Final report HCI

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1 Project Information

Project Name: Nucleo

Value Proposition: "Una piattaforma familiare per i dati sanitari"

Team Members:

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Group Name: Kernel

2 Problem/Solution Overview

Traditional health management systems impose unnecessary complexity on essential tasks. Document retrieval is bound by rigid chronological lists; tracking health evolution relies on manual report comparison; and effective searching demands specific medical terminology. Furthermore, managing dependent family members creates friction through isolated accounts. Nucleo resolves these inefficiencies through a unified platform: static documents turn into active resources, and family care transforms into a cohesive experience rather than a fragmented process.

3 Needfinding

3.1 Description of the Domain

The project operates within the theme of *Health and Well-being*, specifically focusing on the domain of **Personal and Family Digital Health**. This area was selected because health management represents a fundamental aspect of daily life that, in its current state, generates significant friction and anxiety, negatively impacting the mental and emotional well-being of both patients and caregivers.

The investigation moves beyond the generic concept of health to focus on the intersection between administrative management and family dynamics. Rather than viewing the user as an isolated entity, the domain encompasses the entire network of care relationships surrounding the individual. The primary objective is to explore how technology can transform health bureaucracy from a solitary obstacle into a collaborative process, effectively supporting both personal clinical history and the assistance provided to family members.

3.2 Interviews

3.2.1 Partecipants

To capture the domain's needs, five female participants aged between 24 and 85 were involved. This specific selection leveraged personal networks to ensure the necessary trust for discussing sensitive health data. The participants represent the full spectrum of defined target users:

ANONYMIZED: Participants replaced with Pseudonyms.

- **Immediate Users (3 participants)**
  - **Alice:** An adult with digital skills who favors analog methods due to a lack of trust in digital systems.
  - **Beatrice:** A user managing her own health while acting as a delegate for her parents, exposing the friction of managing multiple identities.
  - **Carla:** A young student (24) accessing health records sporadically, who occasionally manages access for her grandmother.
- **Lead Expert (1 participant)**
  - **Diana:** A proactive patient utilizing digital tools weekly, actively seeking to visualize trends within her health data.
- **Extreme User (1 participant)**
  - **Elena with her daughter:** An elderly user (85) lacking digital autonomy. Her case is critical for investigating "mediated interaction", as her daughter operates as the actual user.

3.2.2 Methodology and execution

Location: Interviews were conducted mainly in the participant's homes to ensure maximum comfort and facilitate the discussion of sensitive data.
The interview with the *Extreme User* was conducted via video call and facilitated by a family member, highlighting the user's lack of digital autonomy.

Recruitment: Participants were recruited from the personal networks of team members. This choice was crucial in establishing the climate of trust necessary to discuss sensitive health data.

Consent: Participants signed an informed consent form before the interview to ensure privacy and ethical data management.

Question Structure: The interviews followed a semi-structured outline exploring:

- Current practices in managing health records (both digital and analog).
- Pain points regarding service access and booking procedures.
- Dynamics of family care and delegated management responsibilities.
- Needs related to data organization, information retrieval, and health monitoring.

Team roles: Each session was attended by an interviewer dedicated to conducting the interview and an observer to note dynamics and non-verbal reactions.

Equipment: Smartphones were used for audio recordings and a computer was used to follow the list of questions. Paper notebooks were employed for manual note-taking.

Observation: Where possible, contextual observation was conducted by asking participants to show their current management methods (physical files, apps used, electronic health records).

3.2.3 Results

The interviews revealed recurring pain points and significant behavioural patterns:

Key quotes:

Beatrice (Immediate User):

> *"The main problem is access, credentials expire... (it's about) managing the file at a family level."*

This statement exposes the critical friction within delegated administration, emphasizing the need for a collective approach to care. The requirement to constantly authenticate across isolated accounts creates a fragmented workflow and an unsustainable administrative overhead.

Alice (Immediate User):

> *"I have several files in my study where I divide everything according to my conditions... my history is there. The documents are always there."*

Trust in the tangibility of physical archives emerges as an alternative to the uncertainty of digital ones. The materiality of paper documents offers a sense of control and permanence that current digital systems do not guarantee.

Carla (Immediate User):

> *"There is no search bar where you can type in exactly what you need. You have to scroll down through the years until you get the result."*

Confirms the critical need for efficient, indexed search. The current chronological "blind list" organisation forces inefficient manual exploration.

Diana (Lead User):

> *"It would be nice if he could remember them... have a trend. For example, cholesterol: see if it ever goes back down."*

Highlights the lack of longitudinal vision and the static nature of current data. Reports are perceived as disconnected snapshots rather than an evolutionary narrative of one's health.

Elena with her daughter (Extreme User):

> *"It's impossible... the test you wrote on the request doesn't match the online list. You can never find it."*

This reveals the critical semantic gap between the doctor's paper prescription and the digital booking system. The barrier is not only technological but also linguistic.

Key learnings:

- Healthcare management is inherently familial, not individual.
- There is a cognitive gap between medical language and the technical terminology of systems.
- Historical documents are only valuable if they are organised and accessible.
- Trust in digital systems must be built through transparency and reliability.
- Age and technological skills require mediated modes of interaction.

3.3 Synthesis

3.3.1 Brainstorming process to extract the needs

The synthesis process began with an analysis of the transcripts and observations collected during the interviews. We mapped recurring problems (such as difficulty logging in or incomprehensible medical terminology) to uncover user's latent needs.

3.3.2 List of brainstormed user needs

The following user needs emerged from the brainstorming, each related to one or more interviews:

Semantic Translation: *Bridging the gap between natural language and technical terminology.*

- Elena's daughter fails to book: "It's not necessarily true that they're written the same way."
- Carla: Difficulty understanding which section to use for bookings.

Unified Family Management: *Manage the health of multiple members without constant identity changes*

- Beatrice: "Create a system that includes the entire family unit."
- Daughter manages Elena's file.
- Carla needs to log in for her grandmother with her SPID.

Understanding and Search: *Identifying documents without manually opening them*

- Daughter: "You have to look inside one at a time."
- Carla: "There's no search bar... you have to scroll down through the years."

Trend Visualization: *Read health as evolution, not as a snapshot*

- Diana: "I have to take out the previous one... it would be nice to have a trend."
- Carla: "To see if there's been any improvement or deterioration."

Simplicity and clarity of the interface: *Reduce cognitive complexity and the number of steps*

- Elena's daughter: "With all those buttons... both because there are so many and because I don't know what they mean."

- Beatrice: "It needs to be more simplified... too much information, too much effort."
- Alice: Limited literacy, prefers paper.

System reliability and stability: *Confidence in the availability and consistency of the service*

- Beatrice: "Credentials expire too quickly."
- Carla: Bug with available seats appearing/disappearing.
- Alice: Mistrust digital, prefers the tangible.

3.3.3 Deep user needs

Among all the identified needs, four priority *deep user needs* were selected. They represent the most critical and transversal challenges that emerged from the interviews.

1. **Semantic Translation**

   This need was selected because it represents the most critical entry barrier to the use of digital healthcare systems. As Elena's daughter highlighted, the failure is not technological but linguistic: "The exam you wrote on the request doesn't match the online list." Without addressing this gap, any other functionality becomes inaccessible. Semantic translation is therefore a prerequisite that enables all subsequent tasks.

2. **Unified Family Management**

   This need emerged from the observation that healthcare management is intrinsically collaborative. Beatrice expresses frustration with continuous logins and the desire to: "Create a system that include the entire family unit." This need is fundamental because it reflects the real context of use: healthcare is not managed in isolation, but inside care networks. Ignoring this aspect would mean designing for a user that does not exist.

3. **Content Understanding and Search**

   This need was selected because the current chronological list is a "blind list". Elena's daughter criticizes the system: "You have to look inside one at a time." Carla confirms this issue: "You have to scroll down through the years." Without efficient indexing and visible metadata, the digital archive becomes an unusable repository, losing its value when compared to physical documents. This need is key to transforming passive data into active resources.

4. **Trend Visualization**

   This need reflects the transition from a static view of health data to a longitudinal narrative. Diana expresses the desire to: "See if my cholesterol ever goes back down." This need was selected because it represents the highest level of value: not just finding data, but understanding it in order to make informed decisions. It transforms the user from a passive data retriever into an active protagonist of their own health journey.

3.4 Solutions

3.4.1 Solution Ideation

For each deep user need, the team generated at least five alternative solutions through individual brainstorming sessions followed by group discussion. The goal was to explore the solution space without prematurely committing to a single direction.

For the "Semantic Translation" requirement, ideas such as:

- Intelligent search that understands the user's everyday language
- Built-in dictionary that links medical terms to common words
- Typing suggestions that help formulate the correct search
- Spoken search mode for users who prefer voice
- Multiple document tagging with both technical and colloquial terms
- Symptom-based search that guides the user to the appropriate services
- Interactive assistant that helps formulate complex requests through dialogue
- Contextual explanations of technical terms when necessary
- Automatic scanning of the paper prescription to identify the correct service to book
- Search that starts from the perceived problem and suggests appropriate solutions
- Instant help when hovering the mouse over complex terms

For the "Unified Family Management" requirement, the team explored:

- Centralized access that allows managing multiple family profiles from a single location
- Flexible permission system that defines who can do what for each member
- A consolidated view that displays information from all family members
- Unified notification center that collects events and deadlines for the entire family
- Simplified mechanism for temporarily sharing access with caregivers
- Specific workflows to manage those who cannot act independently (children, elderly)
- Cross-profile reminders to coordinate family care
- Automatic integration of information from different sources
- Quick access to critical information, even in emergency situations
- Sharing mode for extended care networks
- Physical token to facilitate profile changes for users with digital disabilities

Solutions for "Content Understanding and Search" have been designed such as:

- Automatic extraction of text content from scanned documents
- Automatic recognition of key information in documents
- Visual previews that allow you to recognize documents quickly
- Significant content extraction, displayed in results
- Deep search that explores the entire content, not just the titles
- Flexible combination of multiple search criteria
- Highlighting of search terms in previews

- Adaptive sorting based on relevance and context
- Intelligent grouping of related documents
- Automatic organization of documents belonging to the same care pathway
- Memorization of frequent searches and notification of new matches
- Clear navigation that always shows where you are in the archive
- Automatic categorization with meaningful labels
- Scrolling timeline view for temporal navigation

For the "Trend Visualization" need, ideas such as:

- Interactive timeline graphs that allow to explore the evolution of parameters over time
- Customizable space where the user selects which health parameters to monitor
- Comparative views that show multiple parameters together to identify correlations
- Timeline enriched with annotations of relevant clinical events (therapies, hospitalizations)
- Automatically distributed periodic health status summaries
- Immediate visual alerts when values exceed critical thresholds
- Projections of future trends based on clinical history
- Comparisons between different periods to assess year-over-year progress
- Intensity maps that show the frequency and concentration of events over time
- Alert system that alerts the user to significant changes in trends
- Simplified representation with indicators of improvement/deterioration compared to the previous visit

3.4.2 Selected Solutions

From collective discussion and comparative analysis of the proposals, the team selected the most effective solutions for each need, favoring those that offered the best balance between innovation, usability, and responsiveness to the user needs that emerged.

Semantic Translation:
The solution breaks down the language barrier through a **search that understands everyday language**: users express themselves with familiar words ("back pain", "heart check"), which the system automatically translates into appropriate technical terms. The search is also available in **voice mode** for users with keyboard difficulties. The interface adopts progressive **information enrichment** with multiple labels and contextual explanations that make technical information accessible. The search **starts from the perceived problem** and suggests appropriate solutions, guiding the user to relevant services or documents.
Without bridging this gap, any functionality becomes inaccessible. The solution balances seamless automation and progressive enrichment, allowing users to operate in their own natural language.

Unified Family Management:

An **unified login** allows to manage multiple family profiles from a single location with quick and seamless switching, eliminating repeated log-ins and log-outs. The **aggregated view** displays appointments, due dates, and notifications for all members in a single screen, making it easier to coordinate group care.
The centralized access paradigm takes advantage of existing models (streaming platforms) and solves the problem of multiple authentication.

Content Understanding and Search:

Each document becomes an **immediately understandable piece of information**. The **visual preview** leverages photographic memory for instant recognition. **Key information** (date, doctor, summary) is always visible. **Multiple labels** allow for flexible organization: the same document can belong to different categories. A **summary of the content** is presented directly in the preview. This information density transforms the experience from blind sequential scanning to selective visual recognition.
Without efficient indexing, digital archives lose their advantage over paper. The combination of visual elements, structured information, and flexible categorization creates a multidimensional system that adapts to different search styles for every type of user.

Trend Visualization:

A **modular space** allows users to independently choose which parameters to monitor. **Timeline views** show evolution over time, comparing periods. **Immediate visual alerts** highlight values above critical thresholds.
This represents the highest level of value: understanding data to make informed decisions about your health.

4 Tasks and Storyboard

4.1 Task Identification

To validate the design direction and ensure the solution addresses real user needs, the team identified six representative tasks spanning different complexity levels. These tasks were derived directly from the pain points and scenarios observed during the interviews.

Simple Tasks:

- **Semantic Booking:** Search by symptom (e.g., "back pain") with automatic suggestion of the correct specialty.
  This task addresses Elena's linguistic barrier and is critical for enabling autonomous booking without medical terminology knowledge.
- **Recent Consultation:** Immediate access to the most recent report.
  This supports Diana's need for quick reference without navigating the entire archive.

Moderate Task:

- **Appointment Verification:** Quick check of date and time for the next visit.
  Essential for all users to maintain awareness of upcoming commitments without friction.
- **Pharmacy (Caregiver):** Immediate retrieval of a prescription from a family member's profile.
  This task directly addresses Beatrice's scenario of managing her parents' health or the need to quickly access Elena's medications. The moderate complexity stems from the profile switching requirement combined with document identification.

Complex Tasks:

- **Diabetes Check-up:** Massive collection of historical documents after a specific date.
  This represents the high-complexity scenario where a user (or caregiver) needs to collect comprehensive documentation for a specialist visit, requiring efficient filtering and organization capabilities.

- **Health Trend:** Analysis of parameter evolution over 12 months.
  This task responds to Diana's explicit need to "see if it ever goes back down" and transforms passive data consultation into active health monitoring.

4.2 Storyboard

Figure 1: Storyboard illustrating the caregiver's continuous flow through two critical scenarios: pharmacy urgency (moderate task) and diabetes check-up preparation (complex task)

The storyboard narrates the experience of a caregiver managing health needs for two family members in a single continuous flow, demonstrating how the system eliminates friction in real-world scenarios.

Scenario 1 - Moderate Task (Pharmacy): The caregiver needs to urgently retrieve medicine for her father. The storyboard shows how rapid profile switching enables accessing the father's prescription in seconds. The narrative emphasizes the elimination of the login/logout cycle that was identified as a critical pain point.

Scenario 2 - Complex Task (Diabetes Check-up): The caregiver prepares for her mother's upcoming diabetes specialist visit. The storyboard demonstrates how the tem-

poral filter allows collecting all relevant documents from the last visit forward, without manual chronological scanning.

Selection Rationale and Analysis:
This particular storyboard was selected because it captures the essence of family health management: the need to act rapidly for one member while maintaining comprehensive oversight for another.

The narrative successfully demonstrates how profile switching eliminates authentication friction in urgent situations. The storyboard also illustrates the practical utility of intelligent temporal filtering for complex documentation tasks, showing how caregivers can efficiently collect comprehensive medical histories without the manual chronological scanning. By presenting realistic use cases derived directly from interview scenarios, the storyboard validates that unified family management genuinely reduces the caregiver's cognitive load.

However, the storyboard presents certain limitations that became come out during analysis. The semantic translation functionality does not appear in the narrative and neither scenario requires booking a new appointment using natural language input. Similarly, the trend visualization functionality receives limited representation, as the focus remains on document retrieval rather than longitudinal parameter analysis. The exclusive focus on the caregiver perspective, while validating the collaborative care model, may not fully represent autonomous user scenarios.

Despite these limitations, the storyboard effectively validates the moderate and complex tasks, demonstrating that the unified access model directly addresses the "unified family management" deep need. The rapid profile switching and temporal filtering mechanics shown in the narrative directly resolve the pain points. Importantly, the storyboard reveals an additional design requirement: the necessity for an extremely clean interface to avoid confusion between profiles. This insight suggests that visual differentiation strategies will be critical in the high-fidelity prototype to prevent the caregiver from accidentally operating on the wrong family member's data.

5 Low-fidelity Prototypes

5.1 Modalities Exploration

Alternatives Considered: The team explored three interaction modalities before converging on the final selection:

1. **Web App (Selected):** The web modality provides the screen space necessary for complex data management and deep analysis. Large displays enable simultaneous visualization of multiple information streams (appointments + documents + trends), sophisticated filtering interfaces, and comfortable reading of document previews. Web becomes the modality of depth and comprehensive management.

2. **Mobile App (Selected):** The mobile modality offers immediate accessibility: the device is always at hand. This makes it ideal for rapid verification tasks (appointment checks, quick document retrieval) and urgent scenarios (pharmacy prescription access). The portability advantage directly addresses the "always available" requirement evident in caregiver scenarios. Mobile becomes the modality of immediacy and convenience.

3. **Chatbot (Rejected):** A purely conversational interface would excel at rapid voice-based input and could elegantly handle semantic translation. However, it proves inadequate for the comprehensive visualization requirements: displaying document archives, comparing trend graphs, and managing family profiles require spatial organization and persistent visual reference that conversation cannot provide. The chatbot mode was rejected because it was optimized for input complexity rather than output complexity.

Rather than committing prematurely to a single modality, the team adopted a comparative prototyping strategy. Both Mobile and Web were prototyped to explore two distinct interaction paradigms and identify their respective strengths and limitations. This approach allows validating the trade-off between Portability (Mobile advantage) and Depth of Management (Web advantage), determining which modality better supports the full spectrum of identified needs.

Target Devices/Platforms:

Web: Desktop and laptop browsers (primary target: screen widths 1280px+), with responsive considerations for tablets

Mobile: iOS and Android smartphones (primary target: screen sizes 5.5" - 6.7")

5.2 Paper Prototypes

5.2.1 Web App Prototype

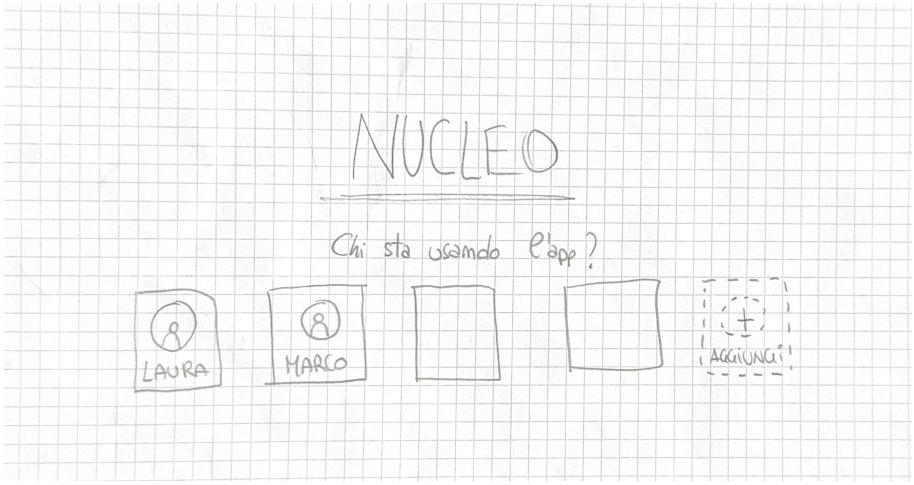

Figure 2: Paper Prototype - Web - Login Page

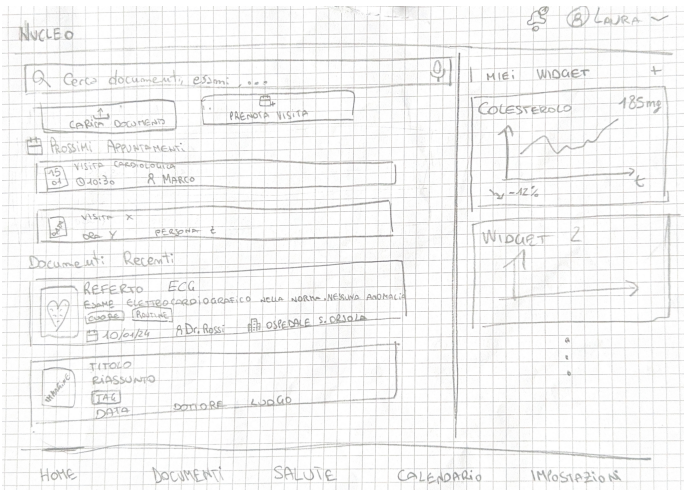

Figure 3: Paper Prototype - Web - Home Page

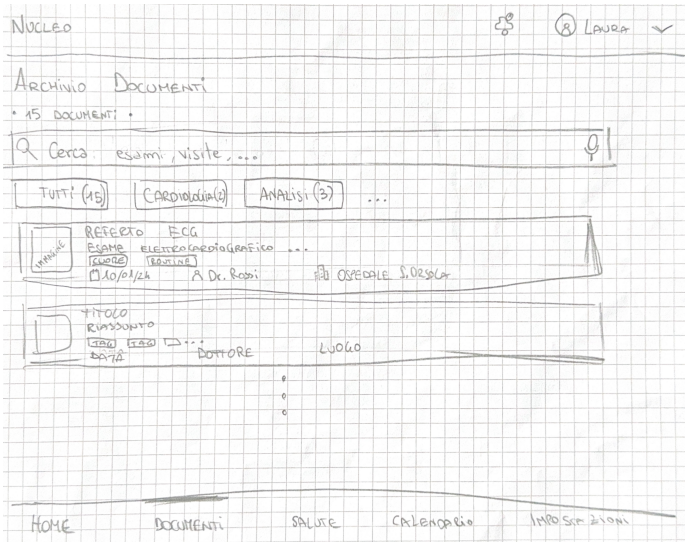

Figure 4: Paper Prototype - Web - Documents Page

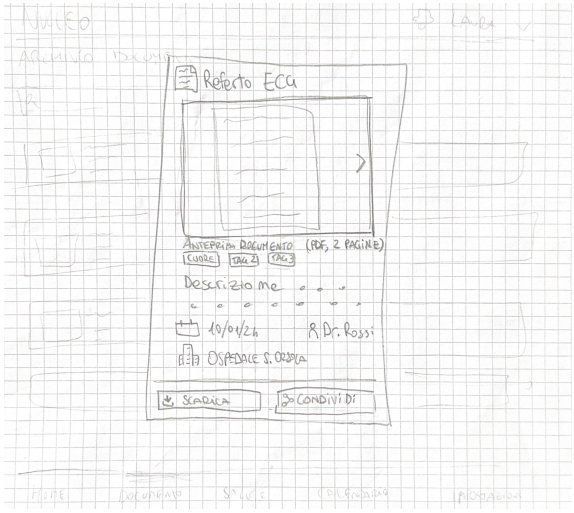

Figure 5: Paper Prototype - Web - Document Report

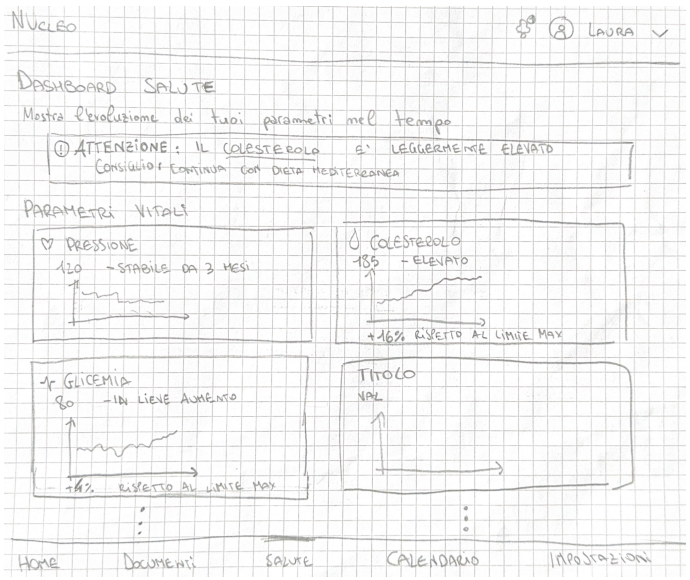

Figure 6: Paper Prototype - Web - Health Page

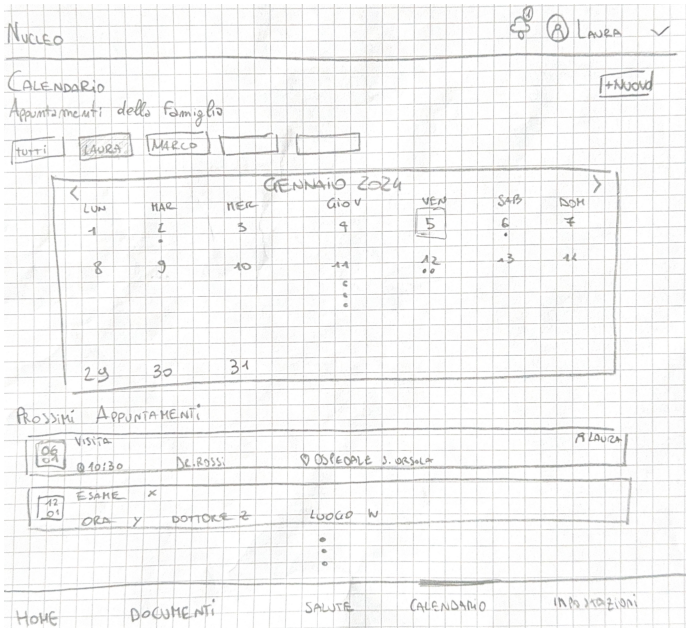

Figure 7: Paper Prototype - Web - Calendar Page

Key Screens:

- **Login Page:** The login interface offers an immediate visual selection of family profiles via avatars and includes a dotted line option to dynamically add new members to the core.
- **Home Page:** Three-column layout featuring:
  - (top) semantic search bar with document upload and appointment booking buttons,
  - (center) "Upcoming Appointments" calendar and "Recent Documents" cards,
  - (right sidebar) customizable "My Widgets" with evolutionary trend graphs.
- **Documents Page:** A digital archive that organizes medical reports using a tabbed filter system (e.g., Cardiology, Analysis) and text search. Documents are displayed

as cards containing essential metadata (preview, tag, date, doctor), designed to facilitate quick retrieval and access to report details.

- **Health Page:** An analytics dashboard dedicated to health parameters, displayed through time graphs that highlight stability or changes. It includes a top-of-the-page alert system that provides immediate feedback and contextual recommendations based on the collected data.

- **Calendar Page:** Family planning tool that combines a calendar with a user-filtered list. The grid is synchronized with a lower list that expands the details (location, time, specialist) of upcoming scheduled medical appointments.

5.2.2 Mobile App Prototype

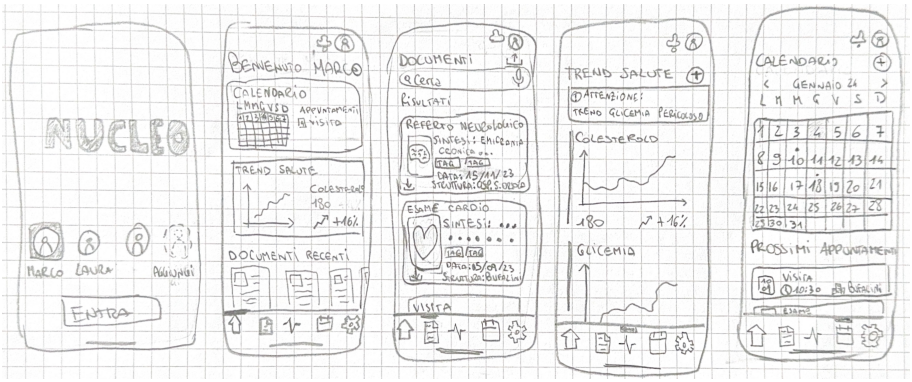

Figure 8: Paper Prototype - Mobile

Key Screens:

- **Login Page:** A simplified login interface for touch interaction, organizing family profiles into spaced visual tiles. Confirmation is delegated to a full-width "Enter" button located at the bottom of the screen (thumb zone), improving ergonomics for one-handed use.

- **Home Page:** Vertically scrolling layout that organizes information into stacked widgets: a compact calendar summary, a single highlighted health trend graph, and a horizontal carousel for "Recent Documents".

- **Documents Page:** A vertical list of information cards that condense visual previews, text summaries, tags, and metadata (structure, date) into a small space. Semantic search is positioned at the top, but browsing the archive requires significant scrolling to view more than two items at a time.

- **Health Page:** Stacked display of clinical parameters, with each timeline graph taking up a significant portion of the viewport. The presence of warning banners pushes the content down, making it difficult to visually compare multiple graphs on a single screen without scrolling.

- **Calendar Page:** The calendar has been adapted to the width of a mobile device, with smaller cells requiring precise interaction. The view is synchronized with a scrollable list below detailing "Upcoming Events", visually separating the timeline from the logistical details of the event.appointments.

5.2.3 Connection to Storyboard, Goals and Tasks

Storyboard Connection:

The pharmacy urgency scenario (moderate task) directly provide the architectural choice of a persistent session with *fast-switching context*. The prototypes address this requirement through the centralized profile selection interface, which eliminates the latency of traditional logout/login authentication cycles, allowing the caregiver to access a dependent's prescription in a near-atomic interaction sequence.

Parallelly, the diabetes check-up scenario (complex task) highlights the user's need to aggregate clinical history based on specific temporal events. This is translated into the UI's temporal filtering and query-based retrieval capabilities, enabling the user to isolate time windows without manual linear scanning. In the Web App implementation, this workflow is further enhanced by the *document preview functionality*, which allows to visually verify the content and relevance of clinical reports directly within the search context before collection, significantly reducing cognitive load during data retrieval.

Project Goal:

Nucleo is an integrated system that redefines the interaction with family digital health. Unified management, with centralized access, transforms care from fragmented to cohesive: a single login to quickly manage all family profiles. Documents become interactive cards with thumbnails, visible metadata, and intelligent tags that allow immediate identification without manual opening. Semantic search includes everyday language and common symptoms, automatically translating them into medical terminology, with voice support and progressive enrichment. The customizable space with widgets transforms the archive into a proactive monitoring tool: temporal and comparative views allow a clear view of health trends to guide informed decisions.

Tasks Support Analysis:

Simple Tasks:

- *Semantic Booking:* The search bar, located at the top of both prototypes, supports natural language input (e.g., "back pain") and generates real-time specialty suggestions.
- *Recent Consultation:* Inside the Home Page, in both versions, features "Recent Documents" section for immediate access allows to view documents.

Moderate Task:

- *Pharmacy (Caregiver):* The **Mobile** interface utilizes a profile switch combined with a "Recent Documents" carousel for two-tap access. In the **Web** prototype, users select the profile at the Login Page and navigate to the Documents Page, where the prescription is retrieved using the search bar or filtering tags.
- *Appointment Verification:* To ensure awareness of caregiver, the **Web** dashboard features an "Upcoming Appointments" section listing imminent visits directly. Instead, the **Mobile** homepage utilizes a summary card acting as a shortcut to the dedicated Calendar Page. Both platforms include a Calendar Page, which presents caregiver through both a visual calendar and a list of appointment cards.

Complex Tasks:

- *Diabetes Check-up:* Both platforms utilize document filters to facilitate collection. However, the **Web** interface provides a distinct advantage by exclusively offering visual document previews, enabling faster identification compared to the mobile list view.

- *Health Trend:* Dedicated Health/Trends section in both prototypes allows parameter selection and temporal comparison. Web's widget customization and larger graphs provide richer analysis, while the display on mobile devices is slightly reduced.

Modality Optimization:

Both prototypes leverage platform-specific strengths, but the comparative analysis reveals how effectively each supports the identified user needs. The **mobile prototype** adopts familiar patterns optimized for rapid access: bottom tab navigation for thumb-reachable zones, vertical scrolling for one-handed operation, and progressive disclosure to maintain focus. These choices successfully address simple and moderate tasks—verifying appointments, accessing recent documents, or quick prescription retrieval work efficiently within mobile constraints. However, complex tasks expose significant limitations. The diabetes check-up scenario requires extensive tapping to access filters and repeatedly switching between list and preview views. Trend graphs become compressed, demanding zoom and pan interactions for the detailed temporal analysis Diana explicitly requested. The mobile modality, optimized for velocity, struggles with depth and comprehensive workflows.

The **web prototype** fully exploits spatial advantages through a three-column dashboard enabling simultaneous visibility of calendar, documents, and trends without mode switching. Persistent sidebar controls eliminate navigation overhead, while grid layouts allow visual comparison of multiple documents simultaneously—dramatically accelerating complex collection tasks. Larger displays support richer trend visualizations with multi-parameter overlay and extended temporal views. This directly aligns with interview needs: Beatrice benefits from parallel information streams while managing her parents' health, Diana's longitudinal parameter monitoring finds full expression in customizable widgets, and Elena's mediation becomes more effective on the clearer, more spacious interface.

Mobile's portability advantage represents a limited use case inside Nucleo's comprehensive workflow. While pharmacy prescription retrieval validates this value, the deeper, more frequent interactions — document organization, trend monitoring, family coordination — demonstrate web's clear superiority. The spatial richness potentially overwhelming for users like Elena is precisely what transforms fragmented data into coherent family health management. Consequently, the **web prototype was selected** as the foundation for medium and high-fidelity development.

5.2.4 High-Level Flow - Web App

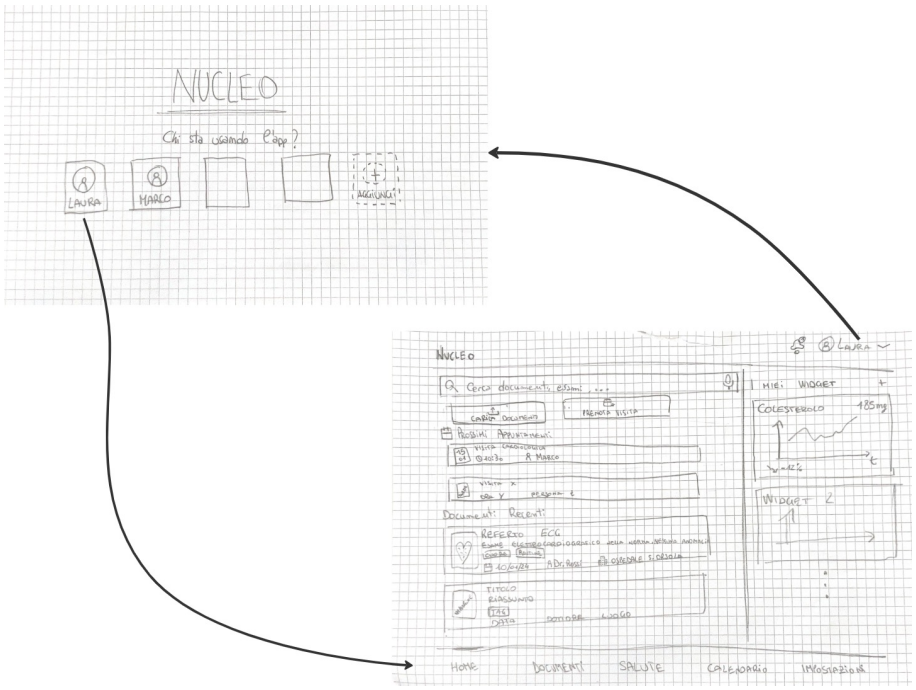

Figure 9: High Level Flow - Web Login/Switch user

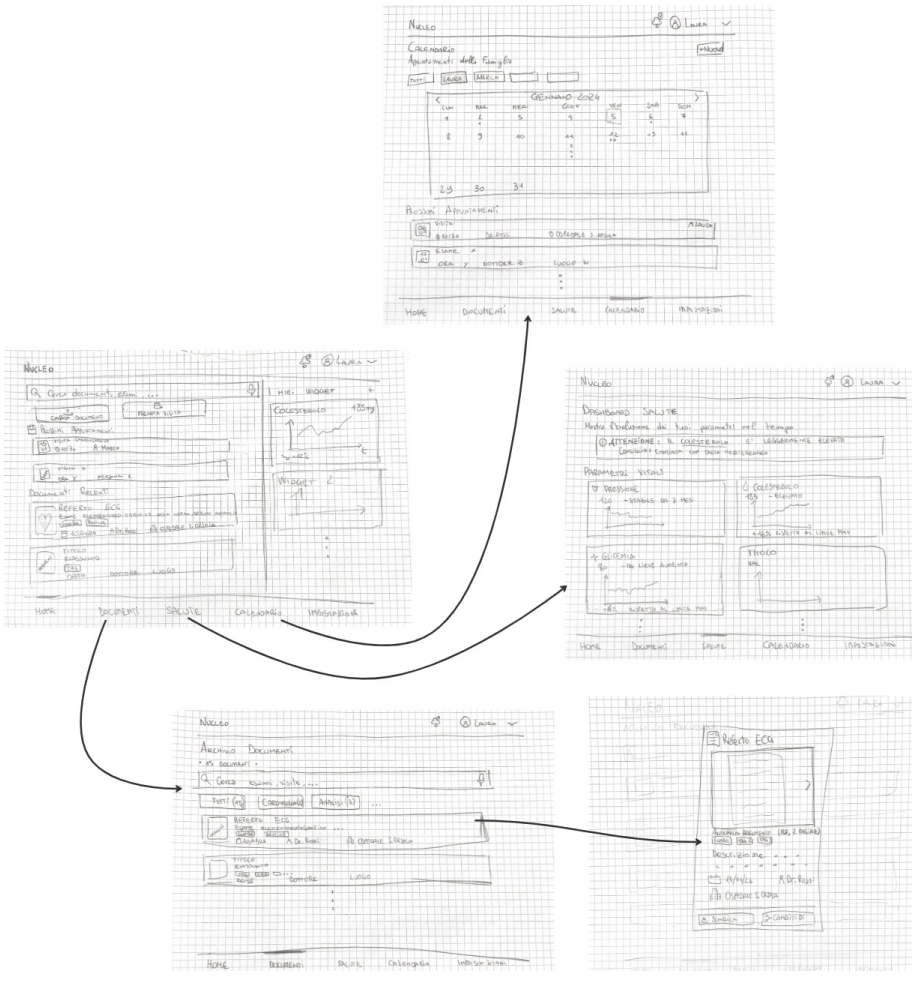

Figure 10: High Level Flow - Web Main

The web prototype adopts a flat navigation architecture where all sections operate independently. From Login/Profile Selection, users access the Home dashboard. The persistent bottom navigation bar enables direct transitions between any sections: Home ↔ Documents ↔ Health ↔ Calendar ↔ Setting, without requiring return to Home. Each section is self-contained—the Documents page displays its own interface with filters and document grid, the Health page presents its parameter controls and visualizations, and so on. Unlike mobile, the Home dashboard does not contain interactive shortcuts; its widgets (calendar preview, recent documents, health trends) are informational only and do not navigate to other sections. Profile switching occurs via the header user icon (visible on all pages), which returns users to the Login/Profile Selection screen to choose a different family member. The key architectural characteristic is the elimination of hierarchical navigation: every section is one click away from every other section via the bottom bar, supporting efficient multitasking across different health management activities.

5.2.5 High-Level Flow - Mobile App

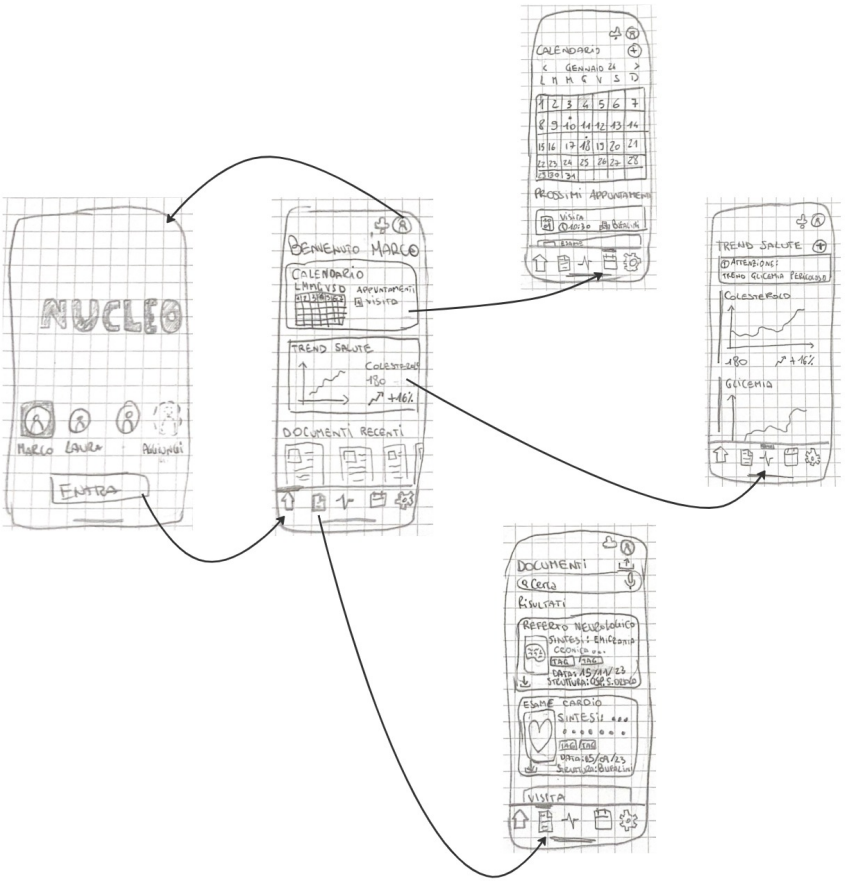

Figure 11: High Level Flow - Mobile

The mobile prototype employs a dual navigation system. The bottom tab bar provides direct access to all main sections (Home, Documenti, Salute, Calendario, Impostazioni) from any screen, enabling users to jump between sections without intermediate steps. Additionally, the Home dashboard functions as a shortcut hub: tapping on the "Recent Documents" section navigates to the full Documents page, while tapping on "Health trend" opens the Health page. This creates two parallel navigation paths—direct via bottom bar, or contextual via Home shortcuts. Profile switching is accessible from any screen via the top-right user icon, which returns users to the Profile Selection screen to choose a different family member.

6 Medium to High-Fidelity Prototype

6.1 Tool Selection

The medium-fidelity prototype was developed using **Figma**, a collaborative interface design tool that enables rapid iteration, component-based design systems, and interactive prototyping. Figma was selected for several strategic reasons: its cloud-based architecture facilitates real-time collaboration among team members, the component and variant system allows maintaining design consistency across screens while exploring different states, and the prototyping features enable linking screens to simulate user flows for preliminary usability validation. Additionally, Figma's accessibility from any device without software installation aligned with the team's distributed workflow requirements.

6.2 Screen Selection

The team developed four screens for the medium-fidelity prototype: Login/Profile Selection, Home Dashboard, Documents Section, and Document Preview. However, the two screens selected as most significant for detailed development and evaluation are the **Home Dashboard** and the **Documents Section**.

These screens represent the highest-frequency interaction points for the target user. The Home Dashboard serves as the primary entry interface and information hub, while the Documents Section addresses the most common task patterns identified in interviews: accessing test results, retrieving prescriptions, and collecting historical documentation for specialist visits. Together, they support both simple tasks (appointment verification, recent document access) and moderate-complexity workflows (prescription retrieval, filtered document collection) that constitute the daily usage pattern of Nucleo.

More advanced functionality—such as detailed parameter customization in the Health section or permission management in Settings—serves narrower, less frequent use cases.

Additionally, the widget integration strategy adopted from the mobile prototype means the Home Dashboard already surfaces critical health monitoring through the right sidebar, reducing the necessity of the dedicated Health screen for initial validation.

Finally, these screens establish the fundamental design patterns that propagate throughout the application: card-based document representation, widget architecture, search and filter mechanics, and profile context indication.

6.3 Prototype Access

The medium-fidelity prototype is publicly accessible via Figma: `https://www.figma.com/design/2Kxn5tEYDuYKeH01EXiLmb/HCI---Medium-Prototype`

The prototype includes interactive connections demonstrating the primary navigation flows and component states across the Login Page, Home Page, Document Page, and Document Preview screens.

6.4 Evolution from Paper to Medium-Fidelity

The Web App prototype was selected as the foundation for medium-fidelity development, based on the comparative analysis conducted in Assignment 2.
This decision come from three primary factors:

1. **Support for Complex Tasks:** The diabetes check-up scenario requires massive collection and filtering of historical documents. The web prototype provides the

necessary space to display document grids with thumbnails and extended metadata, facilitating clustering operations that on mobile were too large and required excessive scrolling.

2. **Data and Trend Visualization:** A key value of Nucleo is transforming data into "evolutionary narratives." During testing, health trend visualization on mobile was compressed and less readable. The web dashboard enables displaying graphs and comparing clinical parameters for intuitive in-depth analysis.

3. **Centralized Family Management:** The objective is overcoming account fragmentation. The desktop interface better supports simultaneous management of multiple profiles and "desk-based" administrative operations, which represent the greatest cognitive load for our target users.

Feature Migration Strategy: While discarding the mobile architecture, the team imported its core strength—"Immediate Information Access"—into the web application. The mobile prototype's widget logic was integrated into the web's right sidebar, allowing users to view vital parameters and upcoming appointments immediately upon login without navigating to dedicated subsections.

7 High-fidelity Prototype

7.1 Technology Stack

The high-fidelity prototype was developed using a modern stack selected for performance and maintainability:

Core Technologies

- **Vue 3 (v3.5.26):** Selected as the primary framework for its modular component architecture and efficient reactivity system.
- **TypeScript (v5.9.3):** Ensures type safety and code robustness, crucial for reducing runtime errors in health data operations.
- **Vite (v7.2.4):** Utilized as the build tool to provide fast development iteration.

UI Framework and Styling

- **Tailwind CSS (v4.1.18):** Provides a utility-first approach for rapid, consistent, and fully responsive styling.
- **Custom CSS Variables:** implemented to manage dynamic theming (light/dark) and accessible color modes (e.g., for color blindness) efficiently.

Routing and Internationalization

- **Vue Router (v4.6.4):** Manages seamless client-side navigation and supports route-based code splitting for performance.
- **Vue I18n (v10.0.8):** Handles dynamic language switching (Italian/English) and localization of data formats.

Data Visualization

- **Chart.js (v4.5.1) with Vue-ChartJS:** Powers the accessible and responsive visualization of health trends and parameters.

- **FullCalendar (v6.1.19):** Manages the appointment scheduling interface with native support for touch interactions and localization.

Utility Libraries and Tools

- **@vueuse/core (v14.1.0):** Provides a collection of essential composables to reduce boilerplate.
- **@heroicons/vue (v2.2.0):** Supplies a consistent set of optimized SVG icons implemented directly as Vue components.
- **Vue TSC (v3.1.8) and @vue/tsconfig:** Enable strict type checking and standardized configuration across the development environment.

7.2 Repository

The full source code of the high-fidelity prototype is available in the provided Git repository: `https://github.com/LucaSamore/kernel`

Installation and Running Instructions:
Note: Please ensure you are inside the `/kernel/A5/kernel` directory before executing the following commands.

```
# Navigate to the specific project folder
cd kernel/A5/kernel

# Install dependencies
npm install

# Run development server
npm run dev
```

`The development server runs on http://localhost:5173 by default.`

7.3 Design Choices and Evolution

1. **Intelligent Semantic Search:** To bridge the language gap, we implemented a client-side mapping logic that translates colloquial symptoms (e.g., "back pain" → "orthopedic visit") into technical visit types, enabling the "Semantic Booking" simulating backend AI.
2. **Visual Accessibility (Color Blind Modes):** We developed a dynamic theming system supporting three specific color-blind modes (Deuteranopia, Protanopia, Tritanopia), adjusting the entire color palette to ensure data readability for visually impaired users.
3. **Light and Dark Theme Support:** A robust theme switcher was integrated to support both Light and Dark modes, respecting user system preferences and providing high-contrast environments to reduce eye strain.
4. **Internationalization (i18n):** We utilized Vue-i18n to support instant switching between Italian and English. This architecture decouples UI text from data logic, ensuring the platform is accessible to a broader demographic.
5. **Smart Date Filtering:** The document archive includes smart presets (e.g., "Last 6 months") and manual range pickers, allowing users to quickly isolate specific clinical history periods without scrolling through chronological lists.

6. **Document Comparison:** A dedicated modal allows users to view two documents side-by-side with synchronized scrolling, significantly facilitating the comparison of clinical results over time.

7. **Batch Document Actions:** A multi-selection mechanism that allows users to select and download multiple documents simultaneously.

8. **Prescription Barcodes:** Specific handling for medical prescriptions was added, allowing users to visualize the barcode for pharmacy scanning or download the prescription directly, bridging digital management with physical retrieval.

9. **Appointment Management:** Action buttons were integrated directly into appointment cards, enabling users to modify or cancel visits immediately without navigating to a separate dedicated page, reducing friction in schedule management.

10. **Data Source Tracking:** For health charts and parameters, we added a "Source View" that lists the specific clinical documents used to generate that graph, ensuring transparency and trust in the displayed trends.

11. **Legal and Privacy Compliance:** A comprehensive footer was implemented featuring a GDPR-compliant cookie banner (distinguishing necessary vs. analytics cookies) and accessible modals for Privacy Policy and Legal Notes.

7.4 Significant Screens and Task Coverage

The following screens represent the core of the Nucleo experience and address the three key tasks identified in the Needfinding phase.

Home Page and Semantic Search

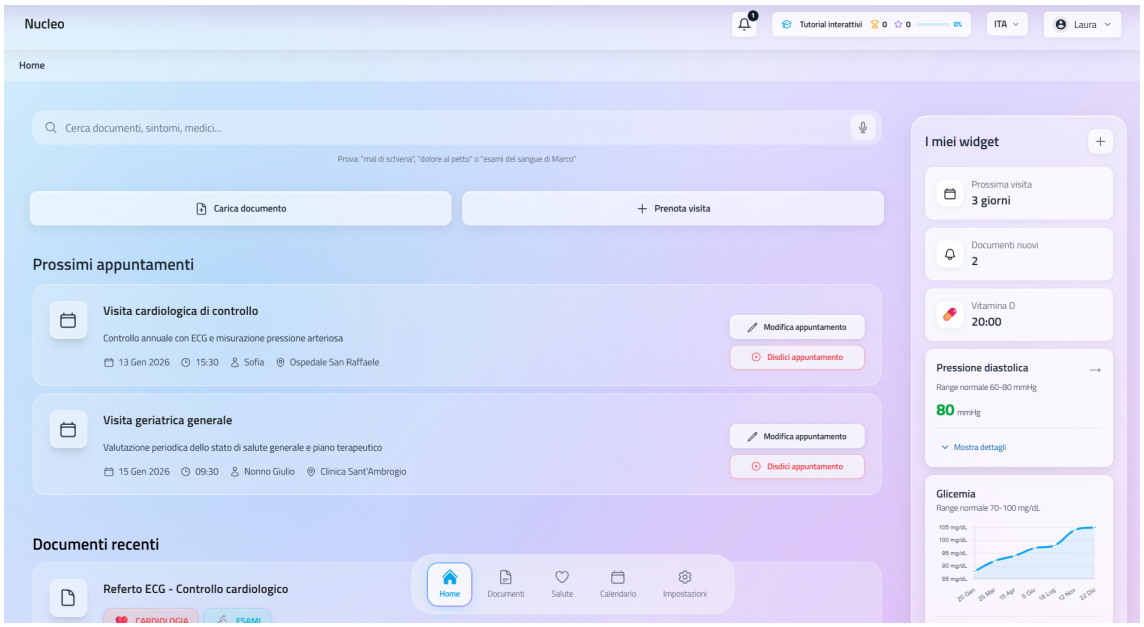

Figure 12: High Fidelity Prototype - Home Page

The Home Page serves as the central information hub and the primary entry interface for the user. As identified during the medium-fidelity phase, this screen represents the highest-frequency interaction point, designed to satisfy the user requirement of having "everything visible at once" without excessive navigation. Synthesizing Nucleo's core:

transforming fragmented health data into an actionable family health overview. The three-column layout addresses the interview finding that users need "everything visible at once" without excessive navigation.

Task Support:

- **Recent Consultation (Simple):** "Recent Documents" section provides one-click access
- **Appointment Verification (Moderate):** "Upcoming Appointments" displays next 2 visits immediately
- **Health Trend (Complex):** Right sidebar widgets show customizable parameter and graphs trend

Key Features:

- **Semantic Search Bar:** Natural language input with real-time suggestions.
- **Quick Actions:** Upload document and book appointment buttons for frequent operations
- **Customizable Widgets:** User-selected health parameters create personalized monitoring dashboard

Document Page

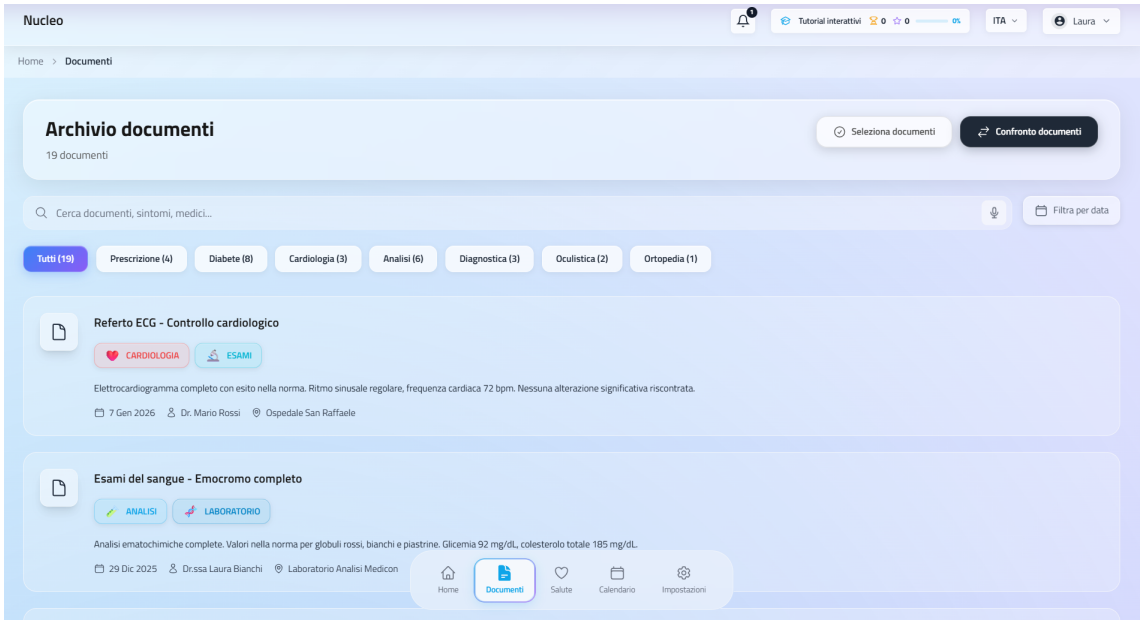

Figure 13: High Fidelity Prototype - Document Page

This screen directly resolves the "Content Understanding and Search" deep need by transforming the chronological "blind list" into a rich visual archive. Each document card displays preview thumbnails, metadata, and tags—enabling users to identify documents without opening them.

Task Support:

- **Semantic Booking (Simple):** Search bar accepts symptoms, suggests matching document types

- **Pharmacy Prescription (Moderate):** Tag filter + search rapidly isolates prescriptions
- **Diabetes Check-up (Complex):** Date range filter + multi-select enables bulk collection

Key Features:

- **Visual Document Cards:** Thumbnail preview, title, date, doctor, hospital, tags all visible
- **Multi-dimensional Filtering:** Tags, date ranges, text search combine flexibly
- **Batch Selection Mode:** Checkbox overlay enables selecting multiple documents for download
- **Document Comparison:** A dedicated modal allowing side-by-side analysis of two distinct documents with synchronized scrolling.
- **Prescription Handling:** Special "Show Barcode" button appears on prescription cards

Health Page

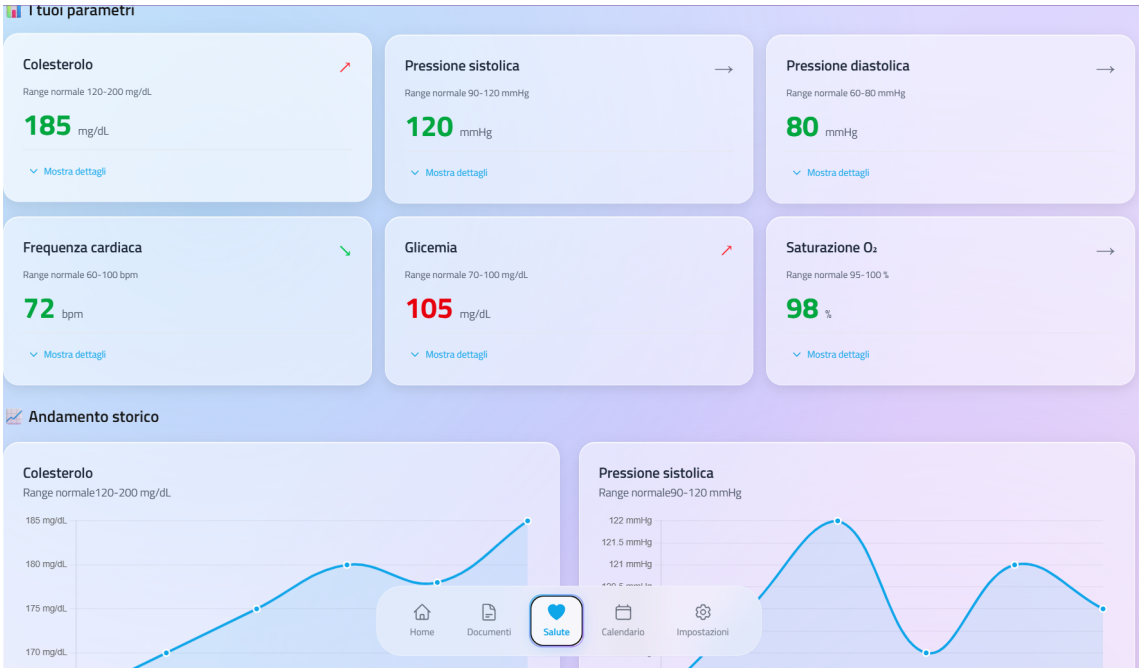

Figure 14: High Fidelity Prototype - Health Page

This screen represents the highest-value functionality identified in interviews: transforming static data into longitudinal narratives. It directly implements Diana's explicit request to "have a trend... see if cholesterol ever goes back down."

Task Support:

- **Health Trend (Complex):** Primary interface for parameter selection and temporal analysis

Key Features:

- **Alert System:** Top banner highlights abnormal values with contextual recommendations
- **Parameter Cards:** Each metric displays current value, trend indicator ($\nearrow$, $\searrow$, $\rightarrow$), and normal range
- **Timeline Graphs:** Interactive charts show evolution with range overlay
- **Source Document Links:** Expandable section reveals which clinical reports generated each data point

7.5 Standards and Visual Design

7.5.1 Target Device Standards

The platform implements a fully responsive design architecture, ensuring seamless functionality across the entire device spectrum. The interface fluidly adapts its layout to the viewport size, guaranteeing accessibility and usability on both desktop workstations and mobile devices.

Desktop/Laptop Devices

- Resolution Range: 1280px - 1920px width (optimized for 1440px)
- Minimum Requirements: 1024px $\times$ 768px height
- Browser Support: Chrome, Firefox, Safari, Edge

Mobile Devices

- Resolution Range: 430px - 932px width
- Interaction Model: Full touch optimization with minimum 44px $\times$ 44px touch targets (compliant with WCAG 2.5.5)
- Adaptive Behavior: Components stack vertically to maintain readability and eliminate horizontal scrolling.

7.5.2 Visual Design System

Glassmorphism Aesthetic

We adopted a "glassmorphic" visual language characterized by translucent surfaces with backdrop-filter blur effects. This design choice deliberately counteracts the clinical sterility typically associated with healthcare interfaces.

Color Palette and Accessibility

- **Primary Gradient:** Sky Blue (`#0ea5e9`) to Purple (`#a855f7`), derived from healthcare standards to evoke trust and calmness
- **Semantic Meaning:** The gradient represents the "bridge" between family members in unified health management
- **Color-Blind Adaptations:** Three adaptive palettes (Deuteranopia, Protanopia, Tritanopia) ensure accessibility for users with color vision deficiencies, using pattern differentiation alongside color coding

7.6 Limitations and Hard-coded Elements

As a high-fidelity frontend prototype, the system operates with the following logical and technical limitations:

Data Persistence and Processing: The application relies on a single `mockData.ts` file to simulate the database. Consequently, the data structure is uniform across all profiles: the system acts on a shared static dataset rather than retrieving distinct, isolated data for each user. While widget preferences are saved in `localStorage`, changes to clinical data (e.g., appointments) are temporary and reset upon reload.

Authentication and Privacy: The Login mechanism is simulated. We do not use a real backend for authentication; profile switching mimics the flow but does not strictly enforce security tokens, as the focus was on the interaction flow rather than backend security.

Search Scope: The intelligent search relies on string matching against a pre-stored dictionary. It effectively covers the specific scenarios defined in the tasks (e.g., "Back pain" mapping to Orthopedics) but lacks a full Natural Language Processing (NLP) engine to handle synonyms or undefined symptoms.

8 Usability testing

8.1 Preparation and Run

The usability evaluation was conducted following a structured protocol designed to validate the high-fidelity prototype against the six representative tasks identified during needfinding. The evaluation employed a **think-aloud methodology** in a controlled environment, prioritizing detailed observation of user behavior over statistical significance.

Participants: Four users were recruited to match the diversity of our target demographic:

- **Carla (Female, 24):** A young student accessing health records sporadically, who occasionally manages access for her grandmother.
- **Beatrice (Female, 55):** A user managing her own health while acting as a delegate for her parents, exposing the friction of managing multiple identities.
- **Aurora (Female, 29):** A young researcher who uses health apps to book medical appointments, representing a digitally confident user navigating healthcare within a demanding work routine.
- **Francesco (Male, 25):** A tech-expert professional who relies heavily on his computer for work, he manages his health independently and, since he has no particular medical issues, uses digital health tools about ten times a year.

This selection deliberately mirrors the participant spectrum from our initial interviews, ensuring representation of both autonomous users and caregivers managing multiple family profiles.

Team Roles: Each session involved three team members:

- **Facilitator (rotating role):** Guided the session, provided task instructions, and encouraged think-aloud verbalization without influencing behavior
- **Observer:** Documented interaction patterns, hesitations, error recovery strategies, completion times, success rates, and specific UI element interactions

Location and Setup: Testing occurred in a controlled environment. The setup consisted of:

- A computer running the prototype via local development server
- Physical notepad for manual observation logging

The laboratory setting was selected to eliminate external distractions while maintaining ecological validity for desktop-centric health management tasks, which interviews revealed typically occur in home "administrative" contexts rather than on-the-go.

8.1.1 Task Selection

The evaluation protocol included all six tasks originally identified, organized by increasing complexity:

Simple Tasks:

1. **Recent Consultation:** Need to quickly review your most recent medical report. Find it and open it.
2. **Semantic Booking:** You're experiencing persistent back pain. Use the system to find and book an appropriate specialist visit.

Moderate Tasks:

3. **Appointment Verification:** Your spouse asks you when your next doctor's appointment is scheduled. Find this information and tell them the date and time.
4. **Pharmacy Prescription Retrieval:** Your father urgently needs to refill his blood pressure medication. Find and display the prescription barcode so you can pick it up at the pharmacy.

Complex Tasks:

5. **Diabetes Documentation Collection:** Your mother has a diabetes specialist appointment next week. Collect all relevant documents from the past 6 months.
6. **Health Trend Analysis:** Your doctor asked you to monitor your cholesterol trend over the past year to see if the medication is working.

8.1.2 Success Criteria and Metrics

For each task, we defined explicit success criteria and quantitative metrics following standard usability evaluation practices. A task was considered successfully completed when the participant achieved the stated goal, regardless of the path taken. We distinguished between **critical errors** (preventing task completion or leading to incorrect outcomes) and **non-critical errors** (causing inefficiency but allowing successful completion).

Task	Time Target	Success Criterion	Critical Errors	Non-Critical Errors
Recent Consultation	< 45 s	Opens correct recent document	Clicks wrong document	Hesitations, explores other sections
Semantic Booking	< 90 s	Receives appropriate specialty suggestions	Books wrong specialty	Tries multiple synonym queries
Appointment Verification	< 30 s	Provides correct date and time	States incorrect information	Checks multiple sections
Pharmacy Prescription	< 90 s	Switches profile and displays barcode	Searches in wrong profile for > 30 s	Hesitation on profile menu
Diabetes Collection	< 180 s	Uses temporal filter and selects relevant documents	Selects irrelevant documents	Opens documents individually to verify
Health Trend	< 160 s	Finds cholesterol graph and interprets it correctly	Misinterprets trend direction	Attempts widget interaction first

Table 1: Success criteria and metrics for each usability task

8.1.3 Methodology and Evaluation Instruments

The **think-aloud protocol** was employed to capture user mental models and decision-making processes in real-time. The facilitator intervened minimally, only prompting with neutral phrases when participants fell silent for extended periods. This methodology trades precision in timing metrics for depth of understanding regarding *why* users succeed or fail.

Following task completion, participants filled out the standardized **System Usability Scale (SUS)** questionnaire (10 items, 5-point Likert scale), yielding a 0–100 score benchmarking perceived usability. `https://forms.gle/XxBiM6Xn9NH1AGgD7`
A **semi-structured debriefing session** then clarified observed behaviors and gathered improvement suggestions through open-ended questions.

8.1.4 Consent and Ethics

All participants signed informed consent forms prior to testing, explicitly authorizing screen recording, audio capture, and anonymous data usage for research purposes. Participants were reminded of their right to withdraw at any point without consequence.

8.1.5 Protocol Documentation

The complete usability testing protocol (including the facilitator script, task scenario descriptions, pre-test questionnaire, SUS questionnaire and results, debriefing guide) and consent forms available at: `https://github.com/LucaSamore/kernel/tree/main/A5/usability-test`

8.2 Results

8.2.1 Quantitative Findings

Task	Success Rate	Critical Errors	Non-Critical Errors	Avg. Time (sec)
Recent Consultation	100% (4/4)	0	2	60
Semantic Booking	50% (2/4)	0	2	87.5
Appointment Verification	75% (3/4)	1	1	37.5
Pharmacy Prescription	100% (4/4)	0	3	67.5
Diabetes Collection	50% (2/4)	1	2	115
Health Trend Analysis	75% (3/4)	2	2	206.5

Table 2: Task success rates and error counts (n=4 participants)

System Usability Scale The prototype achieved an average SUS score of **81.25/100**, clearly exceeding the industry acceptability threshold of 68 and falling within the "Excellent" usability category according to standard interpretation benchmarks. This result indicates a strong perceived ease of use, good functional integration, and rapid learnability across participants.

Error Analysis The study recorded a total of **4 critical errors**. Half of these (2 errors) occurred in *Health Trend Analysis (Task 6)*, which also registered the highest average completion time (206.5s), highlighting a specific complexity in data visualization tasks.

In particular, *Semantic Booking (Task 2)* shows a 50% failure rate despite recording zero critical errors. This apparent discrepancy is due to participants successfully completing the booking process via alternative navigation paths (e.g., "Appointment booking" button) instead of utilizing the required semantic search feature, resulting in a protocol failure rather than an interaction error. Finally, **12 non-critical errors** were observed, primarily in *Pharmacy Prescription* and *Diabetes Collection*, reflecting minor usability friction that did not hinder task completion.

8.2.2 Qualitative Insights

Successful Interactions

- **Appointment Booking Clarity:** Participants consistently validated the clarity and guidance of the booking workflow. Beatrice confirmed this efficiency, describing the process as "very quick and straightforward," noting that the step-by-step design successfully eliminated ambiguity.
- **Recent Documents as Quick Access:** Carla and Francesco immediately identified the value of the "Recent Documents" section. Aurora also successfully utilized this section on the Home page to retrieve her most recent report, confirming it as a reliable entry point for rapid data retrieval.
- **Filter Utility Recognition:** Once discovered, temporal and tag-based filters received positive feedback across all participants. Aurora specifically utilized the "Prescrizioni" (Prescriptions) tag to efficiently isolate medication barcode.
- **Health Trend Interpretation:** Francesco completed the cholesterol trend analysis in under 30 seconds. Similarly, Aurora correctly identified the cholesterol widget on her first attempt, demonstrating that the modular dashboard supports quick clinical assessment.

- **Appointment Verification Flow:** Francesco efficiently located upcoming appointment, a success mirrored by Aurora, who completed the verification task in just 15 seconds without errors.

Critical Pain Points

- **Health Trends (Task 6):** Beatrice experienced a critical 10-minute blockage attempting to locate trend visualizations within the Documents page. Aurora, while reaching the correct section, struggled with the trend arrows and expected the graphs to be integrated directly into the parameter badges rather than located at the bottom of the page.
- **Profile Context Ambiguity (Task 3):** Beatrice's approach exposed a gap in profile awareness; she bypassed the in-app switcher and incorrectly assumed all displayed appointments belonged to the active profile. Aurora also initially mistook an appointment card for a medical report on the Home page, suggesting a need for stronger visual differentiation.
- **Semantic Booking and UI Obstacles (Task 2):** Francesco failed the task by manually searching for a specialist instead of using symptoms. Aurora similarly bypassed the semantic search bar, clicking "Prenota visita" directly, which led to confusion regarding which specialty was appropriate for her symptoms. Additionally, she was temporarily blocked by the time-selection buttons, which were hidden "below the fold" in the modal.
- **Document Archive Strategy (Task 5):** Francesco incorrectly navigated to the Health section to retrieve documents. Aurora successfully used the Documents page but expressed frustration with the "endless list" format, suggesting that the archive should be paginated for better organization.
- **Home Page Cognitive Load:** Francesco described the home page as dispersive. This sentiment was partially shared by Aurora, who noted that while the elements were well-disposed, the density of information required an initial period of orientation.

Positive Surprises

- **Home Page Content Layout:** Carla commented positively the spatial organization of the three-column layout. She found the Home page particularly intuitive because all primary elements were immediately visible and easy to understand.
- **Health Page Trust:** Carla and Francesco engaged deeply with the Health section. Aurora spontaneously recognized the value of longitudinal graphs for sophisticated monitoring, despite her navigational difficulties.
- **Bottom Navigation Bar Intuitiveness:** Francesco explicitly praised the bottom navigation bar as the most user-friendly element for orientation. Aurora's fluid transitions between sections further validated this persistent navigation as a stabilizing architectural choice.
- **Perceived Superiority Over Existing Systems:** Francesco and Aurora both compared the prototype favorably to the national Fascicolo Sanitario Elettronico (FSE). Aurora noted that Nucleo's booking flow was as intuitive as commercial apps like "MioDottore", validating the design's alignment with high-standard industry patterns.

8.3 Proposed Changes and Justifications

Based on the synthesis of quantitative metrics, qualitative feedback, and observational data, the team identified eight priority improvements for implementation in the next iteration.

8.3.1 Change 1: Integrated Telemedicine Chat

Problem: The system lacks a direct communication channel with healthcare professionals, a feature users expect based on existing medical platforms.

Proposed Solution: Integrate a dedicated chat or video-consultation module to allow users to interact with doctors directly within the platform.

Justification: Aurora noted the absence of a "medical chat" feature (e.g., for urgent consultations) and compared the system to apps like "MioDottore", which provide integrated booking and communication services.

Implementation Priority: Low (feature expansion, not a usability fix).

8.3.2 Change 2: Document Print Functionality

Problem: Explicit user request for direct printing.

Proposed Solution: Add "Print" action to document preview modal toolbar, triggering browser print dialog with optimized layout.

Justification: Download-then-print workflow adds friction for users who need physical copies for appointments or administrative purposes. Direct printing is a standard document viewer feature with straightforward implementation.

Implementation Priority: Low-Medium (convenience feature; workaround exists but adds steps).

8.3.3 Change 3: Visual Differentiation of Appointments and Reports

Problem: There is visual ambiguity between upcoming medical appointments and recently received clinical reports on the dashboard.

Proposed Solution: Introduce distinct iconography and color-coding to clearly separate "Upcoming Events" (appointments) from "Historical Data" (reports/documents).

Justification: During the testing session, Aurora initially mistook an appointment card for a medical report, indicating that the current visual categorization is not sufficiently distinct for rapid identification.

Implementation Priority: Medium (optimizes efficiency and error prevention).

8.3.4 Change 4: Unified Search Bar with Cross-Section Indexing

Problem: The user did not use the search function at all, despite acknowledging afterward that it could have been helpful. This suggests that the current search feature is either not visible enough or not powerful enough to be perceived as a primary navigation tool.

Proposed Solution: Implement a unified, always-accessible search bar capable of cross-section indexing across:

- Documents (reports, prescriptions, lab results)
- Upcoming and past appointments
- Health parameters
- Family member profiles (with automatic suggestions to switch profiles)

Search results should be grouped into categories ("Documents", "Appointments", "Family Members", "Health") and include quick actions such as "Show barcode", "Switch profile", or "Download document".

Justification: The user explicitly stated that search could have helped but did not feel compelled to use it. A more visible and more powerful unified search system would significantly reduce navigation time, prevent errors, and support users who rely on intuition rather than structured browsing.

Implementation Priority: Medium-High (improves efficiency and reduces errors, but requires advanced indexing).

8.3.5 Change 5: Profile Switching Guidance and Error Prevention

Problem: Users consistently failed to switch profiles when required, resulting in critical errors in Task 4 and Task 5. The participant reported relying on "intuition" and preferring to remain on their own profile, indicating that the system does not clearly communicate when a profile change is necessary.

Proposed Solution: Introduce a contextual guidance system that detects when the user is attempting to access information belonging to a family member and proactively suggests switching profiles.

Justification: Failure to switch profiles was the primary cause of task failures. Users do not perceive profile switching as a natural part of the workflow and tend to ignore it. Contextual guidance reduces critical errors, increases accuracy in document retrieval, and improves overall task success.

Implementation Priority: High (directly addresses critical errors and failed tasks).

8.3.6 Change 6: Document Preview Full-Screen Zoom

Problem: Users specifically requested the ability to enlarge document content to improve readability.

Proposed Solution: Integrate a zoom button within the document preview toolbar. This action activates a full-screen mode equipped with dedicated zoom controls.

Justification: Medical documents frequently contain dense tabular data, small-font annotations, or detailed diagnostic images requiring close examination. The current fixed-scale preview forces users to download documents for external viewing, breaking workflow continuity.

Implementation Priority: High (directly impacts core document review workflow; explicit user request).

8.3.7 Change 7: Interactive Health Dashboard with Integrated Graphs

Problem: The Health page was identified as the most difficult section to navigate. Users found it hard to interpret trend indicators and noted that graphs were inconveniently located at the bottom of the page, requiring significant scrolling.

Proposed Solution: Redesign the Health page into a compact, widget-based layout. Clicking on a specific parameter badge (e.g., cholesterol) will dynamically display its corresponding trend graph directly within the badge or in an expanded section immediately below it.

Justification: Aurora explicitly requested a more compact interface where graphs are integrated within the badges to provide immediate visual feedback and better accessibility.

Implementation Priority: High (usability blocker for the "Health Trend" task).

8.3.8 Change 8: Enhanced Appointment Booking Workflow

Problem: Booking workflow lacks filtering options for real-world use cases.

Proposed Solution: Expand booking interface with two additional filtering dimensions:

1. **Visit Type Classification:** Add mandatory selection step after choosing visit specialty:
   - "AUSL (Public Healthcare)" shows public facilities, covered by national health service
   - "Private Specialist" shows private clinics, typically faster but paid
2. **Doctor-Centric Search:** Add alternative booking flow:
   - "Search by Doctor Name" input field alongside specialty search
   - Selecting a specific doctor filters availability to only their slots

Justification: Beatrice's feedback reveals the current booking flow oversimplifies real-world decision-making. Users often have constraints (preference for specific doctors, AUSL coverage requirements, location convenience) that the generic specialty-date-time flow cannot accommodate.

Implementation Priority: High (transforms booking from proof-of-concept to production-ready; addresses real user constraints).

9 Conclusions

9.1 Main Learnings

This semester-long project fundamentally transformed our understanding of software development by centering the process on users rather than technology.

Iterative Design Process

The course's progressive assignment structure, distributing needfinding, task analysis, prototyping, and implementation across the semester, proved invaluable. This iterative approach prevented the technical debt of rushed development while ensuring each design decision was grounded in prior research.

Usability Testing as Critical Validation

The most critical lesson was recognizing that *we are not the user*. Our preliminary evaluation exposed severe issues invisible to the development team: locate health trends, profile confusion risking data misattribution and discovery failures for batch operations. Features that seemed intuitive to us as developers became barriers for first-time users. Without this validation phase, we would have delivered a technically functional system that practically failed its users. Testing taught us that usability validation is not optional polish, but a fundamental requirement.

9.2 Group Collaboration and Workflow

The team adopted a workload distribution strategy across project phases. Interview and usability testing sessions were divided equally among members to ensure diverse perspectives and prevent bias. Each member conducted sessions as facilitator, with rotating observer roles to maintain consistency.

Individual Contributions:

- **Lucia Castellucci:** I was responsible for identifying the main idea behind the project. I actively contributed to the decision-making process during the needfinding phase and to the identification of key tasks. My work focused primarily on the high-fidelity prototype. Specifically, I designed the Calendar, Documents, and Settings pages, as well as the shared components of the interface, including the base layout, top bar, bottom bar, and footer. I also implemented all internal elements and interactions within these pages to ensure a complete and coherent user experience. I implemented the Glassmorphism design system. In addition, I reviewed government guidelines related to design and accessibility, ensuring the product met the required standards. I also created the dark theme and the themes dedicated to different forms of color blindness. Moreover, I provided materials for interviews and user testing.

- **Roberto Mitugno:** I structured the material deliverables for all the assignments and created both the low and medium-fidelity prototypes. I wrote the final report, summarizing our research and design choices. On the technical side, I developed the Login Page, Home Page, Document Preview, Documents Comparison, the Widget Selector, Booking workflow, Prescription Barcode display and other auxiliary UI components.

- **Luca Samorè:** I contributed to the early stages of the project by identifying the Value Proposition and collaborating on the interview protocols and the definition of target users. I was also responsible for drawing the storyboards. For the high-fidelity prototype, I specifically developed the Health page, the semantic search mock, and functional features such as date-based filtering and multiple document selection. Additionally, I improved the document tagging system and designed the widget loading animations. Finally, I established the overall visual identity of the platform by defining a Design System based on Glassmorphism.

The team's prior collaborative experience on academic projects provided a strong foundation for efficient coordination. We established clear communication channels (weekly meetings, Slack coordination, shared repositories) and leveraged complementary skill sets. The division between design and development tasks created natural parallelism, maximizing productivity without bottlenecks.

Despite remaining challenges — extending user testing, longitudinal validation, real healthcare system integration (e.g. APIs), and security hardening — this project successfully demonstrates that rigorous application of HCI principles can transform complex,

sensitive domains like family health management into intuitive digital experiences.

The most valuable takeaway transcends this specific project: **effective software development begins not with code, but with understanding the humans who will use it.**