GERONTOINFO: Information system for research in gerontopsychiatry at the San José University Children's Hospital

Carlos E. Rodríguez Angarita [a] ; Lina María Rueda Reatiga [b] ; Carlos Alberto Santa Villamil [c].

a. Medical specialist in psychiatry. Specialist in epidemiology. Postgraduate psychiatry lecturer, Fundación Universitaria de Ciencias de la Salud. Bogotá, Colombia. ORCID: https://orcid.org/0000-0002-1771-0450

b. Psychiatry resident physician. Fundación Universitaria de Ciencias de la Salud. Bogotá, Colombia. ORCID: https://orcid.org/0009-0006-2710-7459

c. Psychiatry resident physician. Fundación Universitaria de Ciencias de la Salud. Bogotá, Colombia. ORCID: https://orcid.org/0009-0001-9957-6610

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Abstract

Introduction: In the field of geriatric psychiatry, clinical data management presents challenges related to the diversity of pathologies and the need for standardization. In this context, GERONTOINFO was developed as an information system for research in geriatric psychiatry at the San José University Children's Hospital, facilitating the collection, storage, and secure analysis of clinical data.

Objective: To develop GERONTOINFO as an information system aimed at research in geriatric psychiatry, contributing to improved clinical data management.

Methods: This is an applied research study focused on software development and health technology assessment in mental health. Initially, a comprehensive needs and requirements analysis of the service was conducted to define critical areas of data management. Subsequently, a modular architecture was designed and developed using Node.js and MySQL, enabling the secure and efficient integration of multiple modules, including personal data management, clinical history, mental status examination, assessment scales, and psychometric test results.

Results: During the implementation phase, pilot usability testing was conducted using the System Usability Scale (SUS), yielding an average score of 88 in a sample of ten researchers, indicating high acceptance and ease of

use. Additionally, security measures such as data encryption and automated backups were implemented, ensuring the integrity and confidentiality of the collected information.

Conclusion: GERONTOINFO is presented as a specialized and efficient tool for research in geriatric psychiatry, improving the quality of clinical information and laying the foundation for more robust studies in this field. Its continuous evolution, including potential integration of artificial intelligence, will expand its capacity to optimize data management and analysis.

Keywords: Information systems; geriatric psychiatry; research; medical informatics; software.

Introduction

In the digital health ecosystem, personal information—particularly health-related data (Protected Health Information, PHI)—is collected, used, and shared extensively, giving rise to new models of healthcare delivery as well as strengthening research. These digital health systems, ranging from mobile applications to complex platforms based on artificial intelligence, are designed to provide more personalized, preventive, and predictive services (1).

Studies using retrospective medical data have become essential for biomedical research, contributing significantly to the scientific literature. Clinical data repositories are key resources for fields such as personalized medicine, clinical trials, epidemiology, and public health.

However, the collection of medical data is a slow process that may take years within a single institution. To expedite this process, or when data are diverse and cannot be obtained from a single source, multiple institutions may collaborate to gather information. Nevertheless, this aggregation of distributed medical data poses challenges related to privacy, data quality, and interoperability among different healthcare systems (2,3).

The structure and representation of healthcare data for research depend on the specific requirements of each study; therefore, it is not possible to establish a single fixed schema for all clinical investigations. To ensure both data utility and patient privacy, database design and protection parameters must be tailored to the particular needs of each study (3).

One of the main challenges faced in research is bias, which can be classified into three groups: selection bias, information or measurement bias, and confounding. Information or measurement biases are among the most frequent and occur during data collection, once participants have been se-

lected. These errors affect the quality of the information obtained and may result from a lack of standardization in processes, the use of inadequate or poorly calibrated instruments, or errors generated by the participants themselves.

Therefore, it is essential to have data collection tools that minimize these errors. In this context, the present study proposes the development of a data management system specifically designed for use in psychiatry, enabling more efficient and accurate data collection, preventing incomplete, erroneous, or duplicate data, and improving the overall quality of the collected information (4).

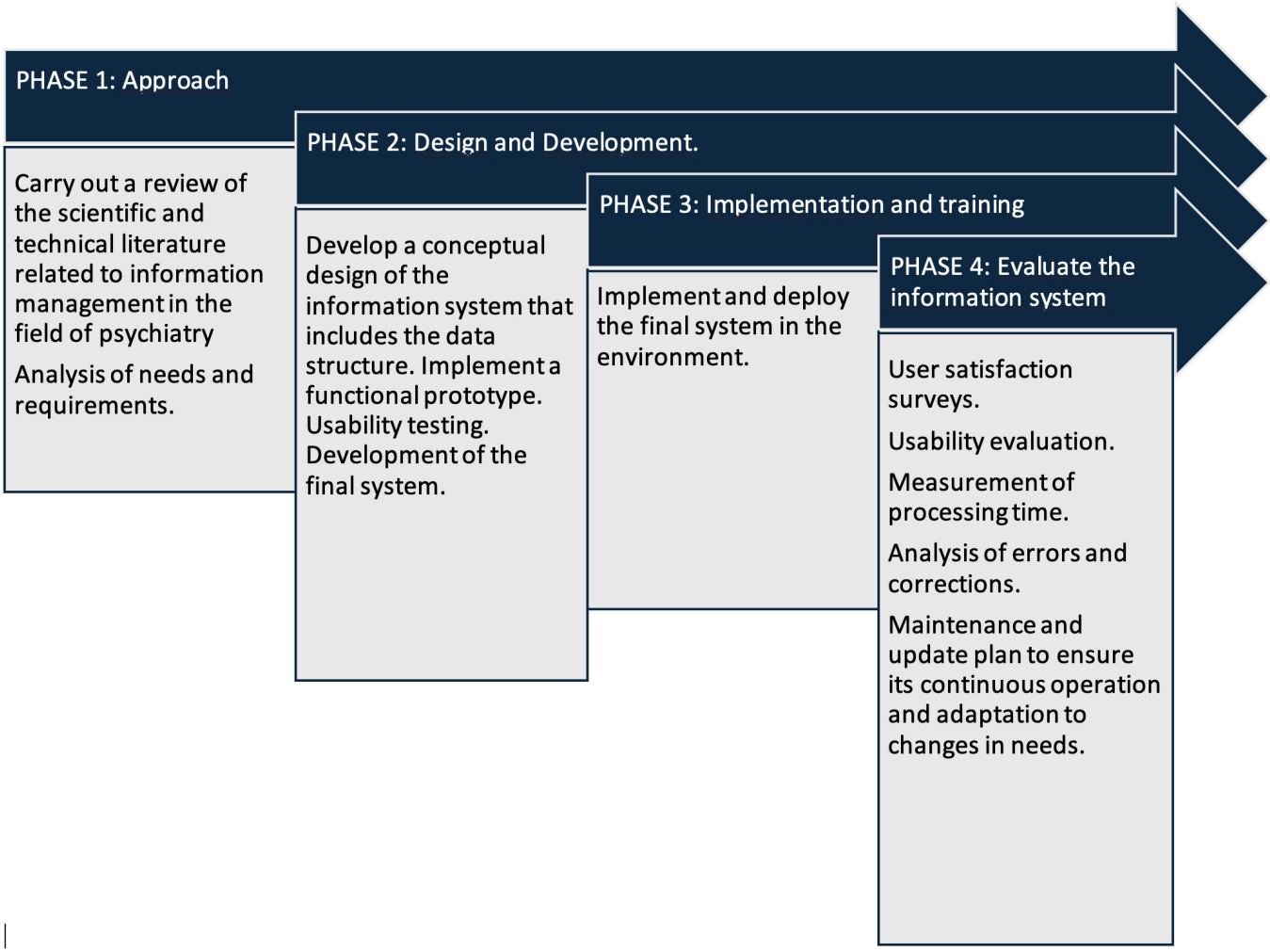
Methods

Study Design

This is an applied research study aimed at the design, development, and implementation of an information system in the field of psychiatry, using a software engineering approach and health technology assessment in mental health.

The development followed a structured process that included needs and requirements analysis of the service, system design and construction according to functional and technical specifications, and a pilot test with users from the psychiatry service to evaluate its usefulness, effectiveness, and usability in a real-world setting. Based on the feedback obtained, the necessary adjustments were made, and full system implementation was carried out.

Subsequently, a process of continuous evaluation and monitoring was established to ensure proper system performance and its adaptation to the needs of both the service and its users. Overall, the study integrates applied research, software development, and health technology assessment within the field of mental health (Figure 1).



Software Architecture

The system was developed using Node.js and JavaScript for the backend, and MySQL as the database management system. A modular, service-oriented architecture was adopted, enabling scalability, flexibility, and efficient management of the system's various components.

A RESTful API was implemented to facilitate communication between the frontend and backend, ensuring secure and efficient data access as well as the integration of new functionalities. The database was normalized to ensure integrity, consistency, and the handling of large volumes of clinical information.

Access to the system was provided through a web-based platform called GERONTOINFO, designed for the secure management of clinical records. The system included credential-based access control for authorized users, ensuring data confidentiality. The application was hosted in the cloud, with access via a public IP address and enhanced security measures.

Additionally, the software enabled graphical visualization and interrelation of clinical data, as well as the generation of statistics, facilitating data analysis and the characterization of the patient population.

Software Overview

The software was designed for the comprehensive management of patients' clinical profiles in the geriatric psychiatry context. It included modules for the recording and retrieval of relevant clinical data, such as medical history, mental status examination, and laboratory results (Table 1).

Table 1: System Requirements

Personal Data	Age, Sex, Educational level, Occupation, Who the patient lives with.
Admission characteristics	Treating specialty, Reason for discharge, ICD-10 of psychiatry, ICD-10 of hospitalization.
Background	Pathological, Surgical, Toxicological, Polypharmacy, Psychiatric: previous episodes of delirium.
Mental exam	State of consciousness, Bearing, Attitude, Attention, Thought, Affect, Language, Sensory perception, Memory, Intelligence, Judgment, Introspection, and Prospection.
Scales	Delirium Severity Scale, Cornell Scale, Mini-Mental, Yesavage Short Form, Goldberg Anxiety-Depression, SAD PERSONS, Barthel, Subjective Memory Complaint, Lawton Scale, Plutchik Scale, Salamanca Test, PANSS Scale, AUDIT, CIWAR-AR, Zarit, Anticholinergic Burden Index, ZUNG Scale, Charlson Index, NEUROPSI.
Paraclinical tests	Images, Laboratories (blood count, AST, ALT, creatinine, BUN, Toxics...)
Pharmacological management	Type, dose, duration.

Source: own elaboration

Clinical assessment scales with automatic score calculation, a document manager for medical files, and a user management system with differentiated roles (administrator, teacher, and consultant) were integrated, which allowed access control according to the assigned functions. The system aimed to centralize and automate clinical information, facilitating research, optimizing medical decision-making, and improving the efficiency of the care process in a safe and accessible environment.

Results

The GERONTOINFO research data management system was developed and implemented on the website https://gerontoinfo.com/. After completing the first version, a pilot testing program was initiated, including functionality assessments, load testing, and user satisfaction surveys, with the aim of verifying proper system performance and measuring user acceptance.

1. Service Needs and Requirements Report

During the needs analysis phase, key requirements of the psychiatry service were defined, including the use of standardized clinical scales, structured fields for data normalization, and specific sections for recording mental status examination, diagnosis, and psychopharmacological management.

Additionally, the system incorporated updates of clinical scales according to current guidelines and real-time graphical data visualization, with the aim of facilitating statistical analysis and supporting clinical research.

2. Preliminary Design and Functional System Prototype

The GERONTOINFO interface was designed with a focus on usability and organized into four main modules: Home, Patients, Studies, and Settings. The Home module displays monthly statistics with download options; Patients allows the recording and retrieval of clinical information; Studies facilitates the assignment and completion of assessments; and Settings manages users, permissions, and tests (Figure 2).

Figure 2. Home section of the GERONTOINFO system.

The system integrates 21 validated psychiatric tests in Spanish, along with options for recording clinical and paraclinical data, with automatic score calculation and real-time results visualization (Table 2).

Table 2. Description of the test groups created and the associated tests and examinations.

Name of the group	Description of the group	Associated tests
General Test	It includes all the scales.	All the scales.
Suicidal behavior	Scales for patients with suicidal ideation, attempt, and gesture.	Mental exam, Sad-Person, Plutchick, Zung Scale, Goldberg Anxiety-Depression, Salamanca.
Cognitive decline test	For older adults with suspected dementia.	Mental exam, Mini-Mental, Barthel, Subjective memory complaint, Lawton Scale, Cholinergic burden index, NEUROPSI, Charlson Index, NEUROIMAGES, Family support network, Implementation of anti-delirium measures, Pharmacological management.
Affective symptoms in older adults	Scales to assess the presence of depression - anxiety in older adults.	Mental exam, Cornell Scale, Mini-Mental, Yesavage abbreviated, V50 -Sad- Person, Barthel, Family support network, Pharmacological management.
Depressive symptoms in adults	Test to evaluate depressive symptoms in adults.	Mental exam, Sad- Person, Zung Scale, Family support network, Goldberg Anxiety-Depression, and Salamanca.
Addictions	Test to evaluate substance use.	Audit, CIWA-AR Scale, Cannabis, Cocaine, Benzodiazepines, Opiates.
Delirium	Test to evaluate patients who are experiencing delirium.	Mental exam, Delirium Severity Scale, cholinergic load index, Mini-Mental, Charlson Index, Barthel, Family support network, Application of anti-delirium measures, Pharmacological management.
Psychosis	Assessment of psychotic symptoms.	Mental examination, PANSS.
Personality	Test to evaluate personality traits.	Mental exam, Salamanca.
Caregiver evaluation	Test to assess caregiver overload.	Barthel, Lawton Scale, Caregiver Burden Scale (Zarit Test).
Paraclinical tests	Serum and imaging exams.	Leukocytes, platelets, hemoglobin, neutrophils, BUN, creatinine, AST, ALT, TSH, free T4, glucose, HbA1c%, albumin, CRP, folic acid, vitamin B12, sodium, potassium, chloride, VDRL, HIV, neuroimaging, presence of cannabis in urine, cocaine in urine, benzodiazepines in urine, and opioids in urine.

To facilitate data entry, the assessments were organized into groups according to the patient's profile and diagnosis:

- General
- Affective symptoms in adults
- Affective symptoms in older adults
- Suicidal behavior
- Cognitive impairment
- Personality
- Caregiver assessment
- Paraclinical tests
- Delirium
- Psychosis
- Addictions

This design enables efficient and structured data management, optimizing patient evaluation and follow-up.

3. Functional and Secure System

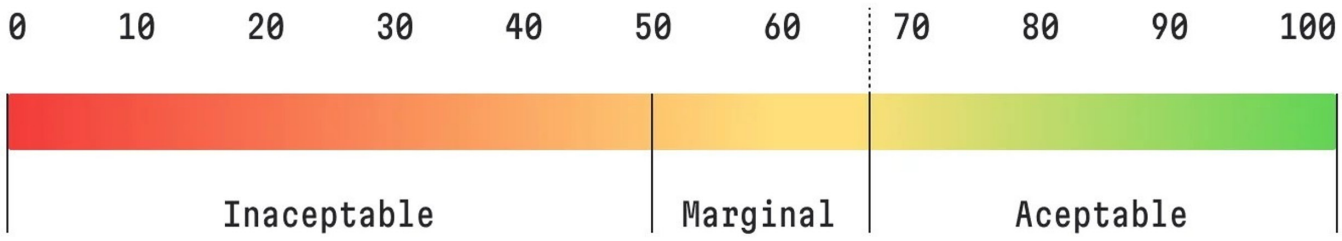
The GERONTOINFO system underwent unit, integration, and usability testing, as well as compatibility testing across different devices and browsers. Usability evaluation, conducted with the participation of 20 users, confirmed an accessible and user-friendly interface.

Load testing was performed using Artillery, simulating up to 300 concurrent users. The system demonstrated optimal performance up to 100 users, relative stability up to 200 users, and progressive degradation beyond 300 users, highlighting the need for infrastructure optimization under high-demand scenarios.

4. Pilot Testing Evaluation

Field testing was conducted using the System Usability Scale (SUS), consisting of 10 Likert-scale items (1–5), which allows usability to be classified between 60 and 100 as acceptable (Figure 3).

Figure 3. Representation of SUS survey results



The evaluation included psychiatry residents and instructors from the Universidad de Ciencias de la Salud Foundation, who interacted with the system after an induction through a video tutorial.

An average score of 88 was obtained from 10 participants, indicating a high usability level and favorable for its implementation (Table 3).

Table 3. Individual and average results of the satisfaction scale, System Usability Scale (SUS)..

Evaluated	Score	Evaluated	Score
Subject 1	87.5	Subject 6	92.5
Subject 2	90.0	Subject 7	100
Subject 3	85.0	Subject 8	77.5
Subject 4	77.5	Subject 9	95.0
Subject 5	100	Subject 10	75.0
Average		88.0	

5. System Adjustments

Based on the feedback obtained, improvements were implemented to optimize system functionality and usability, including the expansion of ICD-10 codes and enhancements to alert and notification systems.

Additionally, future improvements were planned, such as the incorporation of specific assessment batteries for bipolar affective disorder and schizophrenia, as well as scales for evaluating substance use.

6. Full Implementation

Training materials (video tutorial and user manual) were developed to standardize system use. The intuitive interface enabled rapid adoption with minimal training, without requiring advanced technical knowledge. Furthermore, technical support was made available during working hours.

7. Monitoring and Security

The system implemented security mechanisms through data encryption and automated backups every 30 days. Periodic updates were performed to enhance security and functionality, based on user feedback.

Communication channels were established for incident reporting, ensuring timely response and support.

Discussion

The increasing complexity of healthcare processes and the growing volume of clinical information have driven the development of health data management systems that enable the centralization, standardization, and

analysis of information with high standards of security and efficiency. These tools support evidence-based clinical decision-making, optimize institutional processes, and strengthen health research through the adoption of international standards and user-friendly interfaces accessible to non-expert users (6,7).

Additionally, it is recognized that data obtained exclusively in controlled environments do not fully reflect everyday health conditions, which has encouraged the use of mobile technologies for data collection in real-world settings. Mobile devices and sensors allow continuous assessment of clinical and behavioral variables, expanding the possibilities for evaluation and clinical follow-up, with increasing interest in their integration into both clinical and research settings (8).

Among recent developments, StatiCAL stands out as an interactive statistical analysis tool for biomedical data that prioritizes accessibility and enables basic analyses without advanced programming knowledge. Its focus on usability, data visualization, and open access has facilitated its adoption in the scientific community (9,10).

In contrast, in psychiatry, the development of specific data management systems remains limited compared to areas such as radiology, where consolidated platforms like MIRMAID and other widely used and continuously optimized open-source tools exist (11–13). This imbalance is also observed in disciplines such as palliative care, preventive medicine, internal medicine, and general surgery, which have advanced in the design of research support systems. The subjective nature of clinical assessment and the heterogeneity of psychiatric data pose additional challenges for standardization and the development of specialized tools (14–16).

In medical and psychiatric research, there are few specialized data analysis tools. In computational psychiatry, notable examples include TAPAS and COMPASS. TAPAS is an open-source software that enables the development of computational assays from neuroimaging, electrophysiological, and behavioral data, integrating experimental design, quality control, artifact correction, and statistical inference. COMPASS, based on MATLAB, allows the integration of signals for evaluating behavioral models, although the term is also used in other non-psychiatric contexts (17,18). Additionally, systems targeting specific psychopathologies have been developed, such as TEDIS, designed in 2017 for continuous and multicenter data collection in autism spectrum disorder (19).

No design-oriented studies were identified focusing on data management systems specifically for geriatric psychiatry research. This gap is particularly relevant given the growth of a population characterized by clinical frailty, high comorbidity, polypharmacy, and a high prevalence of psychopathologies, generating substantial demand for mental health services (20,22). Despite increased recognition of mental health issues in older adults, there remains a shortage of national and local epidemiological studies, limiting accurate prevalence estimates and the development of effective detection and treatment strategies (23). Some studies indicate that up to half of this population may present neuropsychiatric symptoms, associated with increased mortality and caregiver burden. In Colombia, the last large-scale population study dates back to 2015, showing a high frequency of affective symptoms (24,25).

In this context, GERONTOINFO offers several advantages, including standardized data collection, reduction of human error, and centralization of information, enabling longitudinal patient follow-up and optimization of research processes. Its web-based platform facilitates real-time data entry from multiple devices and enables multicenter data collection, increasing sample representativeness while ensuring data protection in accordance with security standards.

Among its limitations are dependence on internet connectivity, the need for basic user training, continuous system updates, expansion of psychometric instruments, and interoperability with other health systems. Despite these limitations, GERONTOINFO represents an innovative and evolving tool with high potential for research and clinical practice in geriatric psychiatry.

Future phases will evaluate its performance compared to traditional methods and expand its scope to other academic components and research projects. Additionally, the incorporation of artificial intelligence is planned to support clinical pattern analysis, diagnostic assistance, and optimization of information processing (26,27).

Conclusions

A data management system specifically designed for psychiatric research has been developed in response to the need to optimize data recording and processing in this field. This system, with an intuitive and user-friendly interface, facilitates researchers' work by efficiently organizing and analyzing data, representing a significant advancement. However, it is recognized as a

first step toward building a comprehensive tool for research data management.

Future versions are expected to incorporate advanced functionalities, such as integration of data from multiple sources, greater analytical customization, enhanced data security and privacy, and compatibility with other collaborative systems, which will further strengthen the effectiveness and scope of psychiatric research.

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Correspondence: lmrueda@fucsalud.edu.co

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