidul were selected as the development context because they are the planned primary-care settings for the PROLANIS-oriented prototype; anchoring the requirements to two specific health-center settings supports workflow-sensitive design while limiting direct generalization to other facilities. These conditions support the need for health education that is flexible, accessible, and context-sensitive.

The development of EMR opens up new opportunities for personalized patient education. Minister of Health Regulation Number 24 of 2022 places electronic medical records as a crucial component of digital healthcare delivery (4). The digital health strategy also encourages the use of technology to improve access, quality, continuity, and efficiency of healthcare services (5). In the context of PROLANIS, EMR can potentially support the display of selected blood-pressure, blood-glucose, medication, and education information tailored to the patient condition, subject to data-minimization and access-control requirements.

VR offers a more visual, interactive, and immersive learning experience. Reviews and meta-analyses report potential benefits of XR/VR for patient and health education, including engagement, knowledge, satisfaction, and confidence (6-9). Recent primary studies also show that VR patient education can improve hypertension knowledge, support diabetes-prevention communication, improve recall of procedural information, or increase satisfaction with preoperative information, although effects vary by outcome and user characteristics (10-13). These findings reinforce the need to design VR around the target population rather than assuming immersion alone will produce benefit.

Technology acceptance is another design consideration. Studies using the Technology Acceptance Model (TAM), together with foundational TAM and Unified Theory of Acceptance and Use of Technology (UTAUT) literature, identify perceived usefulness, ease of use, facilitating conditions, and social influence as relevant determinants of technology use (14-17). In healthcare VR, these determinants must be considered alongside safety, comfort, digital literacy, data confidentiality, and health-worker workflow.

Research on VR in healthcare is expanding, but the clinical, educational, and technological gaps remain distinct. The clinical gap concerns the limited evidence on EMR-linked VR education for chronic-disease management in primary care (18). The educational gap concerns how to translate hypertension and diabetes information into brief, understandable, repeatable messages for diverse adult and older users. The technological and implementation gap concerns how personalization, accessibility, privacy, and workflow can be reconciled. Recent co-design and user-centered studies in diabetes, chronic disease, and digital health demonstrate the value of involving patients, caregivers, health professionals, and older adults in iterative design (19-25), consistent with established human-centered design principles (26,27). Accordingly, this article aims to develop an initial literature- and process-mapping-based requirements model for an EMR-based VR application for PROLANIS health education at Sidorejo Lor and Sidorejo Kidul Community Health Centers. The model is intended as input for subsequent co-design and validation rather than as a claim of empirically confirmed local user needs.

METHODS

This study used a descriptive design in the initial requirements stage of a Research and Development (R&D) approach. Waterfall was used only as a development-sequencing framework to clarify the progression from problem identification and requirements analysis to system design, implementation planning, prototype testing, and evaluation (28,29). It was not treated as a method for collecting user data. The present manuscript is limited to a conceptual requirements synthesis and initial design input based on literature/documents, a proposed service-process map, and minimum EMR data-element mapping.

The development context was PROLANIS service delivery at the Sidorejo Lor and Sidorejo Kidul Community Health Centers in Salatiga City. PROLANIS participants with hypertension and/or diabetes mellitus were defined as the primary intended users, while doctors, nurses, medical-records officers, PROLANIS program administrators, and health-information-system administrators were defined as supporting stakeholder roles. These groups were stakeholder categories for design and were not recruited informants in the current stage. No participant sample, interviews, focus groups, surveys, direct observational dataset, or identifiable patient-level EMR dataset is reported in this manuscript. The unit of analysis was therefore the source-derived requirement statement, service-workflow element, minimum EMR data element, educational-content requirement, and VR-safety or governance constraint.

Requirements inputs were compiled through four steps. First, peer-reviewed literature was reviewed on PROLANIS/chronic-disease education, EMR, VR patient education, digital-health interventions, technology acceptance, user-centered design, software requirements, usability, health literacy, and VR safety. Second, a proposed PROLANIS service-process map was constructed as a design artifact to identify potential touchpoints for education, documentation, follow-up, and patient understanding; it should not be interpreted as a formally observed or locally validated workflow. Third, minimum EMR data elements potentially relevant to education were mapped, including diagnosis, latest blood pressure, latest blood glucose, medication information, and prior education records, while applying data-minimization and confidentiality principles. Fourth, stakeholder-role requirements were synthesized from the preceding evidence sources rather than from direct local quotations or participant testimony. WHO digital-health guidance, ISO standards, Indonesian EMR regulation, and personal-data-protection law were treated as primary normative sources when a requirement depended on governance, security, privacy, interoperability, or software-quality constraints (30-33); peer-reviewed empirical research was used to inform education, accessibility, acceptance, usability, and VR-comfort requirements.

The methodological flow of the requirements synthesis is summarized in Figure 1.

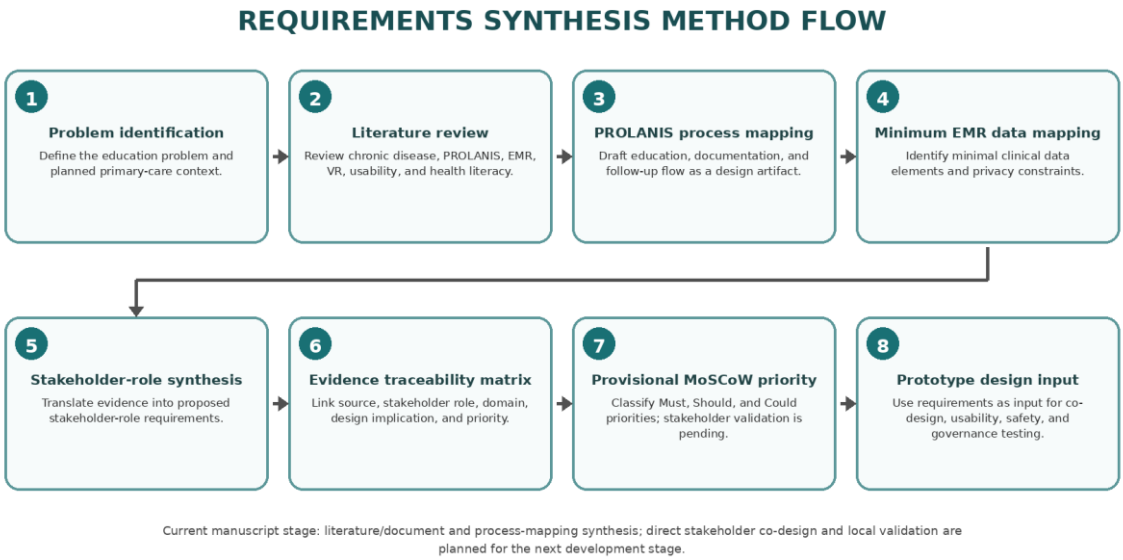

Figure 1. Flowchart of the literature- and process-mapping-based requirements synthesis for EMR-based VR application development.

A structured requirements synthesis was used. Each source-derived requirement statement or workflow constraint was entered conceptually into an evidence-traceability matrix with the fields: evidence/source, relevant stakeholder role, requirement domain, design implication, and provisional priority. Recurring requirements were grouped into information, interaction, technical, data-security, operational, usability, and VR-comfort domains, using thematic grouping principles for organizing patterns rather than claiming a qualitative interview analysis (34). Because there were no interview or focus-group transcripts, participant quotations, saturation, intercoder agreement, and formal disagreement resolution between qualitative coders were not applicable. MoSCoW categories were used to assign provisional Must-have, Should-have, and Could-have design priorities (35). The priorities represent an initial research-team design classification based on core educational purpose, safety, data protection, workflow feasibility, and technical dependency; they were not generated by stakeholder voting and must be re-evaluated during the next co-design stage. Functional and non-functional requirements were aligned with software-quality and requirements-engineering principles (36,37).

To maintain patient safety and service feasibility in the next development stage, the VR design criteria emphasize short session duration, seated mode, simple navigation, smooth visual transitions, audio narration, large text, stop/pause options, and staff assistance. Planned usability and user-experience evaluation will combine task-completion observation with the System Usability Scale (38), a user-satisfaction instrument such as the Computer System Usability Questionnaire (39), and the Simulator Sickness Questionnaire (40). Established work on cybersickness and virtual-environment discomfort will also inform exposure duration, visual-motion choices, and stopping rules (41,42).

Health-education content is proposed for adult and older PROLANIS participants using simple language, concrete visual examples, repeated messages, and audio support, consistent with health-literacy principles (43,44). VR-sickness evidence and clinical VR methodology further support conservative exposure, user control, and explicit safety evaluation (45,46), while usability engineering and heuristic evaluation can support interface review (47,48). If future co-design interviews or focus groups are conducted, reporting should follow appropriate qualitative-reporting guidance such as COREQ (49). Research involving older adults also supports age-adapted interaction and user-friendly VR design (50,51). In the current conceptual stage, patient consent, staff authentication, role-based access, access logging, report anonymization, and educational-purpose limitation are specified as future implementation requirements rather than measures already applied to participant data. Ethical review and informed-consent procedures should be obtained as applicable before direct stakeholder research, usability testing with participants, or patient-level EMR access.

RESULTS

Context of the proposed requirements

The literature- and process-mapping synthesis generated two provisional design problems for the planned VR application. First, the patient-facing experience should support easy-to-understand education without depending on a long face-to-face session. Second, the health-worker-facing workflow should support standardized, concise

education and follow-up without creating an excessive operational burden. These are proposed design requirements derived from the evidence synthesis, not direct quotations or empirically measured local needs.

Literature on chronic-disease education and immersive learning suggests that topics such as high blood pressure, diabetes complications, blood-vessel damage, diet, and test-result interpretation may benefit from visual explanation. VR can potentially represent these topics through three-dimensional or immersive visualization, but the design should remain simple and age-appropriate to reduce cognitive burden, confusion, and discomfort for first-time or older users.

For the healthcare-professional stakeholder role, the proposed model prioritizes ready-to-use educational materials, diagnosis-relevant topic selection, and a concise summary for follow-up. For medical-records staff, it prioritizes limited and secure data exchange. For program managers, it proposes simple usage and technical-issue reporting. These requirements require direct stakeholder confirmation in the next stage.

Table 1. Literature-informed stakeholder requirements matrix for the proposed EMR-based VR application

Stakeholder Group	Proposed Requirements	Design Implications
PROLANIS participants	Education on hypertension, diabetes mellitus, medication, diet, activity, routine check-ups, and danger signs.	Keep content short, visual, simple, and repeatable.
Adult and older participants	Easy navigation, large text, clear narration, step-by-step instructions, and a seated-use option.	Use clear icons, large buttons, limited menu depth, and short sessions of approximately 5-10 minutes.
Health workers	Uniform, rapid, diagnosis-relevant educational media that can be reinforced during care.	Provide a structured educational package and concise usage summary.
Medical records officers	Only data necessary for education should be used, with security and accountability controls.	Apply data minimization, authentication, role-based access, and access logging.
Program managers	Support for usage evaluation, patient feedback, and service improvement.	Provide simple reports on module use, feedback, and technical constraints.

Evidence note for Table 1: PROLANIS-participant requirements were informed by PROLANIS guidance and patient-education/VR literature (2,6-13,19,25); adult and older-participant requirements by co-design, health-literacy, usability, and VR-comfort evidence (22,23,38-45,50,51); health-worker requirements by digital-health and primary-care implementation evidence (24,30,31); medical-record requirements by EMR/privacy/security sources (4,32,33,36,37); and program-manager requirements by digital-health and software-quality sources (30,31,36,37). These are literature-informed stakeholder requirements and have not yet been validated through direct local interviews.

Information and education requirements

The literature-informed information requirements include understanding the disease, interpreting selected examination results, healthy-living behaviors, medication adherence, routine control, and warning signs. For hypertension, proposed priority topics include the meaning of blood pressure, risk factors, safe physical activity, salt intake, medication adherence, and check-up timing. For diabetes mellitus, proposed priority topics include the meaning of blood-glucose results, diet, physical activity, foot care, medication adherence, and signs of hypoglycemia or hyperglycemia.

Personalization was identified as a proposed requirement because education may be easier to interpret when messages are connected to clinically relevant information. The future application could display a limited summary from the EMR, such as diagnosis, most recent blood pressure, most recent blood glucose, current medication information, and prior education records. The application should not reproduce the full medical record; only data necessary for the educational purpose and authorized for use should be presented.

Functional and non-functional requirements

Table 2. Provisional priority of application functional requirements

Feature	Proposed Requirement	Provisional Priority
Patient profile	Displays minimum identity, PROLANIS diagnosis, and educational history.	Must have
Visualization of examination results	Displays blood pressure and blood sugar in simple graphs or color indicators.	Must have
Hypertension education module	Presenting the causes, risks, lifestyle, medications, and danger signs of hypertension.	Must have
Diabetes mellitus education module	Presenting diet, activities, medications, foot care, and warning signs of diabetes.	Must have

Feature	Proposed Requirement	Provisional Priority
Audio narration	Helping patients with reading disabilities and improving focus while using VR.	Should have
Control reminder	Provide messages about check-up schedules, taking medication, and healthy activities.	Should have
Patient feedback	Record brief insights, comfort, and suggestions after the VR session.	Should have
Officer's report	Displays history of modules used and technical issues.	Could have
Limited offline mode	Allows educational modules to continue running when the internet connection is unstable.	Could have

Evidence and priority note for Table 2: Must-have items (patient profile, examination-result visualization, hypertension education, and diabetes education) are core dependencies of the stated educational purpose and are supported by EMR, patient-education, and chronic-disease literature (4,6-13,25,30-33,36,37). Should-have items (audio narration, control reminders, and feedback) are supported by accessibility, health-literacy, and evaluation considerations (38-45,50,51). Could-have items (officer reports and limited offline operation) are operational enhancements rather than prerequisites for the first educational prototype (30,31,36,37). These MoSCoW assignments are provisional and require stakeholder validation.

Table 3. Proposed non-functional requirements of the application

Aspect	Proposed requirement criteria
Usability	Large buttons, minimum 14 pt text on screen, easily recognizable icons, and a maximum of three steps to open the main module.
Accessibility	Audio narration, simple language choices, high contrast, and one-on-one instructions.
VR Comfort	Seated mode, short duration, smooth visual transitions, and the option to stop at any time.
Data security	Staff authentication, patient consent, data minimization, anonymization for reports, and access logging.
System performance	The module's opening time is short, stable on devices available at the Community Health Center, and does not require too high specifications.
Maintenance	Educational materials can be updated, modules can be easily added, and problem logs can be read by administrators.

Evidence note for Table 3: usability and accessibility requirements are informed by human-centered design, usability instruments, health-literacy literature, and older-adult design evidence (26,27,38,39,43,44,47,48,50,51); VR-comfort requirements by simulator-sickness and clinical VR evidence (40-46); data-security requirements by EMR regulation, ISO security and requirements standards, and personal-data-protection law (4,32,33,36,37); and performance/maintenance requirements by software-quality and digital-health guidance (30,31,36,37).

Proposed usage flow

The proposed interface flow is intentionally concise. In a future implementation, the provider would open the patient education profile, select a diagnosis or educational topic, confirm the authorized use of the minimum data needed for education, and assist the patient in using the VR device in seated mode. After the session, the patient could answer brief comprehension and comfort questions, and the result could be stored as an education record according to approved governance rules.

This design scenario aims to reduce the risk of patients becoming lost in complex menus while retaining health-worker oversight for setup and safety. It also positions VR as an educational aid rather than a replacement for clinician-patient interaction. The flow remains a proposed scenario and should be validated with end users and local workflow owners.

Table 4. Proposed application usage flow

Level	Proposed activity	Expected output
1	The officer selects the patient and opens the education profile.	Minimum identity and diagnosis are displayed.
2	The officer selects a module according to the education purpose.	Hypertension, diabetes, medication, diet, or activity content is opened.
3	The patient uses VR in seated mode with assistance.	Visual and audio education is delivered.
4	The patient provides brief feedback after the session.	Understanding, comfort, and suggestion data are recorded if approved.
5	The officer reviews the session summary.	The officer can provide direct educational reinforcement.

Evidence note for Table 4: this sequence is a design scenario derived from the literature/document synthesis and proposed process map; it was not established through direct observation of local workflow. Its feasibility, role allocation, consent point, documentation burden, and data-storage steps should be checked with PROLANIS participants and health-center staff during co-design.

DISCUSSION

The revised synthesis indicates that the planned VR application should be designed around the intended users and service context, while recognizing that the current requirements remain preliminary. PROLANIS participants may benefit from engaging media, but the educational value depends on understandable content, relevance to chronic-disease management, and safe use. This interpretation is consistent with human-centered design and digital-health guidance, and recent co-design studies show why direct user validation should follow a document-based requirements stage (19-27,30,31).

Personalization is a central opportunity and a central trade-off. EMR integration could connect education to diagnosis and selected examination results, potentially improving relevance and continuity. However, greater personalization can encourage greater data use, whereas privacy and security favor minimization. The revised model therefore treats the full EMR as out of scope and proposes only purpose-limited data elements, authorization, role-based access, logging, and governance review (4,32,33,36,37).

Technology acceptance should be considered from the outset. TAM and UTAUT indicate that perceived usefulness, ease of use, facilitating conditions, and social influence can shape technology use (14-17). In this context, a VR tool is more likely to be acceptable if staff perceive that it supports consistent education without excessive setup or documentation, and if patients can complete a short module without complex instructions. These assumptions require empirical testing with the actual stakeholder groups.

Design for adult and older users requires particular attention. Health literacy varies, and older users may have differences in vision, hearing, familiarity with immersive devices, mobility, or tolerance of prolonged interaction. Large text, narration, simple navigation, high contrast, pause/stop control, familiar examples, and low-writing-demand co-design methods are therefore appropriate candidates for validation (22,23,43,44,50,51). The hypertension VR trial also suggests that response to immersive education can differ by age and sex, reinforcing the need for subgroup-sensitive evaluation (10).

VR comfort is a safety requirement rather than a cosmetic preference. Head-mounted displays can provoke dizziness, nausea, eye strain, or other cybersickness symptoms in susceptible users. The proposed seated mode, short sessions, smooth transitions, user control, and staff assistance are consistent with established simulator-sickness and VR-safety literature (40-46). Future testing should define stopping criteria and record discomfort systematically rather than assuming that a short exposure is universally safe.

Health-worker requirements also affect implementation. VR should not become a parallel system that increases workload or fragments documentation. Primary-care qualitative evidence shows that professionals judge VR partly through feasibility and perceived usefulness (24). Accordingly, the proposed workflow keeps staff control at setup and follow-up but should be tested for actual time burden, role clarity, training needs, device cleaning, technical support, and integration with routine documentation. Digital-health and software-quality guidance can define constraints, but local operational acceptability must be established empirically (30,31,36,37).

Several stakeholder priorities may conflict. Personalization may require more clinical data while privacy favors minimization; staff-controlled setup may improve safety but add workload; richer immersive motion may increase engagement yet also increase cybersickness or cognitive burden; and offline operation may improve continuity during unstable connectivity while complicating synchronization and security. These trade-offs explain why the MoSCoW priorities in this manuscript should be interpreted as provisional design decisions rather than final stakeholder consensus. The next phase should use participatory co-design to surface disagreements explicitly and revise priorities transparently.

The main limitations concern the source and validation of the requirements. First, the model was derived from literature/documents, a proposed process map, and conceptual EMR mapping rather than direct interviews, focus groups, surveys, or observation of PROLANIS participants and staff. Second, the process map has not yet been validated as a faithful description of local practice. Third, anchoring the design to two planned health-center settings limits representativeness and transferability to facilities with different workflows, infrastructure, or patient populations. Fourth, there was no formal stakeholder validation, triangulation with participant testimony, or independent qualitative coding, so synthesis and prioritization bias remain possible. Finally, no usability, technology-acceptance, simulator-sickness, data-security, knowledge, satisfaction, adherence, or clinical-effectiveness outcomes were measured. Future work should therefore conduct participatory co-design, local workflow validation, prototype usability and safety testing, data-governance review, and subsequent evaluation of educational and clinical outcomes.

CONCLUSION

This literature- and process-mapping synthesis proposes five preliminary requirement groups for an EMR-based VR application for PROLANIS education: concise chronic-disease educational content, purpose-limited EMR-based personalization, an accessible interface for adults and older users, patient-data security and confidentiality, and operational support for health workers.

Provisional priority features include a patient education profile, simple visualization of examination results, hypertension and diabetes education modules, audio narration, simple navigation, feedback, and a concise usage summary for health workers. Proposed non-functional requirements include short seated sessions, large text, stop/pause control, access control, data minimization, and maintainability. These priorities are design inputs rather than validated user preferences.

The principal limitation is that the requirements have not yet been validated directly by PROLANIS participants or health-center staff and are anchored to two planned implementation settings. They should therefore be treated as an initial model. The next phase should include participatory co-design and stakeholder validation, followed by usability, technology-acceptance, simulator-sickness, privacy/security, and workflow evaluation; only after these steps should the prototype be evaluated for its effect on patient understanding and chronic-disease management.

ACKNOWLEDGMENTS

The authors would like to thank the Semarang Ministry of Health Polytechnic, Dian Nuswantoro University, Sidorejo Lor Community Health Center, and Sidorejo Kidul Community Health Center for their support in developing the EMR-based VR application concept for health education for PROLANIS participants. They also thank all parties who provided input during the needs analysis and initial system design stages.

REFERENCES

1. Health Development Policy Agency, Ministry of Health of the Republic of Indonesia. Key results of the 2023 Indonesian Health Survey (SKI): non-communicable diseases (hypertension and diabetes). Jakarta: Ministry of Health of the Republic of Indonesia; 2024.
2. BPJS Health. PROLANIS Practical Guide. Jakarta: BPJS Health; 2014.
3. Ministry of Health of the Republic of Indonesia. Regulation of the Minister of Health of the Republic of Indonesia Number 43 of 2019 concerning Community Health Centers. Jakarta: Ministry of Health of the Republic of Indonesia; 2019.
4. Ministry of Health of the Republic of Indonesia. Regulation of the Minister of Health of the Republic of Indonesia Number 24 of 2022 concerning Medical Records. Jakarta: Ministry of Health of the Republic of Indonesia; 2022.
5. World Health Organization. Global strategy on digital health 2020-2025. Geneva: World Health Organization; 2021.
6. Curran VR, Hollett A. The use of extended reality (XR) in patient education: A critical perspective. Health Educ J. 2024;83(4):338-351. doi:10.1177/00178969231198955.
7. Li Y, Kim M, Sutedjo A. Effects of virtual reality as a patient education tool: A meta-analysis. J Educ Technol Dev Exch. 2024;17(2):216-228. doi:10.18785/jetde.1702.10.
8. Sung H, Kim M, Park J, Shin N, Han Y. Effectiveness of virtual reality in healthcare education: systematic review and meta-analysis. Sustainability. 2024;16(19):8520. doi:10.3390/su16198520.
9. Tene T, Vique Lopez DF, Valverde Aguirre PE, Orna Puente LM, Vacacela Gomez C. Virtual reality and augmented reality in medical education: an umbrella review. Front Digit Health. 2024;6:1365345. doi:10.3389/fdgth.2024.1365345.
10. Jiravska Godula B, Jiravsky O, Matheislova G, Kuriskova V, Valkova A, Puskasova K, et al. Virtual Reality for Patient Education about Hypertension: A Randomized Pilot Study. J Cardiovasc Dev Dis. 2023;10(12):481. doi:10.3390/jcdd10120481.
11. Gibson B, Simonsen S, Jensen JD, Yingling L, Schaefer J, Sundaresh V, Zhang Y, Altizer R. Mobile Virtual Reality Versus Mobile 360 Degree Video to Promote Enrollment in the Diabetes Prevention Program Among Hispanic Adults: Pilot Study. JMIR Diabetes. 2022;7(1):e26013. doi:10.2196/26013.
12. Siripongsaporn S, Yongsiriwit K, Tantitanawat K, Chirapongsathorn S. Use of virtual reality in patient education program to reduce anxiety in upper gastrointestinal endoscopy: a randomized controlled trial. JGH Open. 2024;8(3):e13046. doi:10.1002/jgh3.13046.
13. El Mathari S, Kuitert L, Boulidam N, Shehadeh S, Klautz RJM, de Lind van Wijngaarden R, Kluin J. Evaluating Virtual Reality Patient Education in Cardiac Surgery: Impact on Preoperative Anxiety and Postoperative Patient Satisfaction. J Clin Med. 2024;13(21):6567. doi:10.3390/jcm13216567.
14. Wang EY, et al. Acceptance of virtual reality in trainees using a technology acceptance model: survey study. JMIR Med Educ. 2024;10:e60767. doi:10.2196/60767.
15. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q. 1989;13(3):319-340.
16. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: toward a unified view. MIS Q. 2003;27(3):425-478.

17. Holden RJ, Karsh BT. The Technology Acceptance Model: its past and future in health care. J Biomed Inform. 2010;43(1):159-172. doi:10.1016/j.jbi.2009.07.002.
18. Mergen M, Graf N, Meyerheim M. Reviewing the current state of virtual reality integration in medical education: a scoping review. BMC Med Educ. 2024;24(1):788. doi:10.1186/s12909-024-05777-5.
19. Malini H, Anwar M, Mailani F, Susianty S, Purna RS. Co-Designing a Digital Health Application for Assisting Self-Care Diabetes Patients: A Qualitative Study. Health Sci Rep. 2026;9(6):e72418. doi:10.1002/hsr2.72418.
20. Shanmugavel A, Shakya PR, Shrestha A, Nepal J, Shrestha A, Daneault JF, Rawal S. Designing and Developing a Mobile App for Management and Treatment of Gestational Diabetes in Nepal: User-Centered Design Study. JMIR Form Res. 2024;8:e50823. doi:10.2196/50823.
21. Naranjo-Rojas A, Perula-de-Torres LA, Molina-Recio G. Patients, caregivers, and healthcare professionals' needs when designing the content of a mobile application for the clinical monitoring of patients with chronic obstructive pulmonary disease and home oxygen therapy: a user-centered design. Internet Interv. 2022;29:100552. doi:10.1016/j.invent.2022.100552.
22. Banbury A, Nancarrow S, Dart J, Gray L, Dodson S, Osborne R, Parkinson L. Adding value to remote monitoring: co-design of a health literacy intervention for older people with chronic disease delivered by telehealth - The telehealth literacy project. Patient Educ Couns. 2020;103(3):597-606. doi:10.1016/j.pec.2019.10.005.
23. Niu J, Yin Y, Wang S. An Age-Adapted Co-Design Methodology for Community Health Research Involving Older Adults With Type 2 Diabetes. Health Expect. 2026;29(3):e70718. doi:10.1111/hex.70718.
24. Skidmore N, Ryan CG, Mankelow J, Martin D. Acceptability and feasibility of virtual reality to promote health literacy in primary care from the health professional's view: a qualitative study. Patient Educ Couns. 2024;123:108179. doi:10.1016/j.pec.2024.108179.
25. Ghodousi Moghadam S, Mazloum Khorasani Z, Sharifzadeh N, Tabesh H. A mobile serious game about diabetes self-management: design and evaluation. Heliyon. 2024;10(18):e37755. doi:10.1016/j.heliyon.2024.e37755.
26. Norman DA, Draper SW, editors. User centered system design: New perspectives on human-computer interaction. Hillsdale: Lawrence Erlbaum Associates; 1986.
27. International Organization for Standardization. ISO 9241-210:2019 Ergonomics of human-system interaction, Part 210: Human-centred design for interactive systems. Geneva: ISO; 2019.
28. Pressman RS, Maxim BR. Software engineering: a practitioner's approach. 9th ed. New York: McGraw-Hill Education; 2020.
29. Sommerville I. Software engineering. 10th ed. Boston: Pearson; 2016.
30. World Health Organization. Classification of digital health interventions v1.0: a shared language to describe the uses of digital technology for health. Geneva: World Health Organization; 2018.
31. World Health Organization. WHO guideline: recommendations on digital interventions for health system strengthening. Geneva: World Health Organization; 2019.
32. International Organization for Standardization. ISO 27799:2016 Health informatics: information security management in health using ISO/IEC 27002. Geneva: ISO; 2016.
33. Republic of Indonesia. Law Number 27 of 2022 concerning Personal Data Protection. Jakarta: Republic of Indonesia; 2022.
34. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. 2006;3(2):77-101. doi:10.1191/1478088706qp063oa.
35. Clegg D, Barker R. Case method fast-track: a RAD approach. Boston: Addison-Wesley; 1994.
36. International Organization for Standardization. ISO/IEC 25010:2011 Systems and software engineering: Systems and software Quality Requirements and Evaluation (SQuaRE): system and software quality models. Geneva: ISO; 2011.
37. International Organization for Standardization. ISO/IEC/IEEE 29148:2018 Systems and software engineering: life cycle processes: requirements engineering. Geneva: ISO; 2018.
38. Brooke J. SUS: a quick and dirty usability scale. In: Jordan PW, Thomas B, Weerdmeester BA, McClelland AL, editors. Usability evaluation in industry. London: Taylor & Francis; 1996. p. 189-194.
39. Lewis JR. IBM computer usability satisfaction questionnaires: psychometric evaluation and instructions for use. Int J Hum Comput Interact. 1995;7(1):57-78. doi:10.1080/10447319509526110.
40. Kennedy RS, Lane NE, Berbaum KS, Lilienthal MG. Simulator sickness questionnaire: an enhanced method for quantifying simulator sickness. Int J Aviat Psychol. 1993;3(3):203-220. doi:10.1207/s15327108ijap0303_3.
41. Stanney KM, Kennedy RS, Drexler JM. Cybersickness is not simulator sickness. Proc Hum Factors Ergon Soc Annu Meet. 1997;41(2):1138-1142. doi:10.1177/107118139704100292.
42. LaViola JJ Jr. A discussion of cybersickness in virtual environments. ACM SIGCHI Bull. 2000;32(1):47-56. doi:10.1145/333329.333344.

43. Sorensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, Slonska Z, Brand H. Health literacy and public health: a systematic review and integration of definitions and models. BMC Public Health. 2012;12:80. doi:10.1186/1471-2458-12-80.
44. Nutbeam D. Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. Health Promot Int. 2000;15(3):259-267. doi:10.1093/heapro/15.3.259.
45. Saredakis D, Szpak A, Birckhead B, Keage HAD, Rizzo A, Loetscher T. Factors associated with virtual reality sickness in head-mounted displays: a systematic review and meta-analysis. Front Hum Neurosci. 2020;14:96. doi:10.3389/fnhum.2020.00096.
46. Birckhead B, Khalil C, Liu X, Conovitz S, Rizzo A, Danovitch I, et al. Recommendations for methodology of virtual reality clinical trials in health care by an international working group: iterative study. JMIR Ment Health. 2019;6(1):e11973. doi:10.2196/11973.
47. Nielsen J. Usability engineering. San Francisco: Morgan Kaufmann; 1993.
48. Nielsen J, Molich R. Heuristic evaluation of user interfaces. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems; 1990. p. 249-256. doi:10.1145/97243.97281.
49. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care. 2007;19(6):349-357. doi:10.1093/intqhc/mzm042.
50. Xie Z, Chen F, Zou L, Wang F, Yang L. Using Virtual Reality in the Care of Older Adults With Dementia: A Randomized Controlled Trial. J Gerontol Nurs. 2023;49(11):25-32. doi:10.3928/00989134-20231011-01.
51. Xie Z, Zou L, Wang Q, Chen Y, Li L, Liao Y, Chen F. Application of immersive virtual reality (IVR) for the care of common diseases of older adults course: a mixed methods study. Geriatr Nurs. 2024;58:399-409. doi:10.1016/j.gerinurse.2024.06.003