



ATENEA ARTIFICIAL INTELLIGENCE FOR ELDERLY PEOPLE

**NO MORE BUTTONS, MENUS OR TACTILE SCREENS. WITH ATENEA, BY A VOICE CONVERSATION,
EVERYTHING IS POSSIBLE**

ALBERT ISERN ¹

¹ MOMENTUM ANALYTICS, SPAIN

KEYWORDS	ABSTRACT
<i>Inclusivity</i>	<i>ATENEA is a NextGenerationEU project managed by the Social Rights Ministry of the Government of Catalonia.</i>
<i>Elderly population</i>	<i>ATENEA uses a mobile phone customized with an extremely simplified user interface that requires only voice interaction (voicebot).</i>
<i>Digital divide</i>	<i>This allows elderly people with limited digital literacy, to request city services, simply through conversation. The ATENEA system manages these requests on their behalf via the corresponding online services.</i>
<i>Artificial Intelligence</i>	<i>Elderly people find themselves in vulnerable situations, as managing tasks online often becomes an impossible mission. The digital divide isolates, increasing the perception of unwanted loneliness, one of the key social determinants of health.</i>
<i>SDG</i>	
<i>Social care</i>	
<i>loneliness</i>	

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1. Introduction

1.1 Digital Divide

Digitalization is now a reality. It has transformed essential public services, increasingly affecting citizens when, for example, applying for social security benefits, using a virtual health card, or accessing digital financial services. However, not all citizens are able to adapt to these changes. Many older adults find themselves in vulnerable situations, as the ability to carry out essential procedures online becomes, in many cases, an impossible task.

Although this digital transformation represents significant progress, online procedures cannot be the only option, as this prevents many people from exercising their fundamental rights and worsens the quality of services provided. Technology should enhance services and make life easier—not create new forms of exclusion or render capable individuals unable to live autonomously and make their own decisions.

There have been reports denouncing how the banking sector mistreats older adults, but even more critical issues exist, such as access to the Minimum Vital Income benefit, which has led to the digital exclusion of many potential beneficiaries living in extreme poverty and social vulnerability. This mistreatment is not exclusive to the banking sector and its rapid digitalization—it affects a growing number of services provided exclusively or almost exclusively online, requiring access via digital devices and applications.

In the “My Health” platform, older adults must request appointments with their family doctor through an app, which is often impossible without help from a family member or caregiver with greater digital literacy, undermining their autonomy—even though many are perfectly capable of managing their lives and needs.

The same applies to access to Basic Primary Social Services. People in vulnerable situations are often users of these services and, at the same time, the ones most affected by the digital divide.

The drastic reduction of in-person service offices and the digitalization of public and private services in cities completely isolates citizens affected by the digital divide. It disconnects them from society, the economy, and democratic participation.

ATENEA solution, uses a smart device—a tablet adapted with an extremely simplified user interface that requires only voice interaction (voicebot). This allows older adults or individuals with limited digital literacy, whether dependent or autonomous, to carry out their daily tasks—such as requesting social services or basic needs provided online—through simple conversation. The ATENEA system manages these requests on their behalf via the corresponding online application.

It is important to highlight that ATENEA offers an option not only for those who cannot access digital resources, but also for those who choose not to. It respects the individual’s right not to be digitized and to freely decide based on personal preferences.

ATENEA also bridges the digital divide through connectivity: wanting to connect does not mean being connected. Despite 4G coverage in 98% of Catalan municipalities, not everyone owns a mobile phone (let alone a smartphone), perpetuating social class divisions and especially ageism—discrimination based on age.

According to Spain’s National Statistics Institute (INE, 2021), only 1 in 10 people over the age of 65 interact with electronic public administration. In addition to this age-based gap, there are gender, social class, economic, and psychological gaps (psycho-digital gap) linked to factors such as mild cognitive impairment or visual deficiencies, which hinder digital inclusion for older adults.

There are also differences between urban and rural areas: the larger the population, the more people with advanced digital skills. It is worth noting that 93% of Catalan municipalities have fewer than 20,000 inhabitants.

Often, the digital divide is due to a lack of digital skills, but also to the complexity of electronic public procedures, online banking, social services platforms, and e-health systems, which lack user-friendliness, security, and responsiveness.

The digital divide isolates older adults, increasing the perception of unwanted or involuntary loneliness, which is considered one of the social determinants of health.

1.2 Unwanted Loneliness

ATENEA has a direct and transformative impact on the prevention and detection of unwanted loneliness, one of the main causes of emotional, cognitive, and physical decline in older adults.

Thanks to its voice-based design, it facilitates communication with the user's social environment (family, friends, social and healthcare professionals), promoting emotional bonds and participation in community life.

Moreover, ATENEA's artificial intelligence establishes a constant and empathetic presence in the home, offering companionship, interaction, and daily monitoring.

The system detects prolonged lack of interaction with the user and triggers alerts to social professionals or family members, enabling early intervention.

ATENEA also serves as a gateway to social services and activities, providing reminders about events, campaigns, or municipal resources, fostering inclusion and active aging.

Overall, the project helps reduce isolation, improve emotional well-being, and strengthen support networks, aligning with public strategies for addressing unwanted loneliness.

1.3 Active ageing

The ATENEA project represents a practical application of the principles of active ageing, as defined by the World Health Organization (WHO, 2002), which emphasizes optimizing health, participation, and security to enhance quality of life in later years. By leveraging voice-based interaction to facilitate access to essential city services, ATENEA addresses one of the most pressing challenges in ageing societies: the digital divide. This divide often isolates older adults, limiting their ability to engage in social, cultural, and civic activities, and exacerbating feelings of loneliness—a recognized social determinant of health (U.S. Department of Health and Human Services, 2023; Yang et al., 2024).

Active Ageing and the Activity Perspective: The activity theory of ageing posits that maintaining social roles and engagement contributes to well-being and life satisfaction (Havighurst, 1961; Loue et al., 2008). ATENEA operationalizes this theory by enabling older adults to remain active participants in their communities through a simplified, voice conversation-driven interface. Functionalities such as initiating video calls to relatives, scheduling medical appointments, and planning public transport routes foster continued social interaction and mobility. These features counteract the tendency toward withdrawal and inactivity, which the activity perspective identifies as detrimental to quality of life.

Life Course Approach and Cumulative Disadvantage: The life course approach emphasizes that ageing outcomes are shaped by cumulative advantages and disadvantages across the lifespan (Kuh et al., 2014). Digital exclusion is one such disadvantage that compounds over time, limiting access to health, social, and economic resources. ATENEA mitigates this by providing an accessible technological solution that does not require advanced digital literacy. Features such as medication reminders, health monitoring via smartwatch sensors, and voice conversation-based health guidelines ensure that older adults can manage their health proactively, reducing the risk of dependency and promoting autonomy.

Beyond Economic Productivity - A Holistic Model: Critiques of active ageing frameworks often highlight their narrow focus on economic productivity, such as extending working life (Foster & Walker, 2021). ATENEA challenges this interpretation by prioritizing social inclusion, dignity, and well-being over labor market participation. Functionalities like shopping for household products, scheduling personal reminders, and accessing social care services via voice conversation illustrate a holistic approach that integrates social, cultural, and health dimensions. This aligns with the WHO's call for policies and interventions that support active ageing across multiple domains, not solely economic engagement (UNECE, 2018; WHO, 2002).

Reducing Isolation and Promoting Participation: Loneliness and social isolation are critical risk factors for morbidity and mortality among older adults (Holt-Lunstad et al., 2015). ATENEA's design directly addresses these issues by facilitating communication and participation. The system's ability to start video calls with relatives, display a carousel of local activities, and enable voice-activated access to emergency and social care services creates a safety net that fosters both emotional security and social engagement. These functionalities exemplify how smart city technologies can operationalize active ageing principles, transforming urban environments into inclusive ecosystems for older populations.

1.4 Algorithmic Ethics and Regulatory Compliance

ATENEA's approach to algorithmic ethics is grounded in transparency, human oversight, and proportionality of risk, in line with the EU AI Act. The system employs three distinct speech recognition strategies, each tailored to specific interaction scenarios. Use Case 1 involves highly constrained responses (e.g., "Yes/No" or numeric selections), implemented through Automatic Speech Recognition (ASR) with Backus–Naur Form (BNF) grammars. These grammars, whether static or dynamically generated from user-specific data (e.g., contact names), ensure predictability and audibility, supporting explainability and accountability. Use Case 2 addresses open-ended queries such as "How can I help you?" using Continuous Speech Recognition (CSR) with Deep Neural Networks and Hidden Markov Models (DNN/HMM). This model transcribes continuous speech to identify user intent from a predefined set of actions (e.g., calling emergency services, booking a doctor's appointment). Use Case 3 handles short but variable responses, such as street names, through End-to-End CSR with Convolutional Neural Networks (CNN), which offers superior handling of proper nouns but introduces higher computational complexity and reduced interpretability.

Despite the presence of deep learning components, ATENEA's role is limited to speech-to-text conversion, not autonomous decision-making, positioning it as a limited-risk AI system under the EU AI Act. Transparency is achieved through the use of deterministic grammars and auditable language models, while human oversight ensures that all critical actions (e.g., emergency calls) remain user-initiated and monitored. Ethical safeguards include minimizing linguistic bias across accents, ensuring GDPR-compliant data handling, and promoting digital inclusion for older adults with low digital literacy. Nevertheless, the reliance on neural networks introduces challenges of explainability, reinforcing the need for continuous auditing and participatory design to uphold accountability and trust in socio-technical systems (Floridi & Cowls, 2022; Peine et al., 2021).

1.5 Critical studies on technology and digital exclusion

While ATENEA demonstrates the potential of digital innovation to promote active ageing, it is essential to situate this intervention within the critical scholarship on technology and ageing. Critical gerontology and socio-gerontechnology studies argue that technologies are not neutral tools but socio-technical constructs that embed assumptions about ageing, autonomy, and competence (Neves & Mead, 2020; Peine et al., 2021). From this perspective, digital exclusion is not merely a matter of individual skills, but a structural phenomenon shaped by design practices, policy frameworks, and cultural narratives that often marginalize older adults (Fang et al., 2025; Seifert et al., 2021). For instance, the discourse of "digital by default" in public services can inadvertently impose a normative expectation of connectivity, creating what Kuzelewska et al. (2025) describe as a "de facto obligation" to engage online, even for those who lack resources or prefer alternative modes of interaction.

ATENEA's voice conversation-based interface challenges these exclusionary dynamics by reducing cognitive and operational barriers, yet critical theories remind us to interrogate whether such solutions risk reinforcing ageist assumptions—such as framing older adults as passive recipients rather than co-creators of technology (Lazar et al., 2023; Mannheim et al., 2024). Moreover, socio-gerontechnology emphasizes the importance of participatory design and

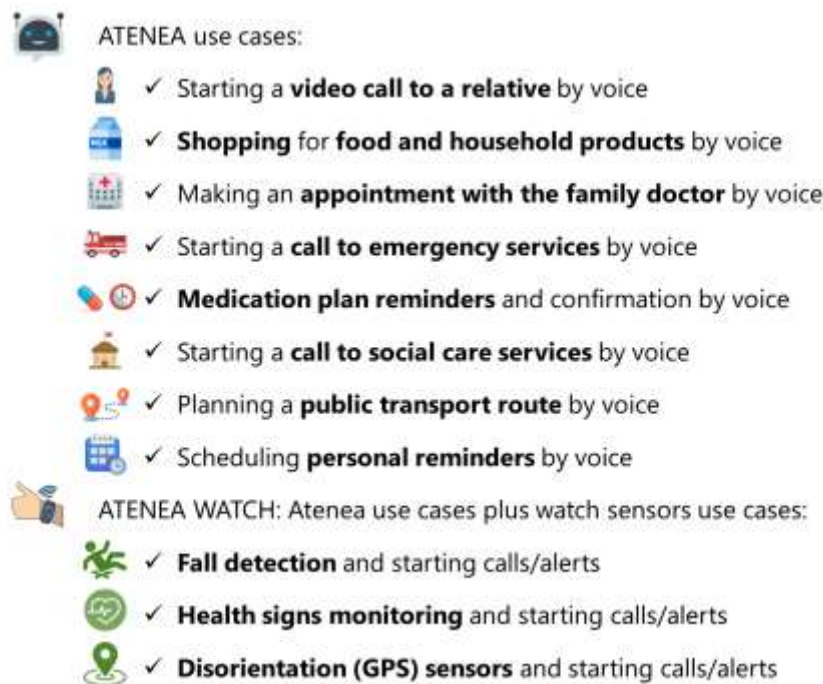
reflexivity in technology development to avoid reproducing inequalities (Peine et al., 2021). By integrating functionalities like voice conversation-activated video calls, health monitoring, and access to social care, ATENEA aligns with inclusive design principles; however, its long-term success depends on continuous engagement with older users to ensure that the system evolves in response to their lived experiences and diverse needs.

Finally, critical perspectives highlight that digital inclusion must go beyond access to encompass agency, trust, and meaningful participation (Aspen Institute, 2024; Chan, 2024). ATENEA's approach—enabling older adults to manage health, mobility, and social connections through natural language interaction—offers a promising pathway toward what Lazar et al. (2023) term a “critical turn” in ageing and technology research: one that resists deficit-based narratives and foregrounds empowerment, equity, and dignity in later life.

2. Methodology

ATENEA is a smartphone (tablet or smartwatch), without buttons, without touch screens, it works only with an interaction as simple as voice. To an elderly person, probably in a situation of dependency, it gives quick answers to his/her basic needs. This artificial intelligence makes it possible to carry out daily tasks with a conversation, such as making an appointment with the family doctor, making a video call to a relative, calling emergency services after a cry for help, shopping for food, beverage and household products, planning a public transport route or checking a bank statement.

Figure 1. ATENEA use cases.



Source(s): Own elaboration, 2025.

The goal of the project is to contribute to the digital transformation of territories, putting the most vulnerable citizens at the center, reducing the digital divide and loneliness, promoting inclusion, well-being, health and ultimately the quality of life of the elderly people.

2.1. Inequality and social exclusion of elderly people caused by digital divide

The digital transformation has changed basic services affecting many citizens, such as carrying out procedures with public administration, utilities, or banks. The drastic reduction of citizen services offices and the digitalization of city services has totally isolated the citizens most affected

by the digital divide. Technology creates new forms of exclusion by incapacitating people fully capable of living autonomously.

2.2. Target. User description

Elderly people (50% +65 years old and 50% +80 years old) who live alone or with an elderly partner. People who have limited digital skills, and without several cognitive limitations. Both in urban and rural environments.

2.3. Project methodology

Atenea is funded with 2.6M€ by NextGeneration EU funds managed by the Social Rights Ministry of the Government of Catalonia:

Product development: +10 technical teams, +60 engineers participated: Artificial Intelligence, Cloud, Mobile app, Robotic Process Automation, Speech technology, Mobile Device Management, Communications, Back office, Frontend, Cybersecurity, Biometrics, Data Analytics, UX/UI, Functional design, Project Manager Office

Collaboration agreements with 15 Catalan municipalities: 4 administrative teams participated: Legal, GDPR, National Security Framework (ENS), Bioethics, RIA

Deployment to 15 cities. A total of 500 people, who live alone or with an elderly partner, participated as users to try out the tool for a year.

Collaboration agreements with new sponsors & new stakeholders: public bodies, retail, media, pharma, third sector entities, etc.

2.4. Innovation. How does this technology provide more value to users compared to existing solutions on the market?

The voice assistants on the market, Siri, Alexa or Google Nest, are for general purposes (they play a Shakira song or tell the weather forecast). ATENEA is a voice assistant customized to the basic needs of users, authenticating them with voice biometrics, they can make an appointment with the doctor or can shop for food, beverage and household products. The artificial intelligence makes itself the connection to online services, such as Healthcare System website "myhealth.com" or an "e-commerce".

This personalization goes further, the market voice assistants. Siri, Alexa or Google Nest, do not speak regional languages such as Catalan, ATENEA in addition to English or Spanish also speaks Catalan and any Romance language.

2.5. Other elements of technological innovation present in the project

Steve Jobs merged a phone, a digital camera, the Internet and e-mail. Atenea merges A.I. voice assistance, robotic process automation, cloud computing, in a smartphone/tablet. The Atenea WATCH includes Vital Signs, Fall Detection and Disorientation (GPS) sensors, A.I. alerts by voice/SMS relatives/emergency services.

ATENEA integrates the latest in technology such as generative artificial intelligence (neural networks), voice assistant, voice biometrics and robotic process automation, combined with mature technologies such as data analytics, cloud computing and tablets, smartphones and smartwatches.

ATENEA is not invasive or intrusive. It does not require digital skills or manipulation on the part of the user, the user interface is by voice, by a natural language conversation. The identification is biometric, it guarantees exclusive individual use and security. It does not require a Wi-Fi or Internet connection installed at home; communications (a SIM card) are included. ATENEA has been designed with the co-creation of elderly people, professional caregivers and the user's environment, establishing a bond of trust and support in case of need.

Figure 2. ATENEA technical architecture.



Source(s): Own elaboration, 2025.

2.6. Multy-stakeholder collaboration

Public-private-citizen co-creation, technology-third sector collaboration.

ATENEA is a public-private collaboration. The current phase of the project is funded, with a budget of €2,600,000, by the Social Rights Ministry of the Government of Catalonia as part of the Recovery, Transformation and Resilience Plan, financed by the European Union, Next Generation EU.

It is a project in production that has the support of 15 Catalan cities, including: Mataró, Mollet del Vallès, Granollers, Vic, Manlleu, Sant Feliu de Llobregat, Esplugues de Llobregat, Vallirana, Vall d'Aran county, Alta Ribagorça county, Lleida provincial council, Terrassa, Sabadell and Vallès Occidental County.

ATENEA is led by a strategic alliance between Technological and Social entities: MOMENTUM Analytics is the leader in partnership with the ABD Group (NGO).

Public partners: Government of Catalonia: Social Rights Ministry (Project owner) & Healthcare system (family doctor appointments agenda) & Emergency services (112 phone line) & Citizen assistance (citizen assistance phone line) & Cybersecurity Agency (Security). 15 Catalan City councils (citizens). University of Barcelona (Evaluation of results and impact) and the Bioethics Commission of the University of Barcelona (Guaranteeing the rights of users).

Third Sector partners: European Social Network (European expansion), Down Syndrome Catalan Foundation (Atenea pilot for Down Syndrome users), Alzheimer Catalan Family Association (Atenea pilot for Alzheimer users)

Private partners: Bonpreu-Esclat (retail), College of Pharmacists of Lleida (medication plan reminders).

Technology partners: ATENEA has a set of top-level partners, MICROSOFT (Cloud services), SAMSUNG (tablets-watches devices), VERBIO (Speech technology), RAONA (Robotic Process Automation & Cloud), PARLEM & ORANGE (Communications).

2.7. Citizen engagement and co-creation

MOMENTUM, ABD and citizens (elderly people) co-designed the use cases and functionalities

- In 2023, the creation year, the ATENEA team organized different focus groups, with the participation of elderly people who live in social housing operated by ABD, and in-depth interviews with social care users who live at their home.

- In 2024, the pilot year, ABD's social caregivers deployed Atenea to 500 user's homes, they accompanied the users, they gathered their feedback and evaluated their satisfaction.

The Psychology Faculty of the University of Barcelona also measured the user satisfaction and collected user's ideas to improve and evolve the functionalities. Some examples of useful and practical ideas suggested by citizens:

- Turn up the volume (hands-free speakers of tablets have a more powerful sound than mobile phones).
- Intimacy: Privacy with the daily conversations at home while Atenea is "inactive", waiting to hear the "wake up word"
- Limitless number of relatives and friends who can be contacted by videocall/call. The initial design was limited to 3 main contacts.
- Availability for two users at the same home: Elderly husband and elderly wife. (Biometrics distinguishing).
- Making appointments with the nurse, not only with the family doctor
- Reducing screen brightness at night
- Watching movies
- Maintenance service
- Co-payment model

2.8. Metrics

The evaluation of ATENEA combined quantitative metrics, qualitative feedback, and functional assessments to measure its impact on elderly users. The process was led by the University of Barcelona, with support from ABD Asociación Bienestar y Desarrollo social care NGO and MOMENTUM Analytics.

Quantitative Evaluation Tools: This report presents the data from the 2024 operational period, compiled through Data Analytics based on the Backoffice information system. This system manages user registrations, modifications, and deactivations, as well as the execution of each use case.

Usage Analytics: Data collected from the ATENEA Backoffice system included:

- 508 registered users (ATENEA has rotated between different users)
- 251 active users
- 65 unsubscribed users

Gender: 76.7% women, 23.3% men

Age: 49.5% aged 75–84, 23.7% aged 85–94, 21.6% aged 65–74

Living Situation: 64.7% live alone, 21.9% with a partner

Marital Status: 52.3% widowed, 27.9% married

Figure 3. User Distribution by Territory and Age Range

Territori	Total	%Total	Rang edat	Masculí	Femení	Total
Sant Feliu de Llobregat	58	23%	<60	4	1	16
Mataró	44	18%	60-64	1	2	3
Granollers	26	10%	65-69	3	14	17
Cardedeu	22	9%	70-74	6	20	28
Vic	16	6%	75-79	4	40	48
Diputació de Lleida	14	6%	80-84	17	48	65
Alta Ribagorça	13	5%	85-89	13	36	49
Esplugues	9	4%	90-95	4	18	21
Privat (particulars)	7	3%	95+	2	2	4
Federació Catalana de Síndrome de Down	5	2%	Total	54	187	251
Manlleu	5	2%				
Mollet del Vallès	5	2%				
Privat	4	2%				
Vallirana	4	2%				
AranSalut	2	1%				
Associació de Familiars d'Alzheimer de Barcelona	1	0%				
Cabrera de Mar	1	0%				
Vall d'Aran	1	0%				
Total	251					

Source(s): Own elaboration, 2025.

80% of users are concentrated in the following municipalities:

- Sant Feliu de Llobregat
- Mataró
- Granollers
- Cardedeu
- Vic
- Lleida Provincial Council
- Alta Ribagorça
- Esplugues

The most actively participating municipalities were clearly Sant Feliu de Llobregat and Mataró. This was due to the strong involvement of the Sant Feliu de Llobregat City Council and the fact that ABD (Associació Benestar i Desenvolupament) was operating the Home Care Service (SAD) in Mataró, which facilitated user recruitment.

Figure 4. Territory Deployment

Date - Mes	enero	febrero	marzo	abril	mayo	junio	julio	agosto	septiembre	octubre	noviembre	diciembre
Sant Feliu de Llobregat												
Mataró												
Granollers												
Cardedeu												
Vic												
Diputació de Lleida												
Alta Ribagorça												
Esplugues												
Privat (particulars)												
Federació Catalana de Síndrome de Down												
Mollet del Vallès												
Manlleu												
Privat												
AranSalut												
Vallirana												
Associació de Familiars d'Alzheimer de Barcelona												
Cabrera de Mar												
Vall d'Aran												

Source(s): Own elaboration, 2025.

The signing of collaboration agreements and the corresponding incorporation of territories was progressive. The pioneering municipalities were Cardedeu, Granollers, Sant Feliu, Vic, and Mataró.

The last agreement signed was with the Lleida Provincial Council, which entered the project with strong momentum and rapid user incorporation. This was made possible by rural pharmacies through the Official College of Pharmacists of Lleida, particularly in the development of the “Medication Reminders” use case, in synergy with the DOSICAT project. DOSICAT is project managed by the Lleida Provincial Council in partnership with the Official College of Pharmacists of Lleida for preparing medication blister packs by rural pharmacies for elderly people.

Figure 5. Usage Distribution by Territory

Territori	Trucada	Recordatori/Pla de medicació	Videoconferència	Videoconferència entrant	Suport tècnic	Cita prèvia metge de família	Trucada entrant	Trucada a emergències	Trucada als serveis socials	Vull anar	Total
Sant Feliu de Llobregat	224	252	144	123	74	45	26	22	10	2	922
Mataró	207	66	68	60	32	23	27	16	3	3	505
Granollers	279	9	18	20	44	27	18	10	3		428
Cardedeu	135	13	4	6	12	30	5	11	3		219
Diputació de Lleida	50	95	10	6	8	6	2	4	1	6	188
Alta Ribagorça	60	51	16	10	11	1	2	2			153
Esplugues	26	75	5	3	14	9	3	1			136
Vic	62	8	6	4	14	16	11	4			125
Privat (particulars)	38	14	24	21	9	7	7	4			124
Mollet del Vallès	34	6	27	28	11	5	3	4			118
Privat	35	2	33	12	1	1	1	2			87
Federació Catalana de Síndrome de Down	38		15	12	6	1	3	2			77
Manlleu	43	1	2	2	6	1	2				57
Associació de Familiars d'Alzheimer de Barcelona	3	4	5	6	1		3				22
AranSalut	4	2	3	4	1	1					15
Vallirana	4				4			1			9
Cabrera de Mar	2		1				1				4
Vall d'Aran			1		1						2
Total	1.279	627	407	344	257	175	134	84	20	11	3.338

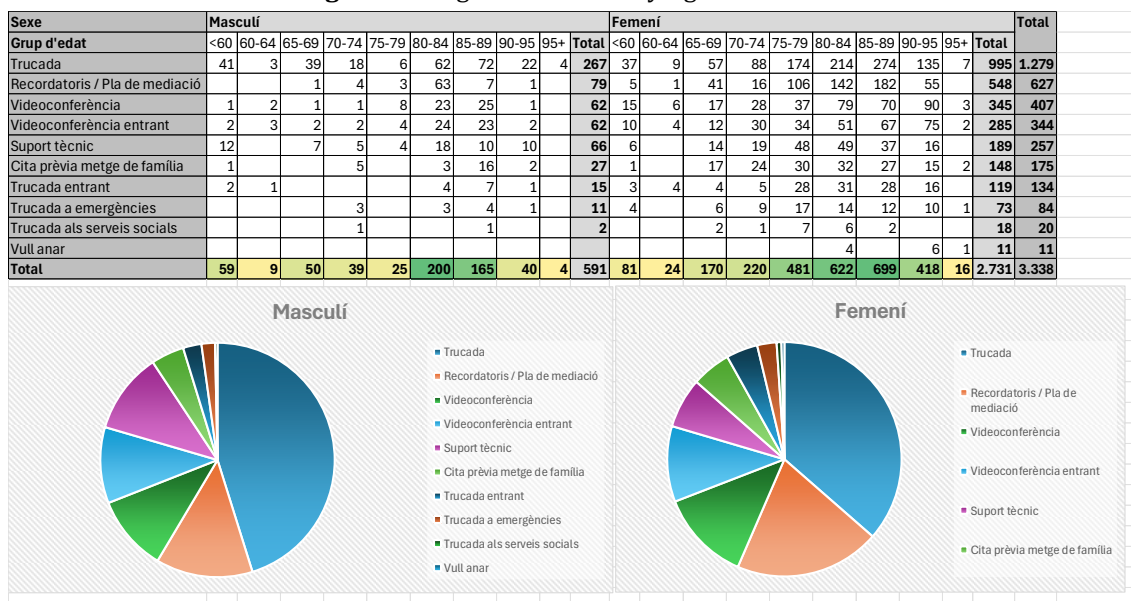
Source(s): Own elaboration, 2025.

The most frequently used cases were:

- Voice calls
- Medication reminders / Medication plan
- Video calls
- Incoming video calls

These reflect the importance of social interaction (addressing unwanted loneliness) and the critical role of reminders for medication and general appointments (e.g., doctor visits).

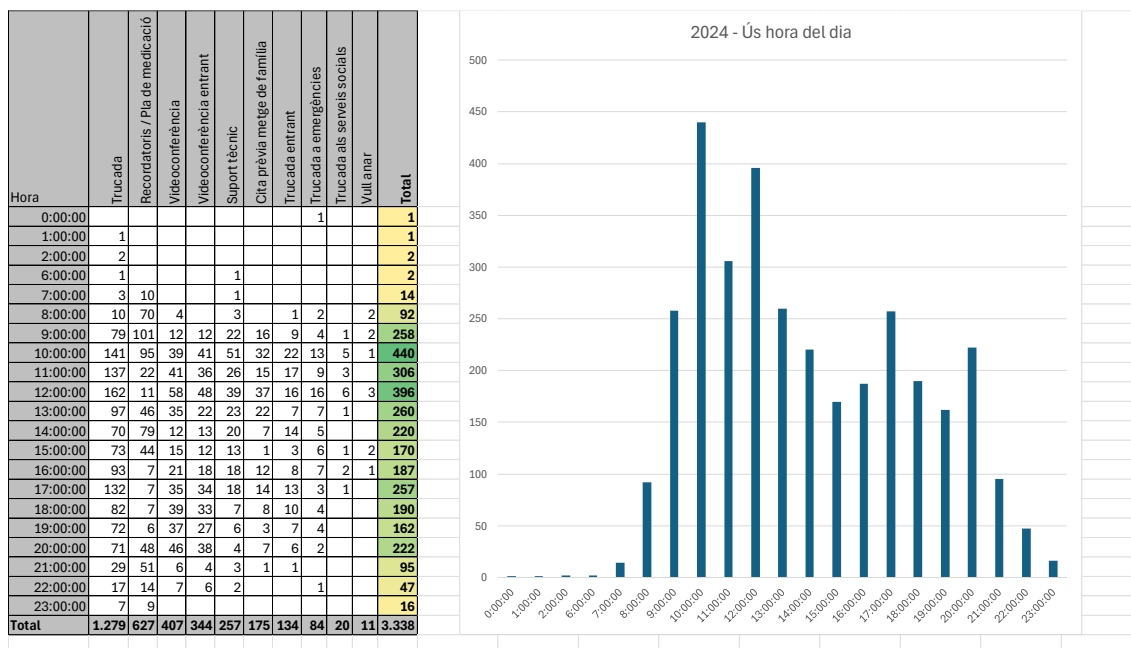
Figure 6. Usage Distribution by Age and Gender



Source(s): Own elaboration, 2025.

There is a clear concentration of users in the 70 to 90 age range.
Use case distribution is similar across genders.

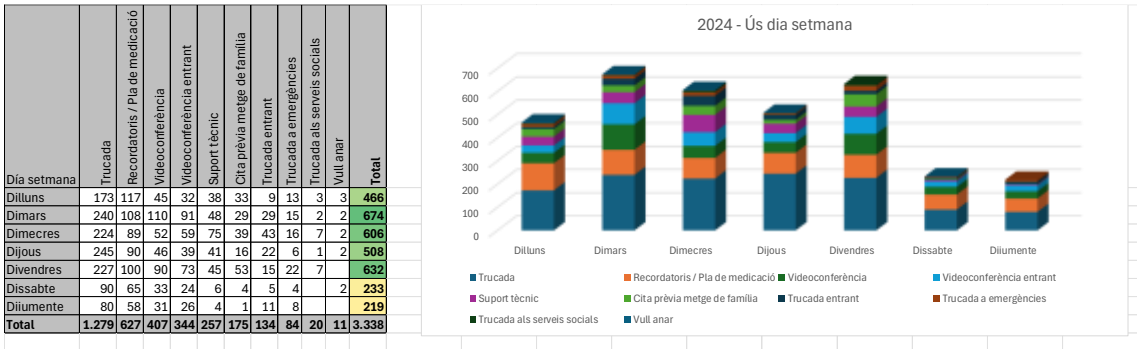
Figure 7. Usage Distribution by Time of Day



Source(s): Own elaboration, 2025.

There is clear daytime activity. Usage begins massively at 9:00 AM and remains steady until 9:00 PM. Peak usage occurs between 10:00 AM and 1:00 PM.

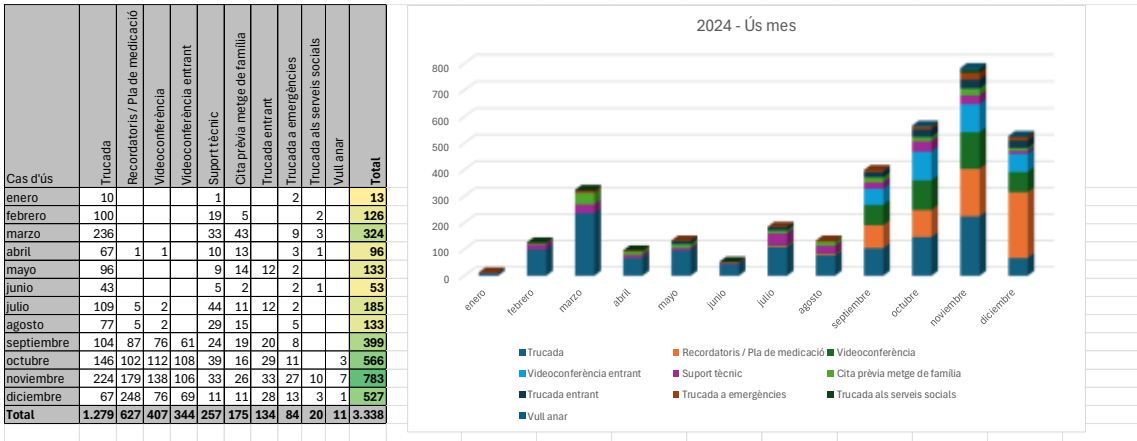
Figure 8. Usage Distribution by Day of the Week



Source(s): Own elaboration, 2025.

Activity is concentrated from Monday to Friday. Medication reminders maintain volume consistently, including weekends.

Figure 9. Usage Distribution by Month



Source(s): Own elaboration, 2025.

The graph shows a clear temporal evolution:

- In the first quarter, the use case “call to a family member/friend” was the initial use case deployed.
- From April to September, platform reworkings were initiated to stabilize the system and progressively develop new use cases.
- This coincided with the gradual incorporation of municipalities and users throughout 2024.

Figure 10. Ticketing System for Incident Tracking

Funcionalidad_10256	Nº incidències		Categoria	Nº incidències
	226		Dispositius	170
Trucada	114		Funcionalitat	161
Videoconferència	39		Reconeixement veu	41
Trucada entrant	24		Activació	34
Recordatoris	21		Altres	20
Pla de medicació	20		BackOffice	20
Cita prèvia metge de família	7		LMS	19
Videoconferència entrant	6		Total	465
Trucada a emergències	4			
Trucada als serveis socials	2			
Salut Temperatura corporal	1			
Vull anar	1			
Total	465			

Source(s): Own elaboration, 2025.

A ticketing system was implemented via a web form, allowing social integrators to log incidents reported by users or detected by the integrators themselves during testing or platform use.

2.9. Functional Assessment Tools

Barthel Index (ADL):

- Autonomous: 68.2%
- Moderate dependence: 22.6%
- Severe dependence: 6.7%
- Total dependence: 2.5%

Lawton IADL Scale:

- Mild dependence: 60.4%
- Moderate dependence: 24.7%
- Severe dependence: 13.8%
- Total dependence: 1.1%

These scales were administered by ABD Asociación Bienestar y Desarrollo team of social integrators and social workers, who also conducted:

- 1,080 in-person visits
- 2,112 phone follow-ups
- 367 internal team coordination sessions
- 59 external partner coordination sessions
- 39 coordination meetings with local social services

2.10 Qualitative Analysis Techniques

User Feedback Collection:

- Focus groups and interviews (2023)
- Onboarding and follow-up by caregivers (2024)
- Satisfaction surveys conducted by the University of Barcelona

Analysis Methods:

- Thematic analysis of user interviews and caregiver notes
- Content analysis of open-ended survey responses

- Grounded theory to identify emerging needs and inform feature development

3. Objectives

This initiative adheres to the inclusivity principles outlined by the European Union, the UN 2030 Agenda, and global human rights standards.

3.1. European Union strategy for EU countries for elderly citizens

The EU warns that online public & private services are a barrier for older people to their fundamental Rights. It can put them at a disadvantage and risks excluding them from our digitalized societies, warns a report from the EU Agency for Fundamental Rights (FRA). EU countries need to ensure access to public services for everyone. Older people should be able to choose how they access public services.

ATENEA allows progress in the digital transformation of social services, combating the inequalities generated by current digital tools for that part of the population with less digital culture or other types of digital gap circumstances.

The EU reports that traditional care options have been focused on residential facilities and this is not sustainable. Home care and community-based care need to be expanded across the EU. ATENEA could be a driver for boosting the EU home care strategy.

Complying with EU guidelines, ATENEA allows people to extend the time of stay at home for longer, with more autonomy, more self-esteem, and a better the quality of life. In other words, ATENEA helps in the de-institutionalization process. It guarantees the right to age in one's own home and stay there for longer.

ATENEA accompanies and facilitates the use of ICT, and also respects the right of the elderly not to want to be digitized. The person can choose when to communicate and when not to communicate with ATENEA, so that it adapts to their routine, their lifestyle and their needs and preferences.

3.2. The Bioethics Commission of the University of Barcelona (CBUB) guaranteed the rights of users.

The CBUB, acting as external ethics committee, gave a favorable opinion on methodological, ethical and legal aspects of the Atenea research project. Atenea takes care of elderly people as they are vulnerable population they are.

3.3. European Social Network (ESN) gave approval to Atenea

The European Social Network (ESN) gave their approval to Atenea and participates in the Atenea's steering committee. ESN was originally established to meet a need for managers of public social services who, whilst facing common challenges, had no European framework to support knowledge exchange to improve the quality and effectiveness of their services.

3.4. Down Syndrome Catalan Foundation & The Alzheimer Catalan Family Association collaborate with Atenea

The third sector entities, Down Syndrome Catalan Foundation and The Alzheimer Catalan Family Association collaborate with Atenea. They are driving a pilot for Down Syndrome users and Alzheimer users, respectively. The objective is to assess the appropriateness of the solution and to identify necessary customizations for each group.

3.5. 2030 Agenda & Human rights

Atenea has been developed in line with Sustainable Development Goals (SDG) 3, 5 and 10, it improves the well-being and quality of life. People feel more fulfilled and empowered by being able to access digital resources autonomously. The project fights against gender, social and

economic inequalities. Also territorial, the rural environment is more affected by the digital divide. Aligned with current human rights, it reinforces compliance with the Convention on the Elimination of Discrimination (especially against women) who can suffer digital exclusion, disconnection from the environment or unwanted isolation and loneliness. These, while also being in line with the International Covenant on Economic, Social and Cultural Rights.

4. Analysis

4.1. Scalability

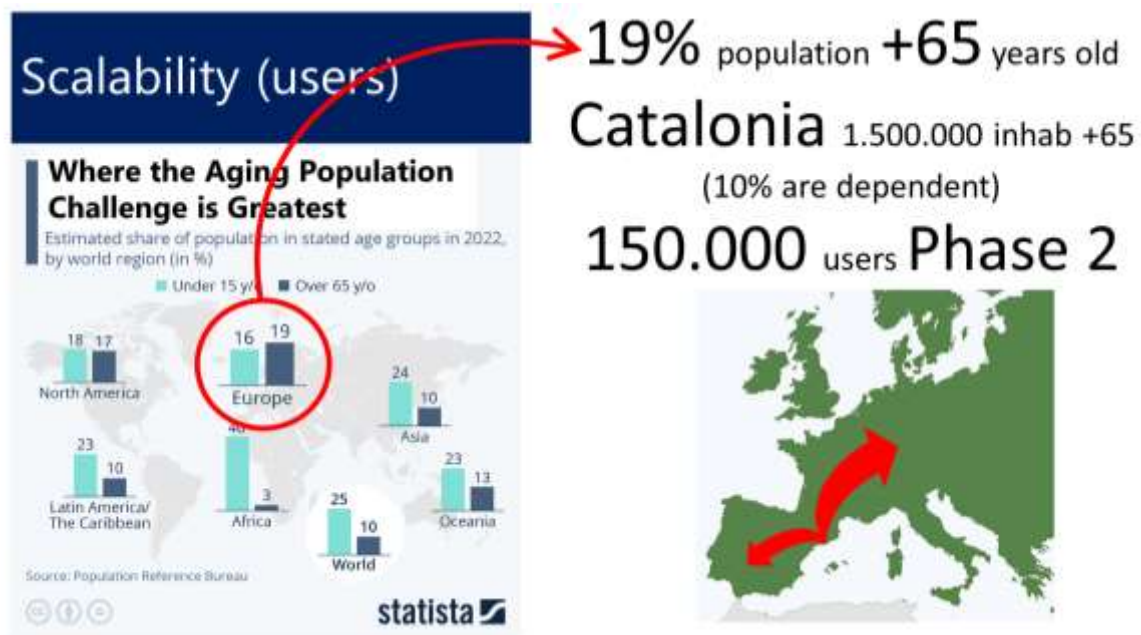
ATENEA is a highly replicable and scalable solution. Atenea pilot project has been successfully replicated to 15 different cities around Catalonia. The objective is to replicate the solution on a mass scale in 2025 and 2026.

Vertically to extend it to the entire target population in Europe

19% of the European population is older than 65. 10% of them are dependent.

2025 & 2026 Phase 2: Deployment: 150.000 dependent people in Catalonia. 1.000.000€/year (plus cost of devices & comms) financed by the Government of Catalonia & cities & private entities (tech, retail, pharma, media).

Figure 11. ATENEA scalability.



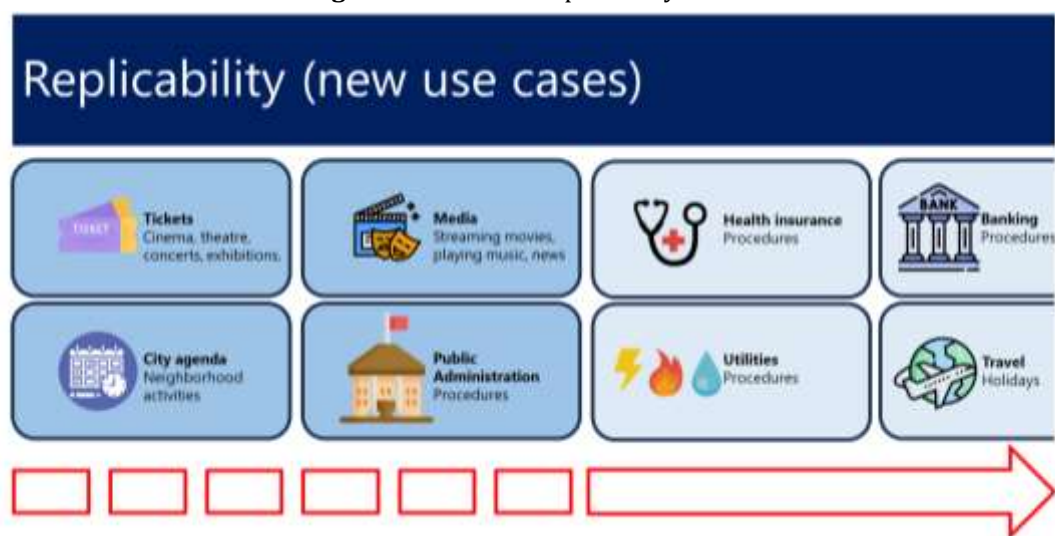
Source(s): Statista - Martin Armstrong, 2022

2025, 2026 and so on, Next phases: Replication to new Spanish territories and replication on an international scale: Business opportunities generated through the collaboration with the European Social Network.

4.2. Replicability

Horizontally, building a robust and flexible system that allows the addition of new and diverse use cases:

Figure 12. ATENEA replicability.



Source(s): Own elaboration, 2025.

5. Results

5.1. Impact. What measurable results can show about the impact of the transformative project?

The Psychology Faculty of the University of Barcelona, in collaboration with ABD Group, measured the impact and benefits (qualitative and quantitative analysis) of the pilot project of Atenea:

Relevant indicator before Atenea: 52% of elderly people feel loneliness

Key indicators after Atenea:

- 95% of elderly people feel more accompanied, Atenea reduces feelings of loneliness.
- 85% of elderly people feel safer, Atenea gives people the autonomy to call relatives or emergency services at any time
- 40% of elderly people are satisfied with the family doctor appointments functionality. This % is lower than others because this procedure is usually carried out by relatives
- 90-95% of elderly people increased their feelings of wellbeing at home
- 98% of elderly people are satisfied with his personal contribution and participation (co-creation, co-design) in a project for a present and a future welfare for elderly people

5.2. Soundness. Social Return of Investment (S-ROI)

For every €1 invested in ATENEA, €4.79 is generated in direct cost savings by the public administration: €3.47 in direct social caregivers, €0.69 in citizen care teleoperators, €0.43 in healthcare teleoperators, €0.20 in social care services teleoperators.

Each of the cities participating in ATENEA contributes approximately 50 elderly people, a total of 500, who live alone or with an elderly partner as users to try out the tool for a year.

The project's target audience is much larger: the increase in life expectancy and the aging of the population has caused a demographic change that accompanies an increase in chronic diseases. According to IDESCAT, in Catalonia 1,492,335 people (19% of the population) are over 65 years of age and of these more than 8% have some degree of dependency (124,698 people). Forecasts indicate that the trend will continue to rise, by 2035 25% of the population will be over 65 years old.

5.3. Sustainability

What elements does the project incorporate to improve environmental sustainability?

Greenhouse effect saving calculation thanks to the Atenea project: Saving of kms on public transport for professional carers at the user's home

- 19% European population >65 years => CAT= 1,500,000 => dependence 10% =150,000 users
- 50 visits a year (one per week)
- 5kms (round trip per visit)
- 50 x 5 = 250kms visits a year professional caregiver to user
- 250kms x 150,000 users = 37,500,000 km
- Urban bus CO2 emissions (*) x 37.5M kms = 2,735.62 tons of CO2 SAVINGS per year
- (*) greenhouse gas calculator from the Catalan Climate Change Office OCCC.

In addition, ATENEA issues reminders that allow you to reduce water consumption; recommendations for the elderly when there are heatwaves and cold spells not to travel (avoid trips to health centers); recommendations on the proper use of electrical appliances (fans, stoves, etc.), how to prevent heat/cold from entering at home or how to avoid pollution.

6. Conclusions

6.1. Report on Value Proposition, Technological Robustness, Replicability, and Scalability of ATENEA

The ATENEA project is part of the Next Generation projects, managed by the Social Rights Ministry of the Government of Catalonia.

Value Proposition: Thirteen use cases* have been developed and are currently operational, allowing various activities, actions, and procedures to be carried out using voice commands only. These are accessible via a tablet or smartwatch, with technical support provided for setup, activation, and operation.

As of today, the system has been deployed to 218 users across 14 municipalities in Catalonia.

From a technological standpoint, the system is robust and secure in the collection and management of personal data.

It is supported by an effective and responsive technical team that ensures training, activation, and routine operation.

The system is replicable and scalable to more users, territories, and functionalities. Agreements have been established with nearly 20 municipalities, third-sector organizations, and others.

The developed system is particularly relevant for mitigating the digital divide, reducing social isolation, and promoting personal autonomy among older adults and individuals in vulnerable situations.

Use Cases:

- Voice-activated emergency call (112)
- Voice-activated call to social services
- Voice-activated call to family/friends
- Voice-activated video call to family/friends
- Voice-activated request for a medical appointment
- Voice reception of calls from social services
- Voice reception of calls from family/friends
- Voice reception of video calls from family/friends
- Voice reminders for medication plan
- Voice planning of a public transport route ("I want to go...")
- Voice reminders
- On-screen carousel of city agenda announcements
- Voice-activated call for grocery shopping

6.2. ATENEA AtDom, the ATENEA's evolution for the primary home healthcare services

ATENEA AtDom is a disruptive innovation in the field of home care, integrating ATENEA's artificial intelligence speech technologies with the health sensors of ATENEA WATCH. It automatically detects incidents through sensors that identify falls, changes in vital signs, unusual behavior patterns, and movements outside safe zones. Additionally, if the person does not respond to scheduled reminders—such as medication intake or routine check-ups—alerts are also triggered.

When an incident is detected, ATENEA initiates a voice conversation with the affected person. It assesses whether the person is conscious, oriented, and responding appropriately. If there is a response, the AI can calm the person, provide useful instructions such as sitting down or waiting for help, and even contact family members or professionals if necessary. If the person does not respond, shows signs of disorientation, or a real emergency is confirmed, ATENEA automatically activates the emergency protocol. It calls 112 and the AI speaks directly with the emergency operator, providing key data such as the person's name and ID number, a detailed description of the incident, their current condition (e.g., unconsciousness or altered vital signs), and location (address). With this information, it requests the urgent dispatch of an ambulance.

ATENEA WATCH acts as a direct interface between the user and ATENEA's cloud-based artificial intelligence. Sensor data—such as falls, changes in vital signs, unusual activity patterns, and movements outside “safe” zones—are automatically sent to the cloud, which serves as the processing center. It enables voice interaction between the user and ATENEA's AI. It includes a SIM communication card to establish automatic connection with the cloud.

The generative artificial intelligence in the cloud enables open, natural, and personalized conversations. Thanks to state-of-the-art language models (LLMs), combined with retrieval-augmented generation (RAG) techniques, ATENEA can interpret multiple intentions in a single interaction, remember the context of previous conversations, and offer relevant, clear, and emotionally appropriate responses. This ability to maintain fluid and meaningful dialogue is key to building trust and companionship for people who often live alone or experience emotional fragility. ATENEA is much more than a voice assistant—it is an intelligent companion, capable of understanding, responding, and caring.

The ATENEA AtDom professional dashboard provides healthcare and social care teams with a clear, comprehensive, and real-time view of the health status of monitored individuals. It displays health data collected by ATENEA WATCH devices in a visual and accessible format, allowing for individualized and continuous monitoring. It also offers historical analysis and trends that contextualize the information. One of its most innovative features is the detection of decompensation patterns through ATENEA's backoffice AI in the cloud.

The family app keeps caregivers connected, informed, and reassured. It allows direct communication with the user via video calls and sends immediate notifications in case of emergencies or relevant events. This constant connection strengthens emotional bonds and enables quick action if something unexpected occurs. It also offers a health monitoring panel showing vital signs, alerts for falls or inactivity, and overall wellness trends. It enhances safety through real-time location tracking and alerts if the person leaves safe zones or shows signs of disorientation. It allows medication reminders to be configured and confirms intake, improving treatment adherence and reducing risks.

The ATENEA AtDom backoffice, hosted in the cloud, is the operational core of the system and orchestrates all functional flows. This centralized platform efficiently and securely manages the various elements of the ATENEA ecosystem: users, devices, reminders, events, communications, and sensors. Its modular and scalable architecture is designed to ensure interoperability with multiple services and devices, and to adapt to the evolving needs of the social and healthcare environment.

6.3 Disruptive Innovation Project

ATENEA is a disruptive project aimed at improving home healthcare, especially for patients with chronic conditions, older adults, or individuals with reduced mobility. It combines accessible technology with occasional in-person visits, prioritizing patient autonomy and professional efficiency. The system includes a button-free tablet with AI and voice interaction to remind users about medication, conduct medical video calls, or contact emergency services. The smart watch monitors vital signs, temperature, falls, or disorientation. Healthcare professionals only visit when necessary. Bluetooth-enabled devices such as blood pressure monitors or glucometers can be connected, and predictive algorithms can be applied. Automated selection prioritizes patients based on risk. With low cost and high scalability, it improves access in rural areas. It breaks away from the traditional reactive model, empowers users, reduces costs, and offers more continuous and personalized care.

6.4 Deep Disruption Compared to the Traditional Home Care Model of the Family Doctor

ATENEA AtDom represents a profound disruption of the traditional home care model provided by family doctors, transforming both the logic of intervention and the communication channels between the healthcare system and citizens. The following are the key elements that make ATENEA a disruptive solution:

From occasional care to continuous monitoring: The traditional model relies on scheduled or reactive visits, with limited frequency and dependent on professional availability. In contrast, ATENEA enables a constant presence in the home through voice-based AI and health sensors that monitor the person's condition in real time and trigger alerts at any sign of deterioration.

From exclusive human intervention to hybrid intelligence: While the classic model depends solely on the clinician's judgment during visits, ATENEA introduces hybrid intelligence: it combines conversational AI, predictive algorithms, and coordinated human intervention. This allows for early detection and action before a situation requires in-person care or hospitalization.

From healthcare to integrated social and healthcare support: The family doctor model focuses on clinical aspects. ATENEA broadens the scope by integrating social, emotional, and functional dimensions. The solution connects healthcare professionals, social workers, family members, and care technicians, creating a coordinated care ecosystem that better addresses the real needs of individuals at home.

From professional dependency to patient empowerment: In the traditional model, the user is a passive recipient of care. ATENEA promotes digital and functional empowerment of older adults, enabling them to interact with technology via voice, request help, manage their medication, or schedule medical appointments independently. This reduces dependency and enhances autonomy.

From reactive intervention to personalized prevention: The family doctor intervenes when there is a request or visible symptom. ATENEA, on the other hand, enables active and personalized prevention through data analytics and risk pattern detection. This allows action before the situation worsens, reducing hospitalizations and unnecessary visits.

From a static model to a scalable and evolving solution:

The traditional model is difficult to scale without proportionally increasing human resources. ATENEA is a scalable technological solution that can adapt to different regions, user profiles, and levels of complexity without compromising care quality. Its architecture also supports continuous innovation based on real-world data.

In summary, ATENEA does not replace the care givers or family doctors—it complements, enhances, and frees them from repetitive tasks, allowing them to focus on cases that truly require direct intervention. It represents an evolution of the home care model toward a more proactive, connected, human, and sustainable system.

6.5 Why Is It Disruptive Compared to Health Wearables Like Smartwatches with Health Sensors?

Although wearables such as smartwatches with health sensors and features like fall detection or geofencing already exist, the smart device proposed here is disruptive because it goes far beyond these conventional devices. Below are the key aspects of its disruptive innovation compared to standard wearables:

Integration of AI with Proactive and Contextual Action

Current wearables collect data (heart rate, steps, falls...) and notify users when anomalies are detected, but:

They do not act autonomously based on context.

They do not interpret the person's overall behavior or routines.

The smart device with AI learns habits, interprets subtle changes, and acts accordingly (e.g., initiates a video call with a healthcare professional if signs of deterioration or disconnection are detected).

Disruption: Shifts from passive monitoring to intelligent and personalized assistance.

Natural, Frictionless Voice Interface

Smartwatches require: Ability to read small screens, press buttons, or use touchscreens.

ATENEA AtDom requires: 100% voice interaction, accessible to people with cognitive, visual, or motor impairments. Users don't need to "know how to use technology" because conversation is the interaction channel.

Disruption: Completely removes the digital barrier, especially for dependent or elderly populations.

Automated Video Calls and Integrated Remote Assistance

Wearables do not support automated video calls or fluid conversations with healthcare professionals.

ATENEA AtDom: Schedules regular calls with doctors or nurses, automatically activates them when a risk is detected, and provides ongoing remote care—not just emergency response.

Disruption: Turns the home into an active node within the healthcare ecosystem.

Home Integration with Environmental Sensors

Smartwatches do not monitor the physical environment (home temperature, ambient activity...).

ATENEA AtDom includes: Environmental temperature sensors, prolonged inactivity detection, presence monitoring. It can detect anomalies such as a home being too cold, excessively hot, or lacking movement.

Disruption: Health is not only physical—it's also environmental.

Multi-Device and Cooperative System (Watch + Voice)

The watch sends data to the home device, which acts as the coordinating brain—not just a passive receiver.

ATENEA AtDom combines the best of smartwatches (data) with a central AI that uses voice and takes action.

Disruption: From isolated devices to a coordinated, empathetic, and proactive ecosystem.

Summary of ATENEA AtDom's Disruptive Features Compared to Health Wearables

- 100% voice interface
- Proactive AI-driven action
- Automated video calls with healthcare professionals
- Coordination with environmental sensors
- Routine learning and behavioral change detection
- Designed for elderly or dependent users

6.6. Quotes by City Mayors

Inspirational quotes made by City Mayors about the appropriateness of Atenea with the municipal plan:

David Bote, Mataró City Mayor: "As 'Mataró caring city' we have made the commitment to promote a caring city that is a reference in the care of people in vulnerable situations, guaranteeing a good quality of life for those people who are at an advanced stage or end-of-life process".

Jordi Ballart, Terrassa City Mayor: "At the moment we are working on a 'Local plan for the comprehensive aging of the Terrassa population 2030' within the global European agenda for 2030. Getting older, aging, is part of the process of life. In Terrassa we are clear that we must be able to do this with dignity and autonomy, and in coexistence spaces where everyone has a place, whatever his condition or stage of life".

Marta Farrés, Sabadell City Mayor: "Sabadell is a 'Friendly city for elderly people'. Being an elderly-friendly place requires the commitment to make it so respecting the needs and abilities of the city's elderly and working to promote of active aging".

Mireia Dionisio, Mollet del Vallès City Mayor: "One of my main objectives as Major of Mollet del Vallès is to design a more convenient and friendly city for elderly people balancing industrial urbanization and green areas to promote a healthy lifestyle".

Lourdes Borrell, Sant Feliu de Llobregat City Mayor: "One of the main challenges for Sant Feliu de Llobregat is taking care of elderly people. Not only meeting their basic health and medical needs, but also, as a City Major I am also concerned about their social connections and loneliness".

Pilar Díaz, Esplugues de Llobregat City Mayor: "Within the 'Smart City Plan' for Esplugues de Llobregat we have the goal to improve the well-being of citizens including medical care, well-being, physical safety and education with special attention to elderly people, as a sensitive part of our community".

Alba Barnusell, Granollers City Mayor: "The 'Active Space for the Elderly' is a facility of the Granollers Town Hall facility, where different activities for the elderly focus on reducing the digital divide with training and advise on using digital platforms".

Josep Quesada, Cardedeu City Mayor: "Elderly people have to become a social asset of great importance, and that is why it is necessary to promote social participation. To achieve this, it is necessary not only to define proactive policies that to ensure well-being in physical, social and mental well-being throughout life, with the aim of promoting healthy living through comprehensively care".

Albert Castells, Vic City Mayor: "'Digital Assistant +65': The digital divide is a strong barrier for elderly people in a digital world. We have made the commitment to support our elderly and make them more comfortable and take an active part in our community"

Àlex Garrido, Manlleu City Mayor: "The Manlleu 2030 Agenda is a collection of proposed actions where the Manlleu City Council are committed orienting the municipality to the challenges set by the United Nations Sustainable Development Goals (SDGs). Within this agenda, we are concerned about specific areas for elderly people with an inclusive perspective to support their specific needs for elderly"

Eva Martínez, Vallirana City Mayor: "The Social Services Department of Vallirana City Council works for people and with people. Especially, with those who are in a situation of social risk. The elderly are a key issue for Social Services with specific support given for medical and social requirements".

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