EUcare4.0 Erasmus+: Health 4.0 training to boost digital transformation of EU healthcare

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Abstract. The EUcare4.0 project addresses a critical gap in European vocational and healthcare education: the absence of structured training on Health 4.0 technologies for mental health professionals. Funded under Erasmus+ (2021–2023), the consortium developed three Open Educational Resources (OERs): (1) an introductory publication on Health 4.0; (2) ten modular training components on eHealth, AI, IoT, big data, and immersive technologies; and (3) an intuitive, multilingual online learning space with case studies, self-assessment tools, and certification. Implemented across six European partners and supported by over 30 associate organisations, the project engaged more than 260 participants in multiplier events, attracted over 20,000 unique website visitors, and achieved a satisfaction rate exceeding 98%. All resources are freely available at https://eucare40.eu under a Creative Commons licence. EUcare4.0 thus offers a replicable, human-centred model for inclusive digital transformation in European mental healthcare.

1 Introduction

Mental health disorders represent one of the most pressing public health challenges of the 21st century. According to the World Health Organization, nearly one in four people in the European Union will experience a mental health condition at some point in their lifetime, with depression and anxiety disorders alone affecting over 84 million Europeans [1, 2]. Beyond their profound personal toll, these conditions generate significant societal costs estimated at €600 billion annually in the EU through lost productivity, healthcare expenditures, and social welfare support [2].

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The clinical landscape of mental health in Europe is shaped by the high and rising prevalence of several major conditions collectively affecting nearly one in four people at some point in their lifetime [1, 3, 4]. Among these, depressive disorders represent one of the heaviest burdens: they affect more than 40 million Europeans and rank among the leading causes of disability worldwide [3]. Added to this are anxiety disorders including generalized anxiety, social phobia, and panic disorder which have a 12-month prevalence exceeding 14 % in the general population [3]. Autism Spectrum Disorder (ASD) affects approximately 1 % of individuals and often requires personalized, lifelong support [1]. Meanwhile, Post-Traumatic Stress Disorder (PTSD) is gaining greater clinical recognition, particularly among refugees, first responders, and survivors of violence groups especially vulnerable to enduring psychological consequences [1]. Finally, bipolar disorder, which impacts 1–2 % of adults, stands out for its high rates of psychiatric comorbidity and elevated suicide risk, underscoring the urgent need for early and integrated interventions [3, 5].

These figures reflect not only a substantial clinical burden but also an estimated socioeconomic cost of roughly €600 billion per year across the European Union encompassing lost productivity, healthcare expenditures, and social welfare support [3]. Despite this scale, mental healthcare systems remain fragmented, under-resourced, and predominantly reactive rather than preventive a gap dramatically worsened by the COVID-19 pandemic, which triggered a global 40 % surge in anxiety and depression cases [1]. It is precisely within this context of systemic crisis that Health 4.0 technologies offer a strategic opportunity to reimagine access, personalization, and continuity of care in mental health.

Despite this overwhelming burden, mental healthcare systems across Europe remain critically under-resourced, fragmented, and reactive rather than preventive. Access is often delayed due to shortages of specialists, stigma, and geographical disparities particularly in rural and underserved regions. The COVID-19 pandemic has further exacerbated these gaps, triggering a 40% surge in anxiety and depression rates globally [1] while simultaneously accelerating digital adoption in health.

It is precisely within this crisis of scale and access that the current era—Health 4.0 emerges as a strategic opportunity. Far beyond isolated apps or teleconsultations, Health 4.0 represents a paradigm shift toward *connected, predictive, and personalized mental healthcare*, enabled by converging technologies: the Internet of Medical Things (IoMT), artificial intelligence, big data analytics, and immersive realities [6–12]. Smartwatches now monitor heart rate variability a known biomarker of stress; passive sensing on smartphones can detect early signs of relapse in bipolar disorder through changes in voice, mobility, or sleep; and virtual reality environments offer safe, scalable exposure therapy for PTSD or social skills training for autism.

Yet, the successful integration of these innovations hinges on a critical, often overlooked factor: the digital competence of professionals. Without targeted, accessible, and clinically grounded training, even the most advanced tools remain underused or misapplied. European vocational and healthcare education curricula have largely failed to equip psychologists, psychiatric nurses, VET trainers, and social workers with the skills needed to ethically, effectively, and critically deploy these technologies [13].

It is within this gap that the EUcare4.0 project was conceived. Coordinated by ECAM-EPMI and implemented with partners from Spain, Romania, and Estonia, EUcare4.0 was designed not only to train professionals in using connected devices and data driven platforms but also to foster a deeper understanding of their clinical relevance, ethical implications, and human-centred design. The ambition extends beyond technical literacy: it aims to empower mental health specialists as ambassadors of a new digital ethos one in which technology serves not as a replacement for human connection, but as a bridge to more timely, personalised, and resilient care.

In doing so, EUcare4.0 sits at the intersection of two key European priorities: adapting vocational education to the evolving demands of the labour market, and driving the inclusive, ethical digital transformation of public health services [4].

The digital transformation of healthcare commonly framed as *Health 4.0* is the latest evolution in a century long journey that began with the integration of electronics into clinical practice and has culminated in today's era of intelligent, interconnected, and patient centred care. This trajectory can be traced through distinct technological waves, each reshaping how health professionals observe, diagnose, treat, and support their patients.

The first wave, emerging in the mid 20th century, introduced analog and then digital electronics into hospitals: electrocardiographs, EEG machines, and early monitoring devices allowed clinicians to record physiological signals with unprecedented precision. By the 1970s and 1980s, this gave way to the second wave: the computerisation of administrative and clinical records. Electronic Health Records (EHRs) began to replace paper files, enabling data storage, retrieval, and, eventually, cross institutional sharing though primarily for billing and logistics rather than clinical insight.

The third wave arrived with the rise of *clinical decision support systems* (CDSS) in the 1980s and 1990s. Often built as rule based expert systems programs that encoded medical knowledge into "if–then" logic these tools aimed to assist diagnosis in relatively structured fields like infectious disease or laboratory medicine. While promising, their rigidity, inability to handle uncertainty, and limited integration into clinical workflows constrained their adoption. Crucially, they struggled to address conditions shaped by context, emotion, and subjectivity hallmarks of mental illness [13]. As a result, mental healthcare remained largely analog, relying on face to face interviews, paper based symptom scales, and clinician intuition [14].

The fourth and most transformative wave began in the early 2000s with the convergence of mobile computing, cloud infrastructure, and data science. Smartphones and tablets enabled a new generation of mental health applications: mood trackers, cognitive behavioral therapy (CBT) platforms, mindfulness coaches, and telepsychiatry services. Yet these tools often operated in isolation, offering fragmented support rather than integrated clinical pathways [2].

It is within this context that the current era—Health 4.0 emerges, defined not by isolated apps but by ecosystems of connected intelligence. At its core lies the Internet of Medical Things (IoMT) [15]: a network of wearable and embedded sensors that continuously capture physiological, behavioural, and environmental data. Smartwatches now monitor heart rate variability a known biomarker of anxiety and stress. Sleep tracking devices quantify the architecture of rest, revealing disruptions linked to depression. Voice analysis algorithms detect subtle changes in speech patterns that may signal early relapse in bipolar disorder. Even everyday objects smart mirrors, connected beds, GPS enabled phones become silent witnesses to a patient's daily life, generating passive, real world data streams far richer than episodic clinical interviews.

These connected objects do not merely collect data; they enable a paradigm shift from reactive to predictive and preventive mental healthcare. When fused with big data analytics and artificial intelligence, sensor streams can identify early warning signs of crisis, personalise therapeutic interventions, and even trigger just in time support such as a mindfulness prompt sent when stress biomarkers spike. Virtual and augmented reality further extend this ecosystem, offering immersive exposure therapy for PTSD, social skills training for autism, or calming environments for anxiety reduction.

The European Commission, in its Communication COM(2018) 233, and the European Parliament have both underscored the urgency of integrating such innovations into health systems, especially in the wake of the COVID 19 pandemic, which dramatically exacerbated mental health needs while simultaneously accelerating digital adoption [3, 4]. Yet, despite the maturity of these technologies, European initial training programmes whether for healthcare

professionals or vocational education and training (VET) instructors rarely equip future practitioners with the digital competencies required to ethically, effectively, and critically deploy Health 4.0 tools [2].

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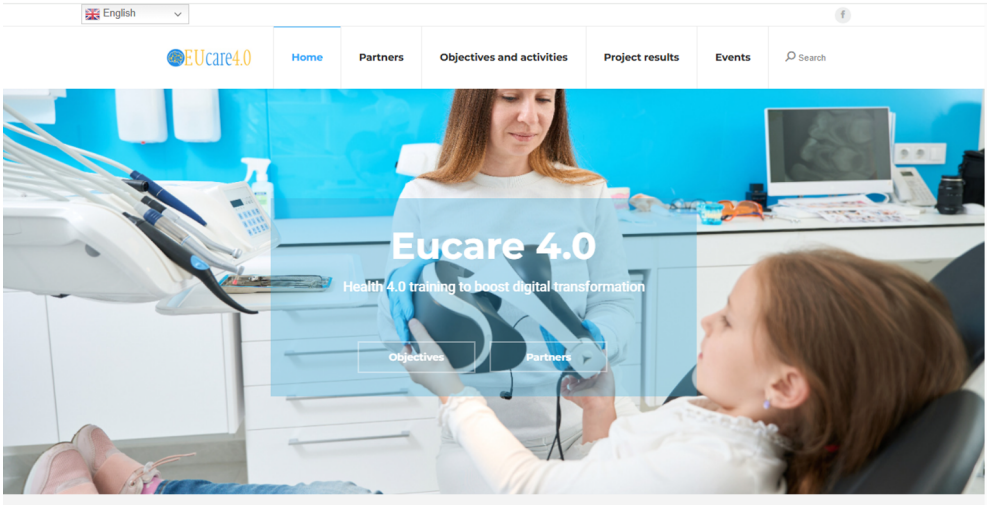


Figure 1: Official EUCARE4.0 project website: https://eucare40.eu.

2 Methodology

The EUcare4.0 project was designed and implemented following the rigorous Project Cycle Management (PCM) approach, structured into four interdependent phases.

The planning phase (November 2021–March 2022) began by identifying key needs within the mental healthcare sector and conducting a state of the art review of digital health technologies. It also precisely defined the target groups: vocational education and training (VET) trainers in mental health, psychiatrists, psychologists, psychiatric nurses, social workers, as well as policymakers and education leaders. During this phase, roles among the six core partners were formalised, and a network of over 30 associate partners—including hospitals, health schools, professional regulatory bodies, and digital innovation clusters was mobilised to ensure relevance, outreach, and long term sustainability.

The development phase (April–September 2022) focused on the collaborative design of the project's three intellectual outputs: (1) an introductory publication on Health 4.0; (2) a set of modular training components; and (3) the architecture of an online learning space.

Each partner contributed its unique expertise: Universidad Carlos III de Madrid (UC3M) on digital pedagogy, SESCAM on clinical requirements, OAMGMAMR on engagement with healthcare professionals, Ludor Engineering and EFCC on e-learning platform engineering, and ECAM-EPMI on integrating Industry 4.0 competencies into health contexts. The training architecture of EUcare4.0 follows a three-tiered cascading model: (i) a foundational publication (*R1: Introducing Health 4.0 to mental health specialists*); (ii) ten modular components (*R2*) covering eHealth, AI, IoT, big data, and immersive technologies; and (iii) an intuitive, multilingual e-learning space (*R3*) integrating videos, case studies, self-assessments, and automated certification.

The pedagogical videos in EUcare4.0 were developed through a collaborative, human-centred design process that prioritised clinical relevance, accessibility, and cross-border consistency. Each video typically 3 to 5 minutes long was co-created by technical experts (engineers, data scientists) and mental health professionals (psychologists, psychiatric nurses, VET trainers) to ensure complex topics like artificial intelligence or the Internet of Medical Things were translated into clear, relatable language grounded in real-world practice. Every script followed a consistent three-part structure: (1) a motivating clinical scenario (e.g., "How can we detect early signs of bipolar relapse?"), (2) a step-by-step visual explanation of the technology often using simple animations or screen recordings and (3) a concrete application example drawn from actual care settings, such as using the NAO robot to support children with autism.

Videos were produced locally by each partner organisation and then harmonised in terms of pacing, visual style, and audio quality to ensure a seamless learning experience across modules. While all videos were recorded in English the consortium's working language they are accompanied by subtitles or full transcripts in the project's five languages (English, French, Spanish, Romanian, and Estonian), significantly lowering language barriers for non-native speakers. This careful blend of co-creation, narrative clarity, and multilingual support has resulted in resources that are not only technically accurate but also immediately useful and engaging for frontline mental health practitioners.

The EUCARE4.0 digital ecosystem is hosted on a dedicated, open-access platform (https://eucare40.eu) (figure 1), maintained and hosted by ECAM-EPMI (France). The website is designed to ensure intuitive navigation, multilingual accessibility, and pedagogical coherence. It follows a clear three-tier architecture that mirrors the project's intellectual outputs: (1) a Resources section hosting the foundational publication "Introducing Health 4.0 to Mental Health Specialists"; (2) a Training Modules area offering ten self-contained, interactive modules on eHealth, AI, IoT, Big Data, and immersive technologies each available in five languages (English, French, Spanish, Romanian, Estonian); and (3) a Learning Space providing direct access to the e-learning platform, where users can register, track progress, complete quizzes, and obtain certification. The interface is clean, responsive, and optimized for both desktop and mobile use, with a persistent top menu and language selector. All materials are distributed under a Creative Commons Attribution-ShareAlike 4.0 International License (CC BY-SA 4.0), enabling reuse, adaptation, and redistribution thus fully embodying the open educational ethos of the Erasmus+ programme.

Each module adheres to a standardized pedagogical template: an introductory motivation, core concepts (delivered via 3–5-minute instructional videos), formative quizzes, discussion prompts, and a summative exam. This ensures both consistency and adaptability across diverse user profiles from VET trainers to clinical psychologists.

(a)

(b)

Figure 2: (a) Official kick-off meeting of the Erasmus+ EUcare4.0 project (Paris, 16 December 2022). (b) Project monitoring and coordination meeting (Iași, Romania, 8 April 2023).

Beyond shared digital tools, regular video meetings (figure 2) have been the backbone of our collaborative rhythm. From the outset, the consortium established a structured yet flexible schedule of virtual gatherings ranging from monthly full-partner coordination calls to focused working sessions among thematic subgroups (e.g., content developers, platform engineers, or evaluation teams). These Visio meetings (figure 3), hosted primarily via secure institutional platforms, were not mere status updates; they served as dynamic spaces for co-design, problem-solving, and mutual alignment. Whether refining a clinical scenario for a training module, troubleshooting interoperability issues on the e-learning platform, or harmonising video production guidelines across five countries, these conversations ensured that technical decisions remained grounded in clinical reality and vice versa. Crucially, meeting agendas were always shared in advance, minutes documented key decisions and action items, and follow-up was systematically tracked through our shared Trello boards. This consistent, human-centred communication culture has been instrumental in maintaining trust, transparency, and momentum across borders, time zones, and professional cultures throughout the project lifecycle.

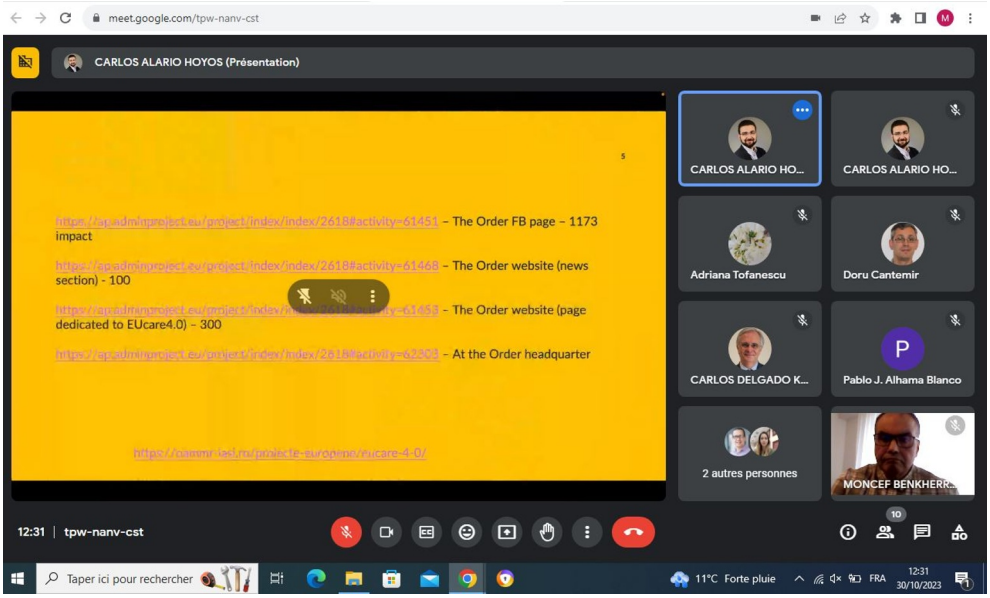


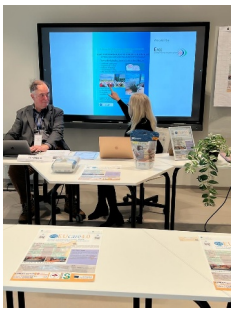
Figure 3: Example of an online coordination meeting within the EUcare4.0 project. These regular video calls enabled partners from six countries to co-design training content, address technical challenges in real time, and maintain strong transnational cohesion throughout the project lifecycle.

The implementation and testing phase (October 2022–June 2023) involved the technical development of all content, translation into five languages (English, French, Spanish, Romanian, Estonian), and pilot testing with more than 180 external users including students, educators, and clinicians to gather feedback and refine the materials.

Finally, the exploitation and dissemination phase (July–October 2023) deployed a multichannel strategy: the project website (https://eucare40.eu), social media channels (Facebook, Twitter, YouTube), four multiplier events (figure 4) in Spain, Estonia, Romania, and France, biannual newsletters, multilingual brochures, and active participation in European platforms such as EPALE.

Project coordination was managed through the AdminProject digital workspace, complemented by eight transnational meetings (four face to face, four online) and a Steering Committee responsible for quality assurance, financial oversight, and pedagogical alignment throughout the project lifecycle.

(a) (b)



(c) (d)

Figure 4: Multiplier events were held in four European cities as part of the EUcare4.0 project: Paris, France – 5 October 2023, hosted by ECAM-EPMI at the École Pratique de Service Social (EPSS), presented by Dr. Moncef Benkherrat; Valladolid, Spain – 13 July 2023, organized by Universidad Carlos III de Madrid (UC3M), presented by Carlos Alario-Hoyos and Carlos Delgado Kloos; Iași, Romania – 18 September 2023, coordinated by Ludor Engineering, presented by Doru Cantemir; Viimsi, Estonia – 27 October 2023, hosted at Viimsi Artium by the Estonian Fieldbus Competency Centre (EFCC).

3 Modules

The outcomes of the EUcare4.0 project are both quantitatively substantial and qualitatively transformative. On a tangible level, three Open Educational Resources (OERs) were developed:

R1 – *'Introduction to Health 4.0 for Mental Health Specialists'*: a 60 page publication, complete with an ISBN, offering a clear, accessible, and contextually grounded overview of Health 4.0 technologies. It is freely available in five languages (English, French, Spanish, Romanian, Estonian).

R2 – *'EUcare4.0 Modular Training Components'*: eight self contained training modules covering eHealth, mHealth, telemental health, the Internet of Things (IoT), big data, artificial intelligence (AI), and virtual and augmented reality. Each module integrates textual content, instructional videos (in English), real world case studies, and interactive learning activities (figure 5).

R3 – *'EUcare4.0 Online Learning Space'*: an intuitive e-learning platform that brings together R1 and R2, complemented by authentic case studies, trainer guidelines, self-assessment quizzes, and an automated certification system. The platform is fully multilingual and openly accessible at https://eucare40.eu.

The project delivers ten specialized modules, strategically mapped to Health 4.0 technologies:

- **M1**: Introduction to Industry 4.0 (EFCC)
- **M2**: Introduction to Health 4.0 (Ludor)
- **M3**: Application of Health 4.0 to the mental health sector (ECAM-EPMI)
- **M4**: Introduction to mHealth and eHealth (OAMGMAMR)
- **M5**: Mental Health Apps (Ludor)
- **M6**: Telepsychiatry (ECAM-EPMI)
- **M7**: IoT for Mental Healthcare (UC3M)
- **M8**: Big Data for Mental Healthcare (UC3M)
- **M9**: Artificial Intelligence for Mental Healthcare (EFCC)
- **M10**: Mixed Reality (AR/VR) for Mental Healthcare (SESCAM)

The ten training modules form the pedagogical heart of the EUcare4.0 project. Designed as self-contained, modular units, they empower mental health professionals, VET trainers, and other practitioners to select the content most relevant to their daily work without being locked into a rigid, linear curriculum. Each module blends clear explanations, real-world examples, and interactive activities: whether exploring the foundations of Health 4.0, discovering how artificial intelligence can support clinical decision-making, or understanding how virtual reality is used in PTSD therapy. Grounded in authentic clinical scenarios such as using the NAO robot to support children with autism or passively monitoring early signs of bipolar relapse through smartphone data these modules make emerging technologies not only understandable but immediately applicable. Developed collaboratively by universities, hospitals, training centres, and tech companies, they reflect a shared vision: a digital transformation that is human-centred, ethically grounded, and seamlessly integrated into everyday mental healthcare.

- **M1 – Introduction to Industry 4.0** (EFCC): This module lays the groundwork by showing how the Fourth Industrial Revolution with its smart sensors, connected production lines, and autonomous systems—has paved the way for a similar shift in healthcare. It explains why skills and mindsets from industry can inspire more integrated, proactive approaches in mental health practice.
- **M2 – Introduction to Health 4.0** (Ludor Engineering): Here, learners discover what Health 4.0 really means: far more than a collection of apps, it's an interconnected ecosystem where data, devices, and clinical decisions work together in real time to deliver care that is personalised, preventive, and truly patient-centred.
- **M3 – Application of Health 4.0 to the Mental Health Sector** (ECAM-EPMI): This module translates Health 4.0 concepts into tangible mental health practices. It features real examples such as using social robots like NAO to support autistic children or analysing event-related potentials (ERPs) to assess cognitive function—all presented with a strong emphasis on ethics and accessibility.

- **M4 – Introduction to mHealth and eHealth** (OAMGMAMR): A practical overview of digital tools already part of patients' everyday lives: mobile apps, remote monitoring platforms, and secure messaging systems. The module helps professionals distinguish trustworthy solutions from gimmicks and integrate them thoughtfully alongside face-to-face care.
- **M5 – Mental Health Apps** (Ludor Engineering): Not all mental health apps are created equal. This module guides users through a critical evaluation of these tools looking at scientific validity, privacy safeguards, user experience, and suitability for specific needs like anxiety, depression, or sleep disorders.
- **M6 – Telepsychiatry** (ECAM-EPMI): Tele-mental health is more than just a video call. This module covers best practices for remote clinical work, managing the therapeutic frame in virtual settings, navigating technical and ethical boundaries, and expanding access for people in rural or underserved areas.
- **M7 – IoT for Mental Healthcare** (UC3M): Everyday objects smartwatches, phones, sleep trackers—become quiet allies through the Internet of Medical Things (IoMT). This module shows how passive data like heart rate, voice patterns, or mobility can reveal early signs of distress or relapse, long before a crisis occurs.
- **M8 – Big Data for Mental Healthcare** (UC3M): When millions of data points are analysed together, hidden patterns emerge. This module demystifies "big data" by showing how it can improve research, inform public policy, and personalise care pathways while rigorously protecting patient confidentiality.
- **M9 – Artificial Intelligence for Mental Healthcare** (EFCC): AI doesn't replace clinicians it extends their insight. This module presents real-world cases: algorithms that detect subtle changes in speech or writing, systems that suggest timely interventions, and tools that reduce administrative burdens so professionals can focus on what matters most: their patients.
- **M10 – Mixed Reality (AR/VR) for Mental Healthcare** (SESCAM): Virtual reality creates safe, controlled spaces for healing. This module illustrates its clinical use: gradual exposure therapy for PTSD, social skills training for autistic individuals, or calming immersive environments for anxiety always grounded in evidence-based protocols.

4 Multiplier Events and Results

A core component of the EUcare4.0 project was the organization of Multiplier Events (figure 4) targeted workshops designed to disseminate the Open Educational Resources (OERs), gather feedback from end-users, and foster dialogue between vocational education, mental healthcare, and digital innovation stakeholders. In total, four events were held throughout Europe between July and October 2023, involving more than 260 professionals from the clinical, educational, and social sectors.

The first event took place in Valladolid, Spain on 13 July 2023, hosted by Universidad Carlos III de Madrid (UC3M) at its ETSI Industriales facilities. It brought together 20 participants, including VET trainers, psychologists, and computer science educators, who tested Modules 7–8 (IoT and Big Data for mental healthcare) and provided formative insights into platform usability.

On **5 October 2023**, ECAM-EPMI coordinated a tripartite event in **Paris, France**, with simultaneous sessions held at the École Pratique de Service Social (EPSS) in Cergy, Simplon.co in Vincennes, and CESI in Nanterre. This distributed format reached 20 social and health

professionals (psychologists, specialized educators, and health management students), who evaluated Modules 3 and 6 (Health 4.0 in mental health and Telepsychiatry), with particular interest in robotics-assisted therapy and ERP-based cognitive monitoring.

In Iași, Romania, Ludor Engineering organized a multiplier seminar on 18 September 2023 in collaboration with OAMGMAMR (IACI). The event gathered 80 participants primarily psychiatric nurses, clinical psychologists, and VET instructors who reviewed all ten modules and completed structured satisfaction questionnaires. Their feedback was instrumental in validating the clinical relevance and pedagogical accessibility of the training materials.

Finally, on 27 October 2023, the Estonian Fieldbus Competency Centre (EFCC) hosted a seminar at Viimsi Artium (Tallinn region) under the theme "New Technologies for Mental Health in the Diagnosis and Treatment of Problems". The hybrid event (in-person and online) attracted 22 professionals, including digital health specialists and policy advisors. Participants evaluated the seminar on a 0–10 scale and expressed strong interest in AI, augmented reality, and the EUCARE4.0 platform, with 90% committing to follow the project's future developments.

Across all events, digital materials were accessed via the official project website (https://eucare40.eu), and all sessions included live demonstrations, group discussions, and hands-on exploration of the e-learning space. These events not only ensured broad validation of the OERs but also initiated a transnational community of practice committed to advancing digital competence in mental health education.

The EUcare4.0 project (2021-2023) addresses the critical need for digital literacy among mental health professionals in Europe. To validate the developed Open Educational Resources (OERs), partners in France, Spain, Romania, and Estonia organized Multiplier Events (ME). This report provides a deep dive into the national results, highlighting how each partner adapted the project's core message to their local healthcare ecosystem.

4.1 Spain: Technological Innovation and Sustainability

The Universidad Carlos III de Madrid (UC3M) focused on the high-tech components of Health 4.0. Events in Valladolid and Madrid specifically targeted the integration of data-driven tools (table 1).

Indicator	**Valladolid Session**	**Madrid Session**
Date	July 13, 2023	September 27, 2023
Participants	20	13
Primary Modules	IoT (M7) & Big Data (M8)	Platform (R3)
Dissemination Strategy	100% Digital / Paper-free	100% Digital / Paper-free

Table 1: Multiplier Events in Spain

Strategic Insight: Spain demonstrated an eco-responsible model. By eliminating physical brochures, they showcased the efficiency of digital-only dissemination, aligning with the project's goal of "digital transformation."

4.2 Romania: Large-Scale Professional Engagement

The event organized by Ludor Engineering and OAMGMAMR Iaşi stands out for its massive turnout and exceptionally high quantitative feedback.

- **Audience:** 80 healthcare professionals (primarily nurses).
- **Participant Feedback:** 100% agreement on the ease of use of the learning platform and 98.75% satisfaction regarding the training materials' quality.
- **Impact:** Participants reported a significant increase in confidence regarding the application of digital tools in daily clinical practice.

4.3 Estonia: The Hybrid Connectivity Model

The Estonian Fieldbus Competency Centre (EFCC) seminar in Viimsi Artium utilized Estonia's advanced digital landscape to offer a hybrid experience.

Key Highlights:

- **Integration:** The project was presented alongside discussions on 5G, Augmented Reality, and AI, providing a "future-proof" context for EUcare4.0.
- **Accessibility:** 70% of the 31 directly invited organizations participated, complemented by online attendees via Google Meet, ensuring a broad national reach despite geographical distances.

4.4 France: Clinical Focus and Telepsychiatry

ECAM-EPMI (Paris) organized three targeted sessions to foster deeper debates on the practical application of the modules (table 2).

Metric	Session 1	Session 2	Session 3
Participants	20	9	9
Core Focus	Telepsychiatry (M6)	Mental Health 4.0 (M3)	Implementation

Table 2: Sequential Sessions in France

Strategic Insight: The French audience emphasized the *urgency* of digital training. The focus on Module 6 (Telepsychiatry) mirrored the post-pandemic needs of the French mental health sector.

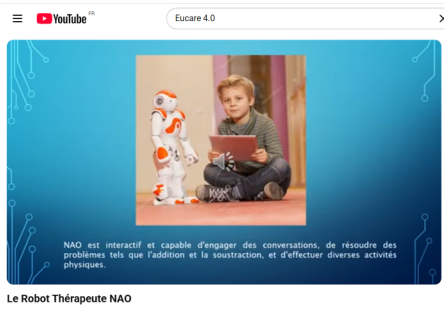
The results across all four countries demonstrate the **high adaptability** of the EUcare4.0 training materials.

1. **Satisfaction:** With an overall project satisfaction rate exceeding 98%, the OERs have proven to be intuitive and professionally relevant.

2. **Methodology:** Romania's success with physical kits versus Spain's digital-only approach shows that dissemination must be tailored to local professional cultures to be effective.

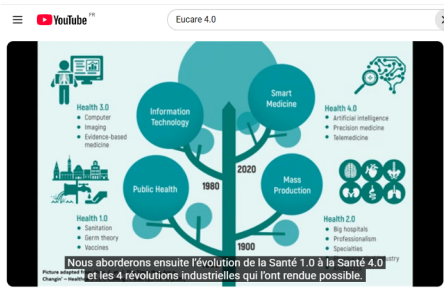
3. **Sustainability:** The digital repository (https://eucare40.eu) ensures that these resources remain accessible beyond the project's funded lifecycle.

EUcare4.0 has successfully established a human-centered framework for digital transformation in European healthcare, providing a replicable model for future vocational training initiatives.



(a) ECAM-EPMI (France)

(b) OAMGMAMR (Iași, Romania)



(c) Ludor Engineering (Romania)

(d) UC3M (Spain)

Figure 5: Examples of training videos developed by EUCARE4.0 partners: (a) ECAM-EPMI (France), (b) OAMGMAMR (Iași, Romania), (c) Ludor Engineering (Romania), (d) Universidad Carlos III de Madrid, UC3M (Spain).

5 Discussion

EUcare4.0 distinguishes itself not only by its ambition but by its deliberate grounding in the realities of mental healthcare a field too often sidelined in broader digital transformation agendas. While many prior initiatives have approached Industry 4.0 or Health 4.0 through sweeping, technology-first narratives, EUcare4.0 reverses this logic: it begins with the clinician, the trainer, and the patient. This human-centred orientation is reflected in three foundational design choices. First, the project exercised rigorous curatorial judgment, selecting only

those technologies such as passive smartphone sensing for bipolar relapse detection, ERP-based cognitive assessment, or NAO robot-assisted therapy that demonstrate clear clinical applicability in mental health settings. Second, complex technical concepts were translated into accessible, narrative-driven learning experiences tailored specifically for non-technical professionals: psychologists who may never code an algorithm, psychiatric nurses unfamiliar with IoT protocols, or VET trainers seeking to update their pedagogical toolkits. Third, and perhaps most consequentially, all outputs were released as Open Educational Resources under a Creative Commons licence (CC BY-SA 4.0), available in five languages and hosted on a permanent, freely accessible platform (https://eucare40.eu). This commitment to openness ensures that knowledge is not locked behind paywalls or institutional silos but flows freely across borders and professions.

The modular architecture of the training components further amplifies this inclusivity. Rather than imposing a rigid curriculum, EUcare4.0 empowers users to construct personalised learning journeys whether a social worker in rural Romania focuses on telepsychiatry (M6) and mental health apps (M5), or a Spanish educator explores AI (M9) and big data (M8) to redesign vocational syllabi. Crucially, each module is anchored in authentic case studies drawn from partner institutions: the use of eye-tracking to assess attention disorders, virtual reality exposure for PTSD, or real-time mood monitoring via wearable sensors. These examples transform abstract technologies into tangible tools, bridging the gap between innovation and daily practice. Feedback from over 260 pilot participants across four countries consistently highlighted this balance of flexibility and relevance as a key strength.

That said, the project is not without limitations. The decision to produce all instructional videos exclusively in English while pragmatic for consortium coordination introduces a subtle but real barrier for professionals with limited English proficiency, despite multilingual transcripts and textual materials. Future iterations could explore dubbed versions or subtitled video tracks to deepen accessibility. Similarly, the lack of formal academic accreditation (e.g., ECTS credits or nationally recognised certification) hinders integration into mandatory continuing professional development frameworks. Yet this gap is already being addressed: SESCAM in Spain is actively pursuing regional validation pathways to accredit EUcare4.0 modules for healthcare staff, a model other partners may replicate.

Looking ahead, the sustainability strategy is both pragmatic and forward-looking. The e-learning platform will remain operational for at least three years post-project, with ECAM-EPMI ensuring technical maintenance. More importantly, all core partners have pledged to embed EUcare4.0 content into their institutional curricula UC3M in master's programmes on digital education, EFCC in Estonian VET trainer courses, ECAM-EPMI in engineering-health interdisciplinary tracks. Simultaneously, key resources are archived on pan-European OER repositories like EPALE and OER Commons, safeguarding long-term discoverability and reuse beyond the project's lifespan.

Perhaps the most compelling legacy of EUcare4.0 lies in its transferability. The same co-design methodology clinicians and technologists working side by side, open resources built around real-world cases, modular learning adapted to local needs could be readily applied to geriatrics (e.g., fall detection via smart homes), public health (predictive analytics for epidemic preparedness), or chronic disease management (IoT-enabled diabetes coaching). Ultimately, the project's success rests on three interlocking pillars: deep co-creation with end users from day one; a governance model that values parity among universities, hospitals, NGOs, and SMEs; and an unwavering ethical stance that positions technology not as an end in itself, but as a means to more equitable, timely, and human-centred care. In doing so, EUcare4.0 offers

more than a training programme it provides a replicable blueprint for the ethical digitalisation of public services across Europe.

6 Conclusion

EUcare4.0 demonstrates that inclusive, open, and needs-driven training can significantly accelerate the digital transformation of mental healthcare across Europe. By focusing on vocational education and training (VET) instructors and health professionals, the project acts as a powerful multiplier extending digital competencies far beyond its immediate scope. The three intellectual outputs, freely accessible in multiple languages and released as Open Educational Resources, constitute a lasting legacy for Europe's educational and health communities alike.

All partners remain committed to maintaining these resources, actively promoting their use, and sustaining the collaborative networks forged throughout the project. In the era of connected health, EUcare4.0 goes beyond merely teaching technology: it fosters the humanisation of technology always placing the patient, the professional, and ethical considerations at the heart of digital transformation.

Thus, EUcare4.0 represents not only a pedagogical and technological success but also a concrete, human-centred, and distinctly European response to the mental health challenges of the 21st century. Partners are now exploring integration into national VET curricula and alignment with the European Digital Competence Framework for Educators (DigCompEdu), ensuring the long-term impact of this human-centred digital transformation.

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