










ORIGINAL REPORT

Enhancing nursing care through technology and standardized nursing language: The TEC-MED multilingual platform

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Abstract

Purpose: This study describes the design, integration, and semantic interoperability process of a minimum data set using standardized nursing language in the caring module of the TEC-MED care platform.

Methods: The caring module was developed in three phases (2020–2022): platform concept, functional design and construction, and testing and evaluation. Phases involved collaboration among academics, information technology developers, and social/healthcare professionals. Nursing taxonomies (NANDA-I, NOC, NIC) were integrated to support the nursing process. The platform was piloted in six Mediterranean countries.

Findings: The final platform features an assessment module with eight dimensions for data collection on older adults and their caregivers. A clinical decision support system links assessment data with nursing diagnoses, outcomes, and interventions. The platform is available in six languages (English, Spanish, French, Italian, Greek, and Arabic). Usability testing identified the need for improved Arabic language support.

Conclusions: The TEC-MED platform is a pioneering tool using standardized nursing language to improve care for older adults in the Mediterranean. The platform's multilingualism promotes accessibility. Limitations include offline use and mobile app functionality. Pilot testing is underway to evaluate effectiveness and facilitate cross-cultural validation of nursing taxonomies.

Implications for nursing practice: The TEC-MED platform offers standardized nursing care for older adults across the Mediterranean, promoting consistent communication and evidence-based practice. This approach has the potential to improve care quality and accessibility for a vulnerable population.

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KEYWORDS

digital health, elderly, health equity, nursing diagnosis, standardized nursing language, taxonomy

RESUMEN

Objetivo: Este estudio describe el diseño, la integración y el proceso de interoperabilidad semántica de un conjunto mínimo de datos utilizando un lenguaje estandarizado de enfermería en el módulo de atención de la plataforma de cuidados TEC-MED.

Métodos: El módulo de atención se desarrolló en tres fases (2020–2022): concepto de la plataforma, diseño y construcción funcional, y pruebas y evaluación. Las fases involucraron la colaboración entre académicos, desarrolladores de tecnología de la información y profesionales sociales/sanitarios. Se integraron taxonomías de enfermería (NANDA-I, NOC, NIC) para apoyar el proceso de enfermería. La plataforma se pilotó en seis países mediterráneos.

Resultados: La plataforma final presenta un módulo de evaluación con ocho dimensiones para la recopilación de datos sobre adultos mayores y sus cuidadores. Un Sistema de Apoyo a la Decisión Clínica (CDSS) vincula los datos de evaluación con diagnósticos, resultados e intervenciones de enfermería. La plataforma está disponible en seis idiomas (inglés, español, francés, italiano, griego, árabe). Las pruebas de usabilidad identificaron la necesidad de mejorar el soporte en idioma árabe.

Conclusiones: La plataforma TEC-MED es una herramienta pionera que utiliza un lenguaje estandarizado de enfermería para mejorar la atención a los adultos mayores en el Mediterráneo. La disponibilidad en varios idiomas de la plataforma promueve la accesibilidad a la misma. Las limitaciones incluyen el uso sin conexión y la funcionalidad de la aplicación móvil. Se están realizando pruebas piloto para evaluar la efectividad y facilitar la validación intercultural de las taxonomías de enfermería.

Implicaciones para la práctica de enfermería: La plataforma TEC-MED ofrece atención de enfermería estandarizada para los adultos mayores en todo el Mediterráneo, promoviendo la comunicación consistente y la práctica basada en evidencia. Este enfoque tiene el potencial de mejorar la calidad y accesibilidad de la atención para una población vulnerable.

INTRODUCTION

Multiple eHealth interventions have been developed in recent decades to support nursing care, including digital platforms (Bohmer & Lawrence, 2008; Escobedo et al., 2019). A digital care platform is an eHealth-based tool that aims to increase coordinated and patient-centered care. Digital healthcare platforms can provide patients with situation-specific information, an overview of their medical records, and a means of direct and secure communication with healthcare professionals (Hopstaken et al., 2021; Meier et al., 2013). Evidence of the use of care platforms for patients with chronic diseases demonstrates their positive effect on increasing and improving physical activity, quality of life, self-confidence, adherence to treatment, and satisfaction with the care received (Slev et al., 2016; Tighe et al., 2020; Xu et al., 2019). In the specific context of older people, a study by Jongstra et al.

(2017) showed that the design of a specific care platform for older people with cardiovascular problems positively impacted adherence to medical treatment and basic health care. However, it highlighted the need to improve digital competence in this group.

On the other hand, current health systems face the challenge of longevity and an inverted demographic pyramid due to the increase in the world's population over 60. In this sense, all countries should implement strategies to ensure their health and social systems are ready to take full advantage of this demographic change (Bonnet et al., 2021). Furthermore, people with social care needs have experienced an increased risk of deterioration of their physical and mental health with the COVID-19 pandemic (Ho et al., 2020). This extraordinary challenge of social assistance requires immediate and well-coordinated responses among different levels of government and non-governmental sectors and the general public worldwide (Comas-

Herrera et al., 2020). Nursing care must also be adapted to this demographic situation, always under the premise of evidence-based care. Thus, the working method of nurses is materialized through the nursing process, based on an organized data collection, using existing tools; that would include evidence-based knowledge resources such as Gordon's (1994) Functional Health Patterns and the research-based standardized classifications (Törnvall & Jansson, 2017). Nurses who use a common standardized language to identify and record patient diagnoses, outcome criteria, and interventions would allow them to communicate patient care to the outside world (Mousavinasab et al., 2020). The NANDA-International taxonomy is an example of standardized nursing language that provides an international uniform definition, defining characteristics, and factors for nursing diagnoses (H. Herdman et al., 2024), as do Nursing Outcomes Classification with definition and indicators to measure (Moorhead et al., 2023) and Nursing Interventions Classification with definition and nursing activities (Wagner et al., 2023). Each provides a common standardized language with evidence-based definitions and context to describe nursing practices to be considered in the planning, implementation and evaluation of nursing process (Müller-Staub et al., 2007).

The "Development of a Transcultural social-ethical-care model for dependent population in Mediterranean basin-TEC-MED" research project (ENI CBC 2014–2020) addresses these international challenges by developing an innovative and ethical cross-cultural social care model. This model aimed to improve the functioning of companies that provide socio-health care and collaboration with public administrations in caring for older people with dependency and at risk of social exclusion in the Mediterranean basin. With an approach based on justice, privacy, confidentiality, gender, universal accessibility, active community participation, digital literacy, and the values of the welfare state and governance, the project involves the countries of Spain (coordinating country), Italy, Greece, Lebanon, Egypt, and Tunisia (Porcel et al., 2019).

Accordingly, one of the outputs of the TEC-MED project is developing a multilanguage (English, Spanish, French, Italian, Greek, and Arabic) online multipurpose platform. The TEC-MED platform is multipurpose and composed of three modules: (1) a management module aimed to promote the communication and collaboration between the partners and stakeholders, (2) an e-learning module, and (3) social-health caring module.

The implementation of the platform also constitutes a validation tool for the TEC-MED model. The information collected through the online platform is useful to increase awareness of the perception of the social care model and gathers feedback on the ground to support future implementation of a larger integrated model of social care (Porcel-Gálvez et al., 2021). Additionally, the online platform is user-oriented and attends to guide ubiquitous communication and collaboration among social workers, patients, and families. The information collected through the online platform is useful to increase the knowledge of model perception and collect feedback from the ground in view of the next future implementation of a wider integrated social-care model. It will allow social and health workers (SHW), older people, and their families to receive instructions, share experiences and best practices, and

receive training and coaching support in a well-established community of practices. In this context, this study aims to describe the design, integration, and semantic interoperability process of a minimum data set in the caring module of TEC-MED care platform.

MATERIALS AND METHODS

The design and development of the electronic caring module for the TEC-MED platform was accomplished during the period 2020–2022, in three phases: (1) platform concept; (2) functional design and construction of the care platform; and (3) testing and evaluation. It was developed in close collaboration between the consortium partners, with academic profiles and IT developers, together with key players at the micro–meso–macro level from public and private institutions, universities, nongovernmental organizations, NGOs, and the general population.

The research project obtained the approval of the Andalusian Research Ethics Committee (Cod.2412-N-19) and adhered to the recommendations on the protection of personal data described in the European Directive 2016/679 of the European Parliament and of the European Council of April 27, 2016.

Before the development of the caring module of the TEC-MED platform, the team developed the TEC-MED care model, on which the development of the TEC-MED care module was based (Figure 1).

Phase 1: platform concept

This phase was developed during the second half of the year 2020 and the first quarter of 2021.

The care platform module consists of four modules: (1) assessment, (2) diagnosis, (3) planning, and (4) implementation and evaluation (Figure 2), based on the stages of the nursing process as well as on implementation with taxonomies (Bulechek et al., 2018; H. Herdman et al., 2021; Moorhead et al., 2018; Wilkinson, 2012) (Figure 2).

For developing the assessment module, a review of the digital health and social records existing in the participating countries was carried out during the first quarter of 2021. For example, in Spain, we based on the Diraya's health care system (Servicio Andaluz de Salud, 2010) or the RESISOR's electronic single social record (Gálvez et al., 2016). Furthermore, functional patterns of Marjory Gordon (Gordon, 1994) were considered for the assessment framework for older people (final beneficiary [FB]) as well as their family caregivers (FC), considering also the family and social dimensions. Weekly meetings of working groups and expert panels with the project partners were developed until a consensus was achieved about the dimensions of the assessment. A process of identifying validated scales related to each of the dimensions was carried out to be inserted into the designed care platform through a literature review. It was considered to select the assessment scales if validated in the languages of the countries participating in the project. Permission from their authors was obtained.

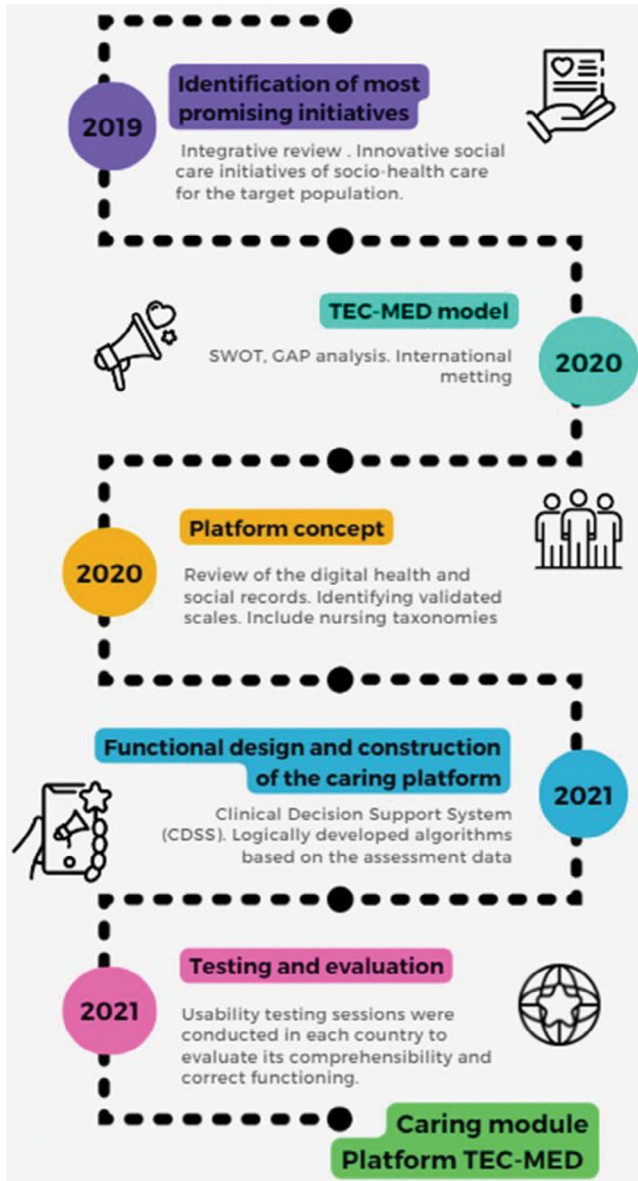


FIGURE 1 TEC-MED model and caring module in TEC-MED platform development process.

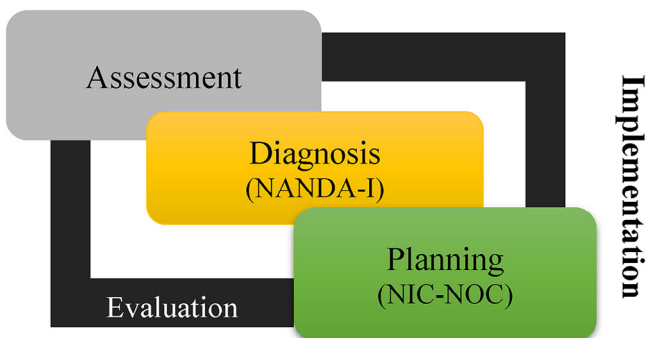


FIGURE 2 Overview of the modules of the TEC-MED digital care platform that is based on the nursing process and the nursing taxonomies.

The consortium agreed on the need to include nursing taxonomies, given its scientific evidence and international systematization, concerning the diagnostic phase and care planning. Similarly, to the assessment design, the consensus about labels, outcomes, and intervention was done through working groups and panel of experts. NANDA International diagnostic labels related to the assessment dimensions and the labels related to Nursing Outcomes Classification and Nursing Interventions Classification related to the identified diagnostic labels were identified. Once the final list was obtained, permission was obtained, and the NANDA International organization, the publisher Thieme, the team of editors of the University of Iowa (USA), and the publisher Elsevier Limited were contacted to request the due permissions for including the labels in the care platform. During the evaluation, the realization of the nursing intervention and the change of outcome indicators are assessed. All data are downloadable under data protection restrictions.

Phase 2: functional design construction of the care platform

This phase was developed during the first and second quarters of 2021. A clinical decision support system (CDSS) was included in the platform to assist SHW in assessing, diagnosing, planning, and evaluating care. The aim was to facilitate a uniform approach to applying the model among multiple professionals from different countries who participated in the project. CDSSs provide clinicians with patient-specific recommendations for clinical decision-making (Kawamoto et al., 2005). They are considered a way of reducing variation in healthcare practice (Coiera et al., 2006).

The CDSS was based on logically developed algorithms based on the assessment data to lead the training agent to an endpoint disposition of the patient's condition, in this case, to a nursing diagnosis. An algorithm was created in the platform for each preselected nursing diagnosis. The following procedure was followed: (1) The components of each nursing diagnosis that were most representative of them were selected, that is, their signs/symptoms (defining characteristic) and the most frequent causes that could cause them (related factor); (2) of all data included in the assessment, those that were equivalent to the most representative components of each diagnosis were identified and assigned to each other; these data came from direct questions about them, from the responses to specific items of psychometric and clinometric instruments included or the overall score of these instruments; (3) based on the above, the algorithms were constructed considering whether the data were collected: dichotomously, that is, as the presence or absence of a sign/symptom or cause of diagnosis, or continuously, that is, when the sign/symptom or cause of diagnosis was quantified in some way, and a certain cut-off point must be considered relevant. A conditional structure was used to develop the algorithms. Conditional structures compare the values of one data item with those of another(s). Based on this comparison, a course of action is followed within the platform. In this case, the conditional structure allowed one to decide that alternative the platform flow will follow, suggesting or not a diagnostic

label for the SHW. When the condition was met, the data of interest for the diagnosis reached specific values simultaneously; the calculation returned a true value and, consequently, assumed that the patient presented the diagnosis to the SHW, which was recorded. If the condition was not met, it returned a false value, implying that the diagnosis was absent. Relational operators (>, <, ≤, = >) were used to establish complex conditions. Once the CDSS assigned a diagnosis, the system automatically assigned the outcome(s) and intervention(s) corresponding to that diagnosis, previously nested them together to achieve the linkage. If an SHW disagreed with the suggested endpoint, there was a facility to override the decision. Similarly, if, based on the assessment, the SHW, applying his/her clinical reasoning, considered that the patient had a nursing diagnosis not suggested by the CDSS, he/she could assign it to the participant and record it.

Phase 3: testing and evaluation

During the third quarter of 2021, two TEC-MED care platform usability testing sessions were conducted in each country to evaluate its comprehensibility and correct functioning. In each test, a fictitious user was assessed by filling in all fields allowed by the platform. In the end, each pilot was discussed in a joint meeting with all participating partners, in which the technology partners took note of the necessary changes.

RESULTS

Phase 1: platform concept

The final configuration of the platform involves the assessment module, which is focused on data collection and interpretation of information that will determine the health situation of FB and FC. It consists of eight dimensions, conceptualized from the conceptual framework that supports the TEC-MED Model, which allow to collect clinical, biological, and psychosocial aspects from a comprehensive perspective. These are as follows: (1) health condition; (2) physical–functional capacity; (3) cognitive ability; (4) basic needs; (5) emotional management and social relations; (6) ability to promote a healthy life/death; (7) family, partners, and caregivers; and (8) socio-economic factors and digital literacy.

Each of these dimensions is supported by subdimensions with items and rating scales. The following scales were identified and selected for the assessment: INICIARE (Morales-Asencio et al., 2015); AROPE (Explained Eurostat statistics- European Committee, 2021); AUDIT test (Saunders et al., 1993); Morisky Green test (Simplified Medication Adherence Questionnaire) (Beyhaghi et al., 2016); AD8 Dementia test (Galvin et al., 2006); EuroQol (quality of life) (M. Herdman et al., 2001); Pfeiffer questionnaire (Pfeiffer, 1975); Montreal Cognitive Assessment—MoCA (Nasreddine et al., 2005); Mini Nutritional Assessment; Duke questionnaire (Koenig et al., 1993); Geriatric Depression Scale 15 Questions version (Yesavage et al., 1983); Perceived Stress Scale (PSS-10) (Cohen et al., 1983); Generalized Anxiety Disorder Questionnaire (GAD-7) (Spitzer et al., 2006); Rosenberg Self-Esteem

scale (Rosenberg, 1979); COPE Questionnaire (short version 28 items) (Carver et al., 1989); Health Literacy (HLS-EU-Q16) (Haun et al., 2014); Elders Health Empowerment Scale (Serrani Azcurra, 2014); Subscale 2 “Proper dying process” of the Collett-Lester Fear of Death Scale (Lester, 2004); Caregiver Strain Index—CSI (Thornton & Travis, 2003); Self-perception of family health status (Lima-Rodríguez et al., 2022); and Caregiver Time (RUD-Lite) and Caregiver Work Status (RUD-Lite) (Wimo et al., 2013).

Phase 2: functional design construction of the care platform

The CDSS specially designed for the platform was composed of 34 algorithms connecting the assessment data with the preselected NANDA-I diagnoses (H. Herdman et al., 2021), Nursing Outcomes-NOC (Moorhead et al., 2018), and Nursing Interventions-NIC (Bulechek et al., 2018). Table 1 reports examples of the rationale behind developing the algorithms for various diagnoses. For this purpose, evaluation criteria that must be complied with for the CDSS to suggest to the SHW the assignment of an FB or FC’s diagnosis were presented. The suggested diagnosis and the intervention for that diagnosis are also presented. Mathematical formulas included in the programming code of the platform have been avoided for ease of reporting. As mentioned above, once the diagnosis was suggested, the SHW had to validate it. If he or she validated the CDSS suggestion, the diagnosis remained assigned to the FB/FC. If he or she felt that additional assessment data did not support the suggestion, he or she could unassign the diagnosis. In addition, he or she could add diagnoses not suggested if they were considered justified.

Phase 3: testing and evaluation

During the two usability testing sessions of the care platform in each country, the assessment implemented on the platform was piloted to detect errors of understanding or technological issues. After that, it was only necessary to improve usability in the case of the Arabic language; thus, the platform was adapted electronically so that codes and diagnostics could be read correctly from right to left. Figure 3 describes the final configuration of the care module of the TEC-MED platform.

DISCUSSION

The present study investigated the creation of a digital comprehensive care platform that allows the execution of the nursing process through all its stages, assessment, diagnosis, planning, execution, and evaluation using the terminology NANDA-I nursing diagnoses, Nursing Outcome Classification, and Nursing Intervention Classification (Bulechek et al., 2018; H. Herdman et al., 2021; Moorhead et al., 2018). Numerous authors highlight the validity and improvement of patient care using this terminology compared to others (Klančnik et al., 2021;

TABLE 1 Examples of the rationale under the interrelationships among assessment criteria, diagnosis, outcome, and intervention.

Assessment criteria	Diagnosis suggested ^a	Outcome suggested ^b	Intervention suggested ^c
Selections of options "Never," "Rarely," or "Sometimes" in INICIARE item "050312 Urinary Continence."	00016 Impaired urinary elimination	0310 Self-Care: toileting	1804 Self-care Assistance: toileting
Selections of option "No" in items: 5.6.1 (Do you have objectives or goals?), 5.6.2. (Do you have plans to carry out?) or 5.6.3. (Do you feel as if you can control your life right now?), OR assignation of diagnosis "risk of depression," "low self-esteem," or "ineffective coping"	00210 Impaired resilience	1309 Personal resiliency	8340 Resiliency promotion
Selection of option "No" in item 5.7.3 (generally, would you say that your sexual relationship is satisfactory?)	00065 Ineffective sexuality pattern	0119 Sexual functioning	5248 Sexual counseling

Note: Codes and labels retrieved from:

^aNANDA International Nursing Diagnoses: Definitions & Classification, 2021–2023 (12th ed.). Thieme Medical Publishers.

^bMoorhead, Swanson, E. S., Johnson, M., & Maas, M. (2018). *Nursing Outcomes Classification (NOC)*.

^cBulechek, G., Butcher, H., Dochterman, J., & Wagner, C. (2018). *Nursing Interventions Classification (NIC)*.

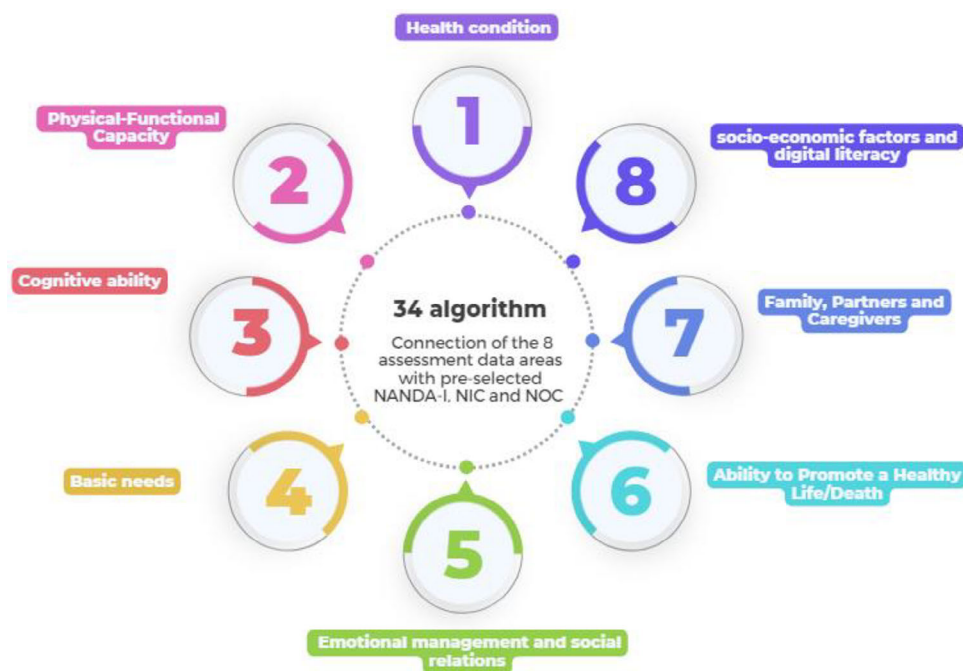


FIGURE 3 Structure of the caring module of the TEC-MED platform.

Park & Lee, 2015; Rabelo-Silva et al., 2017). Although this language is standardized internationally for nursing professionals, there is a digital divide in its use in the digital tools and platforms implemented (Westra et al., 2008). However, scientific evidence highlights the advantages of its use, highlighting that the information included in this digital platform subsequently allows its coding and data processing, making it possible to advance research in nursing classification systems (Jetté, 2007). Likewise, the implementation of nursing taxonomies in digital platforms could improve the quality of care and the care provided, in terms of quality, generalization, and systematization worldwide. On the one hand, it values nursing science as a discipline based on a scientific decision-making process that underpins the nursing process (Nibbelink & Brewer, 2018); this translates into interventions and outcomes that could be identified objectively and have scientific evidence (Törnvall

& Jansson, 2017). On the other hand, the use of these taxonomies in care platforms also offers the possibility for all nurses to work under the same linguistic framework, which can be applied and validated in all the languages of the world. It is nothing more than a vehicle to homogenize nursing language in any context and, at the same time, to avoid language barriers in nursing practice under the same international numerical codes, which maintain the same meanings around the world.

Focusing on the population that concerns us in this study, the older people, a digital divide is observed due to the lack of digital literacy and/or lack of access to technological means for economic reasons that hinder communication among users–caregivers–professionals digitally. In this sense, the TEC-MED project has also carried out specific workshops to train older people in technology to improve accessibility

for people in situations of social exclusion for using the computer tools included in the platform.

Following the strengthening and use of the TEC-MED digital platform, the digital skills of SHW, FB, and FC have increased. In addition, following the COVID-19 pandemic, there has been a digital revolution in the use of technology in care (Abdolkhani et al., 2022; Porcel-Gálvez et al., 2021). Mansour and Nogues (2022) revealed that nurses had proactive attitudes toward new technologies, thus improving efficiency, sustainability, communication, and knowledge sharing. Moreover, the TEC-MED platform involves FC through activities and interventions that can serve to improve or maintain their health. This is a novel aspect because, after the previous research, the importance of caregivers in these countries of the Mediterranean basin was identified. Therefore, this need identified during the execution of the project has been answered. Additionally, Moreno-Cámara et al. (2019) identified this need in family care for people with dementia in the Mediterranean.

Furthermore, the TEC-MED project will contribute to reducing the marginalization of older people and improving the quality of social and health services provided to them. Furthermore, by developing a common model supported by software applications, the project can help establish a reference model for social assistance in the Mediterranean region (Porcel et al., 2019). Moreover, given that the “official language” in most countries around the world is English (59 countries), followed by French (29 countries), Arabic (27 countries), and Spanish (20 countries), 2 billion people could benefit from the use of this care platform (Ramírez, 2018).

CONCLUSIONS, LIMITATIONS, AND FUTURE DIRECTIONS

Creating a digital platform that uses nursing languages as the primary communication and implementation tool to improve the care provided to older people, dependents, and those at risk of social exclusion in countries of the Mediterranean basin is a pioneering milestone.

In addition, the care module of the TEC-MED platform has been developed in English, French, Spanish, Italian, Greek, and Arabic, including NANDA, NOC, and NIC labels. This achievement gives the TEC-MED platform a very high value as a tool for the global dissemination of nursing taxonomies, facilitating their use, and taking advantage of the rise of eHealth systems and platforms applied to the healthcare context with shared nursing knowledge and decision support.

Despite this, it is not exempt from limitations such as the impossibility of using the tool offline without the need for an internet connection. It could also be made more friendly, with a more intuitive format and easy access, and with a mobile module to facilitate the SHW-FB-FC interaction.

The TEC-MED digital care platform is being tested with the target population in a pilot phase in the six Mediterranean countries involved in the project. It is expected that 36 SHW and 28.200 users, FB and FC, will participate in the pilot study phase, and quantitative and qual-

itative indicators will be assessed to validate the platform. Finally, these data will also allow the implementation of cross-cultural validation procedures, together with the authors of the different taxonomies of diagnostic labels, interventions, and outcomes in Arabic and Greek languages.

AUTHOR CONTRIBUTIONS

Ana-María Porcel Gálvez, José-Manuel Romero-Sánchez, Regina Allande-Cussó, Maria-Giulia Costanzo-Talarico, Elena Fernández-García, Fabio D'Agostino and Marta Lima-Serrano conceptualized and drafted the manuscript. Ana-María Porcel Gálvez, José-Manuel Romero-Sánchez, Regina Allande-Cussó, Maria-Giulia Costanzo-Talarico, Marta Lima-Serrano, Fabio D'Agostino, María-Dolores Mateos García, and Mercedes Bueno-Ferrán conducted the data analysis for the study. Ana-María Porcel Gálvez, José-Manuel Romero-Sánchez, Marta Lima-Serrano, Regina Allande-Cussó, Elena Fernández-García, and Fabio D'Agostino designed and critically reviewed the document. All authors read and approved the final version submitted.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data underlying this article are available on request from the authors.

ETHICS STATEMENT


This study did not involve human participants and therefore did not require Ethics Committee approval.

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