ORIGINAL PAPER

Design and Evaluation of a Technological Platform for Monitoring Patients with Dementia: Unifying Requirements from Mexican Day Centers

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Abstract
The monitoring of patients with dementia who receive comprehensive care in day centers allows formal caregivers to make better decisions and provide better care to patients. For instance, cognitive and physical therapies can be tailored based on the current stage of disease progression. In the context of day centers of the Mexican Federation of Alzheimer, this work aims to design and evaluate *Alzaid*, a technological platform for assisting formal caregivers in monitoring patients with dementia. *Alzaid* was devised using a participatory design methodology that consisted in eliciting and validating requirements from 22 and 9 participants, respectively, which were unified to guide the construction of a high-fidelity prototype evaluated by 14 participants. The participants were formal caregivers, medical staff, and management. This work contributes a high-fidelity prototype of a technological platform for assisting formal caregivers in monitoring patients with dementia considering restrictions and requirements of four Mexican day centers. In general, the participants perceived the prototype as quite likely to be useful, usable, and relevant in the job of monitoring patients with dementia (p-value < 0.05). By evaluating and designing *Alzaid* that unifies requirements for monitoring patients of four day centers, this work is the first effort towards a standard monitoring process of patients with dementia in the context of the Mexican Federation of Alzheimer.

Keywords Dementia · patient monitoring · day centers · patients with dementia · mobile applications · software design

Introduction

Dementia is a progressive neurodegenerative syndrome that affects people's cognitive and physical abilities [1]. In advanced stages, patients with dementia (PwD) lose

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self-sufficiency [2]. Day centers provide PwD and their family caregivers with comprehensive care [3], offering services such as nursing, nutrition, geriatric, and physiotherapy [4]. In these areas, formal caregivers provide healthcare for patients with dementia by assisting them in their basic needs and applying cognitive and physical therapies [5].

Patients with dementia receive specific treatment in day centers depending on certain indicators [3–6]. For instance, cognitive therapies may be decided based on the stage of the disease progression. Furthermore, daily decisions about patient care are based on indicators such as patient performance on therapies. In this context, the monitoring of PwD during their stay in the day center becomes crucial to support decision making [7, 8].

The literature reports a variety of proposals to monitor PwD. Among the monitored aspects are medication adherence [9], potentially dangerous activities [10, 11], levels of physical activity [12], and cognitive task performance [13]. However, research focused on monitoring PwD who receive comprehensive care in day centers has received less attention. Among the very few research efforts are [14] that monitors patients' movement trajectories and [15] that monitors patients' heart and respiratory rates as well as their time out

of bed in order to detect anomalies in their physical condition. Nonetheless, most proposals for patient monitoring are designed for home settings and to monitor specific aspects of patients, e.g., pain [16]. Hence, the identification and monitoring of data useful for understanding the progression of PwD and supporting decision-making in day centers to provide better care is usually disregarded.

Alzaid is a technological platform for assisting formal caregivers in monitoring PwD. *Alzaid* aims to support the understanding of the progression of PwD in day centers through data consolidation and visualization. In particular, *Alzaid* consists of a mobile health monitoring application (see [4]); a Web application for patient data management; and a data visualization tool (see [17]). *Alzaid* allows formal caregivers to monitor and record patients' behavioral, clinical, and health-related data as well as patients' performance on cognitive and physical therapies, among other aspects. *Alzaid* was initially designed and implemented based on the requirements elicited from day center *Dorita de Ojeda*, which is a member of the *Mexican Federation of Alzheimer (FEDMA)*. The implementation of *Alzaid* started in 2018, and since 2019 the formal caregivers of day center *Dorita de Ojeda* have been using *Alzaid* to support patient monitoring and decision-making. *Alzaid* is the result of a continuous research effort to provide formal caregivers of day centers with technology-based tools to support the care of PwD, see [4] and [17].

Even though the monitoring process of day center *Dorita de Ojeda* involves several areas (such as nursing and physiotherapy areas) that may be required for the care of PwD, to the best of the authors' knowledge, there are no standard guidelines for the monitoring process of PwD to which day centers could adhere. Consequently, the adoption of the original version of *Alzaid* by other day centers faces a series of challenges such as agreeing on data models and terminology because different day centers may have distinct needs and may even involve different processes for patient care and monitoring. Moreover, by standardizing electronic healthcare records is expected to improve the quality of healthcare (as in [18]).

This work is an effort towards a standard monitoring process of PwD in the context of four day centers of the Mexican Federation of Alzheimer. In addition to day center *Dorita de Ojeda*, the requirements of three other day centers (uninvolved in *Alzaid*'s original/initial design) were elicited and unified to laid the foundation for the redesign of *Alzaid* with the aim of benefiting a larger population of PwD.

Alzaid was redesigned using a participatory design methodology consisting of three phases: i) eliciting requirements from day centers; ii) unifying functional requirements; iii) constructing and evaluating a high-fidelity prototype of the redesigned version of *Alzaid* using the Technology Acceptance Model 3 (TAM-3) [19].

This work contributes with:

- A first effort towards a standard monitoring process of PwD in the context of day centers of the Mexican Federation of Alzheimer, which resulted from unifying requirements for monitoring patients of four day centers.
- The design and evaluation of a technological platform for assisting formal caregivers in monitoring PwD that considers requirements of four Mexican day centers.

Materials and methods

The methodology used consists in three phases (Fig. 1).

Phase 1. Elicitation of requirements from day centers

This phase consisted in eliciting requirements from formal caregivers and administrative staff of day centers uninvolved in the design of the original version of *Alzaid*.

Participants

The directors of twenty-one day centers (belonging to FEDMA) were invited by email to include their day centers as participants in the study. The eligibility criteria were as
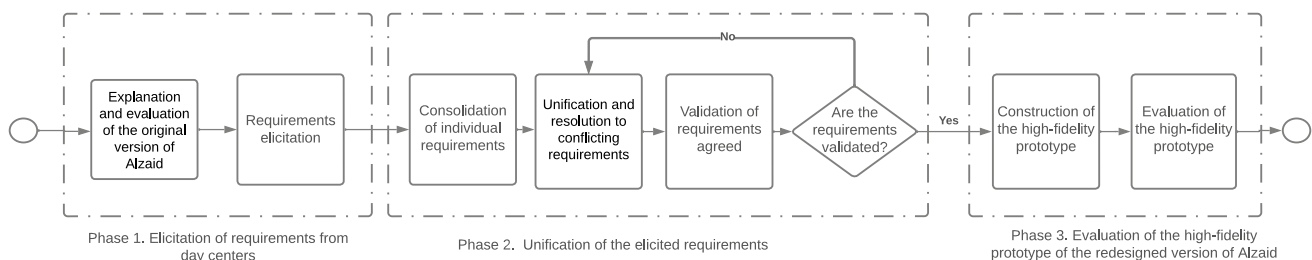

Fig. 1 Methodology for redesigning and evaluating *Alzaid*

Table 1 Participants of Phase 1: Elicitation of requirements from day centers

Day center	Area	Participants
Alzheimer México I.A.P.	Social work	1
	Nutrition	3
	Physiotherapy	2
	Neuropsychology	2
	Geriatric	3
	Nursing	2
	Management	1
	Assistant	1
Asociación Alzheimer Tampico-Madero, A.C.	Medical	1
	Marketing	1
	Administration	1
Centro Gerontológico Ryanmas, A.C.	Nursing	1
	Geriatric	2
	Administration	1

Table 2 A questionnaire (based on the TAM-1) to evaluate the original version of *Alzaid*

Perceived usefulness	
Q_1	Using *Alzaid* in my job would enable me to accomplish tasks more quickly.
Q_2	Using *Alzaid* would improve my job performance.
Q_3	Using *Alzaid* in my job would increase my productivity.
Q_4	Using *Alzaid* would enhance my effectiveness on the job.
Q_5	Using *Alzaid* would make it easier to do my job.
Q_6	I would find *Alzaid* useful in my job.
Perceived ease of use	
Q_7	Learning to use *Alzaid* would be easy for me.
Q_8	I would find it easy to get *Alzaid* to do what I want it to do.
Q_9	My interaction with *Alzaid* would be clear & understandable.
Q_{10}	I would find *Alzaid* to be flexible to interact with.
Q_{11}	It would be easy for me to become skillful at using *Alzaid*.
Q_{12}	I would find *Alzaid* easy to use.

follows: i) the day center must have facilities for patient care; ii) its formal caregivers must have basic computer skills; and iii) it must be willing to participate in all the study sessions. Table 1 shows the three day centers that accepted the invitation and met the eligibility criteria.

Instruments

Instruments of Phase 1:

- The original version of *Alzaid* that served as a starting point to generate interest in participants.
- A questionnaire (Table 2) based on the Technology Acceptance Model 1 (TAM-1) [20] to evaluate the original version of *Alzaid*.
- A semi-structured interview to investigate the processes and data requirements of the areas associated with patient care in day centers (Table 3).

Procedure

1. **Introduction and evaluation of the original version of *Alzaid*.** Participants attended a remote training session to get familiar with the original version of *Alzaid* (Fig. 2) and evaluated it using the questionnaire reported in Table 2.
2. **Requirements elicitation.** Participants were interviewed (Table 3) with the aim of eliciting new requirements and/or detecting differences between their processes and the processes for monitoring PwD reflected in the original version of *Alzaid*. Data collected from

the interviews was analyzed using the *grounded theory methodology* [21] to develop business process models associated with patient care and monitoring. Grounded theory was selected because it is a systematic methodology that generates a theory based on evidence [22], which has been used in software requirements engineering [23]. The resultant substantive theories and business process models of the participant day centers helped to identify new and complementary requirements as well as potentially conflicting requirements for the redesign of *Alzaid*.

Phase 2. Unification of requirements

This phase consisted in consolidating and unifying the requirements.

Participants

The participants were mainly directors and coordinators from the four involved day centers (Table 4). This participant type helped to reach agreements among the day centers because the participants were capable of introducing changes to their day centers' processes.

Instruments

Instruments of Phase 2:

Table 3 A semi-structured interview to investigate the patient monitoring process of participant day centers

ID	Question
Q_1	What kind of activities do you do at the day center?
Q_2	What kind of activities do you do with patients and how often?
Q_3	How do you interact with patients?
Q_4	Do you need any information about patients to carry out your daily activities? if so, what kind of information?
Q_5	Do you measure patients' performance when carrying out the activities? If so, what kind of measures do you take and how are these measures taken?
Q_6	What other information do you take into account regarding the monitoring of patients and the evolution of their disease?
Q_7	What other data do you think may be useful to carry out an analysis on the evolution of patients?
Q_8	What procedure and what means do you use to record information about the patient?
Q_9	How do you use this information and for what is it useful?
Q_{10}	What kind of decisions do you make on a day-to-day basis regarding the care and follow-up of patients?
Q_{11}	Do you participate in the decision-making process related to patients' care? if so, what role do you play?
Q_{12}	Have you used *Alzaid* previously?
Q_{13}	How could *Alzaid* help you carry out your daily activities?
Q_{14}	What features would you like to add to *Alzaid*?
Q_{15}	What features of *Alzaid* do you consider not useful or complex?
Q_{16}	What aspects of patients would you like to be able to register through the *Alzaid* platform?
Q_{17}	What feature would make it easier for you to use *Alzaid*?
Q_{18}	How are *Alzaid*'s processes different from the way you currently carry out your daily processes/activities?

- A questionnaire to guide the unification of requirements (Table 5).
- A questionnaire to validate the requirements agreed (Table 6).

Procedure

1. **Consolidation of requirements**. The requirements were consolidated into a list of new, complementary, and conflicting requirements.

2. **Unification and resolution to conflicting requirements**. A remote session was held with the participant day centers to resolve conflicts and unify requirements using the questionnaire reported in Table 5. Requirements were also refined and complemented.

3. **Validation of agreed requirements.** The list of unified requirements was discussed and validated by the participant day centers in a second remote session using the questionnaire reported in Table 6.

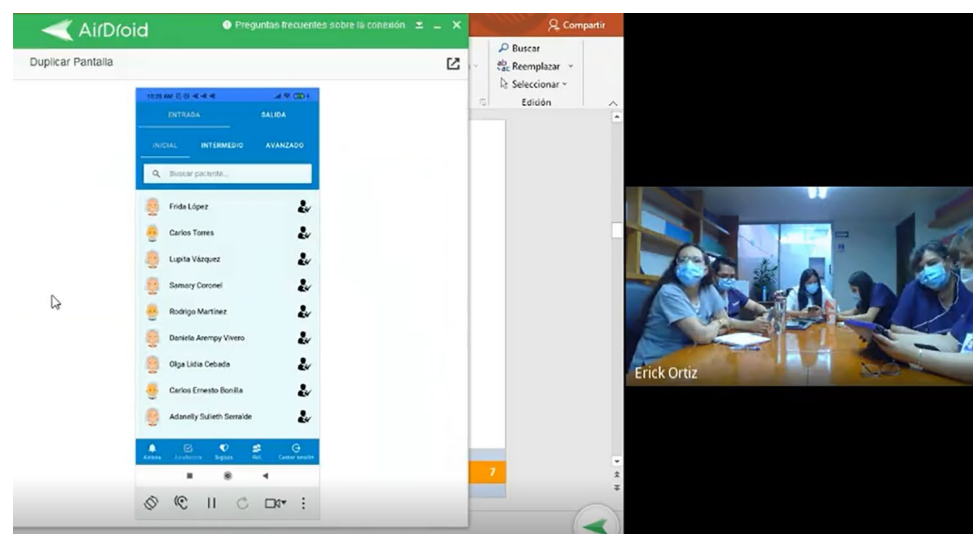**Fig. 2** A remote session with formal caregivers of a day center

Table 4 Participants of Phase 2: Unification of requirements

Day center	Area	Participants
First session		
Dorita de Ojeda	Administration	1
	Phase coordination	1
Alzheimer México I.A.P.	Management	1
	Phase coordination	1
Asociación Alzheimer Tampico-Madero, A.C.	Administration	1
	Medical	1
Centro Gerontológico Ryanmas, A.C.	Administration	1
	Nursing	1
	Geriatric	1
Second session		
Dorita de Ojeda	Phase coordination	1
Alzheimer México I.A.P.	Management	1
Asociación Alzheimer Tampico-Madero, A.C.	Administration	1
	Medical	1
Centro Gerontológico Ryanmas A.C	Administration	1
	Nursing	1

Table 5 Questionnaire to guide the unification of requirements

ID	Question
Q_1	Are the requirements specified correctly? If it is not the case, how should the requirements be adjusted?
Q_2	Is there any irrelevant requirement that should be removed?
Q_3	Is there any requirement that should be associated with a different day center area?
Q_4	Is there any requirement that is missing?
Q_5	Are the order and organization of requirements by day center area as expected?
Q_6	Are requirements in conflict with each other?
Q_7	What feasible solutions are available to resolve the conflicting requirements?

Phase 3. Construction and evaluation of the high-fidelity prototype

The objective of this phase was twofold. First, to construct a high-fidelity prototype of the redesigned version of *Alzaid*. Second, to evaluate the *perceived usefulness*, *perceived ease of use*, *output quality*, and *job relevance* of the high-fidelity prototype in addition to other relevant constructs.

Participants

The participants involved were directors, coordinators, and formal caregivers from the participant day centers (Table 7).

Instruments

Instruments of Phase 3:

Table 6 Questionnaire to validate the unified requirements

ID	Question
Q_1	The requirements elicited from all the participant day centers were unified.
Q_2	The requirements corresponding to my day center were integrated into the unified requirements.
Q_3	The unified requirements are well-defined and do not conflict with each other.
	Possible answers were as follows: 7 (strongly agree), 6 (agree), 5 (somewhat agree), 4 (neither agree nor disagree), 3 (somewhat disagree), 2 (disagree), and 1 (strongly disagree).

Table 7 Participants of Phase 3: Evaluation of the high-fidelity prototype of *Alzaid*

Day center	Area	Participants
Dorita de Ojeda	Phase coordination	1
Alzheimer México I.A.P.	Management	1
	Assistant	1
	Physiotherapy	1
	Geriatric	1
	Nursing	1
	Social work	2
	Nutrition	1
Asociación Alzheimer Tampico-Madero, A.C.	Management	1
Centro Gerontológico Ryanmas, A.C.	Administration	1
	Nursing	1
	Geriatric	2

- A video explaining how the high-fidelity prototype works (Fig. 3).
- A questionnaire based on the TAM-3 to evaluate the high-fidelity prototype (Table 13 of Appendix B).
- A single question to verify the compliance with the unified requirements.

Procedure

1. **Construction of the high-fidelity prototype**. A high-fidelity prototype of the redesigned version of *Alzaid* was designed and developed based on the unified requirements.
2. **Evaluation of the high-fidelity prototype**. Personnel of the four participant day centers evaluated the high-fidelity prototype. A video explaining its functionalities was shared with t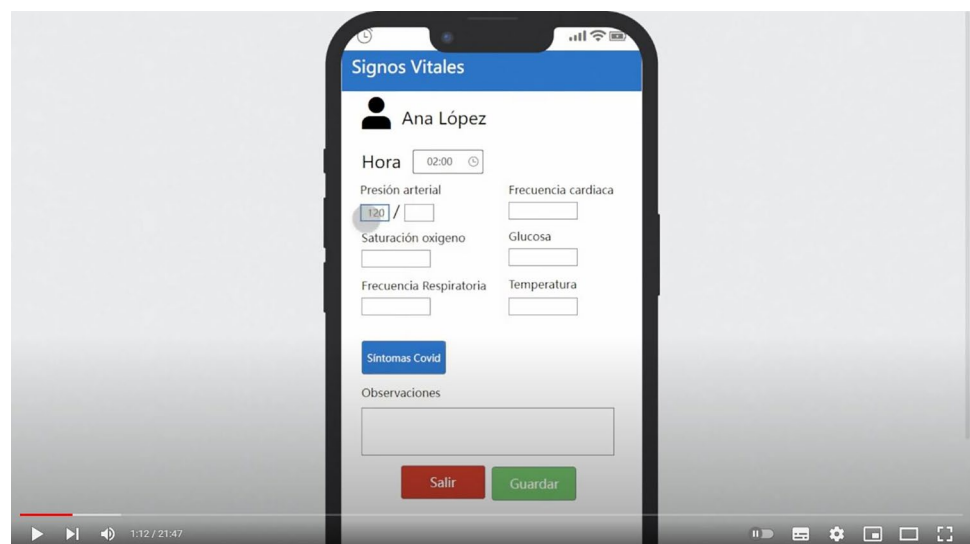he participants. After becoming familiar with the prototype, the participants were instructed to complete a 51-item questionnaire based on the TAM-3 (Table 13 of Appendix B).

The participants' Likert responses were analyzed using Shapiro-Wilk's tests to assess normality and one-sample Wilcoxon signed-rank tests to assess the significance of the medians.

Results

In this analysis, a p-value less than 0.05 was considered statistically significant. The results of Shapiro-Wilk's tests revealed that, for each evaluation construct, the participants' Likert responses are not normally distributed. Consequently, one-sample Wilcoxon signed-rank tests were used to evaluate the significance of the evaluation constructs' medians.

Fig. 3 Video to explain how the prototype of the redesigned version of *Alzaid* works

Fig. 4 Evaluation of the original version of *Alzaid* using the TAM-1

Fig. 5 Word cloud of free-text comments made by participants regarding the original version of *Alzaid*
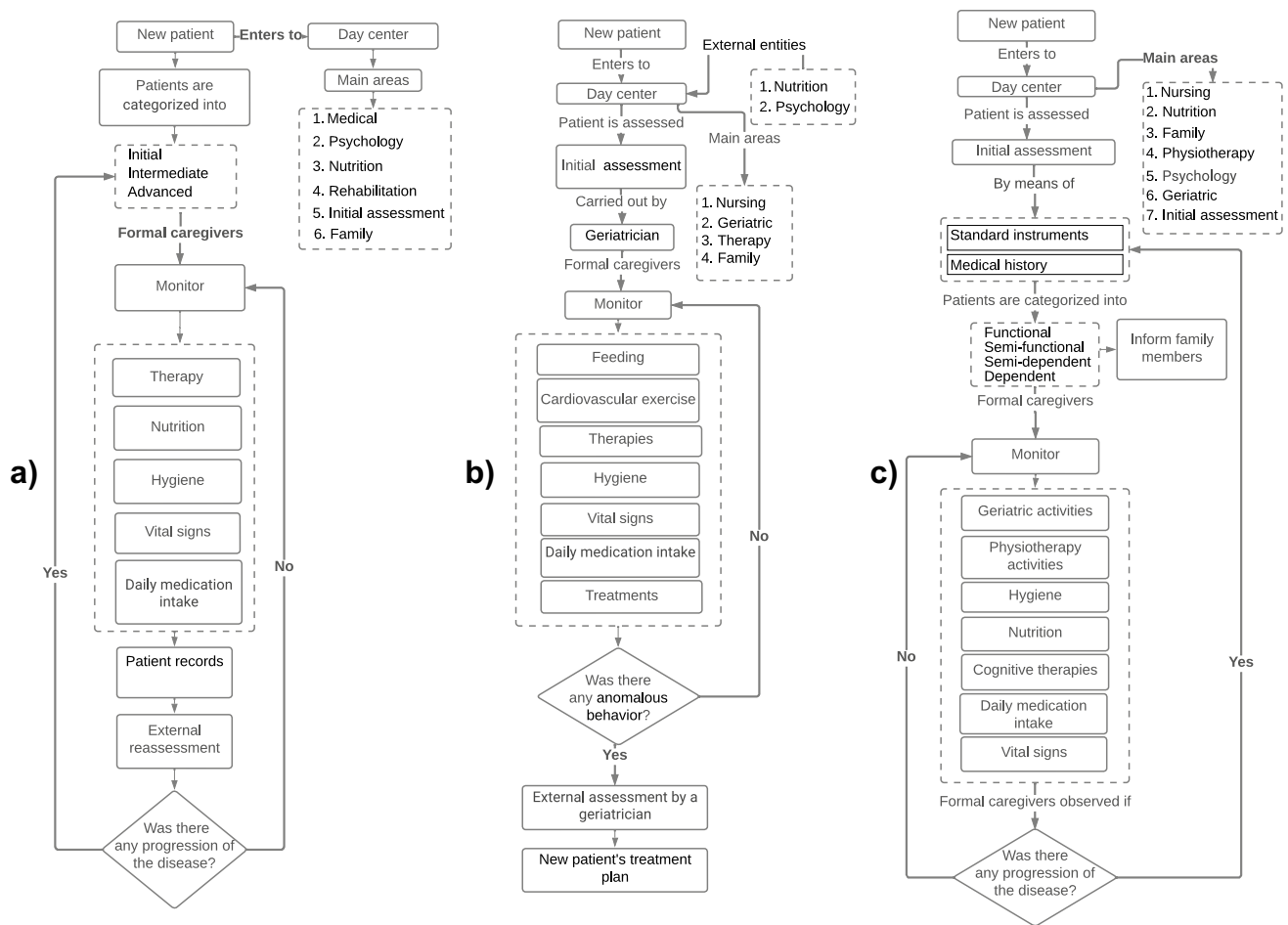
Fig. 6 Explanatory diagrams of **a** day center *Asociación Alzheimer Tampico-Madero A.C.*, **b** day center *Centro Gerontológico Ryanmas A.C.*, **c** day center *Alzheimer México I.A.P.*

Results of the elicitation of requirements

The evaluation of the original version of *Alzaid* and the semi-structured interviews provided a basis for eliciting new requirements. The results of one-sample Wilcoxon signed-rank tests revealed that the medians of the responses on the perceived usefulness ($\mu_{1/2} = 6$) and perceived ease of use ($\mu_{1/2} = 6$) of the original version of *Alzaid* (Fig. 4) are significantly greater than a specified median of 5. Then, overall, the original version of *Alzaid* was perceived as quite likely to be usable and quite likely to be useful regardless of the fact that the processes related to patient monitoring of participant day centers were different from the monitoring process for which the original version of *Alzaid* was designed. As shown in Fig. 4, responses different from the median of 6 were considered outliers according to Tukey's rule. Fig. 5 shows a word cloud (generated using a bag-of-words model) of the comments made by the participants in relation to the original version of *Alzaid*. As observed, the comments of participants were mostly positive and related to *usability* and *usefulness*.

The data from the semi-structured interviews was analyzed using the grounded theory methodology, which resulted in explanatory diagrams (Fig. 6), substantive theories (Table 8), and business process models (Figs. 10, 11, and 12 of Appendix A) for each day center. It should be noted that the business process models were validated by personnel of the participant day centers.

In particular, the qualitative analysis based on the grounded theory and the business process modeling led to the identification of new requirements for the redesign of *Alzaid*, which are listed in Table 9.

Results of the unification of requirements

The outcomes of the requirement unification process include i) results related to new/complementary requirements (Table 9) and conflict detection for the redesign of *Alzaid*; ii) results regarding a set of resolutions to the conflicts in requirements from the involved day centers (Table 10); and iii) results about the day centers' level of agreement on the unification of requirements (Fig. 7).

Table 8 Substantive theories of the participant day centers

Substantive theory of *Alzheimer México I.A.P.*

The day center has seven areas: nursing, geriatric, physiotherapy, nutrition, physiological, family, and initial assessment. Patients are categorized into *functional*, *semi-functional*, *semi-dependent*, and *dependent* according to their physical/cognitive abilities. The *nursing area* keeps records of patients' vital signs, diagnoses, medications, and symptoms. The *geriatric area* is in charge of patients' physiological needs and personal hygiene in addition to keeping logs of patients' performance. The *physiotherapy area* keeps track of patients' performance in physiotherapies. The *nutrition area* keeps records of patients' body composition, nourishment, hydration levels, and feeding problems. The *psychology area* assesses patients and serves as a communication channel between patients' relatives and the formal caregivers of the day center. Also, it coordinates the training of both patients' relatives and formal caregivers. The *family area* coordinates with the relatives of patients to monitor patients at home. The *initial assessment area* is in charge of assessing patients' initial condition. Finally, patients are assessed weekly, quarterly, and semi-annually by the aforementioned areas. If there is a relevant change in patients' health, family members are advised to carry out a reassessment of their physical/cognitive deterioration.

Substantive theory of *Asociación Alzheimer Tampico-Madero A.C.*

The day center has six areas: medical, rehabilitation, psychology, nutrition, family, and initial assessment. Patients are categorized into *initial*, *intermediate*, and *advanced* according to their physical/cognitive abilities. However, the activities carried out by patients are determined according to their preferences and physical/cognitive abilities. Personnel of the *medical area* monitor and assist patients in daily activities. Nurses assist in the healthcare of patients. A physician is responsible for interviewing family members and conducting the initial assessment of patients. In addition, the physician monitors patients' performance on daily activities and defines their diets. The *rehabilitation area* is in charge of providing physical therapies for patients. Regarding psychological support, this is provided by an external psychologist that is in charge of assessing patients' initial condition and determining the type of dementia he/she may suffer. Similarly, nutritional support is provided by an external nutritionist that defines meal menus for patients. The *family area* coordinates with the relatives of patients to monitor patients at home. The *initial assessment area* is in charge of creating a file of patients' personal and clinical data.

Substantive theory of *Centro Gerontológico Ryanmas A.C.*

The day center has six areas: nursing, geriatric, therapy, family, psychology, and nutrition. The first four areas are managed by staff of the day center, while the services of the last two areas are provided by external entities that visit the day center twice a month. When patients are admitted, they undergo an initial assessment by a geriatrician. Subsequently, the *nursing area* assesses patients' physical condition and records recent incidences and treatments. Additional data collected include patients' vital signs as well as data related to patients' performance on physical activities and physical therapies. Also, a detailed record of water consumption is kept. After physical therapy, patients are provided with snacks. In addition, patients are taken to the restroom at specific times of the day. Cognitive stimulation activities are carried out according to patients' abilities. Geriatricians are notified whenever patients exhibit anomalous behaviors or symptoms to reassess their physical condition and cognitive functions, and thus, adjust treatments and activities. All the above data is considered to determine patients' progression in a monthly basis.

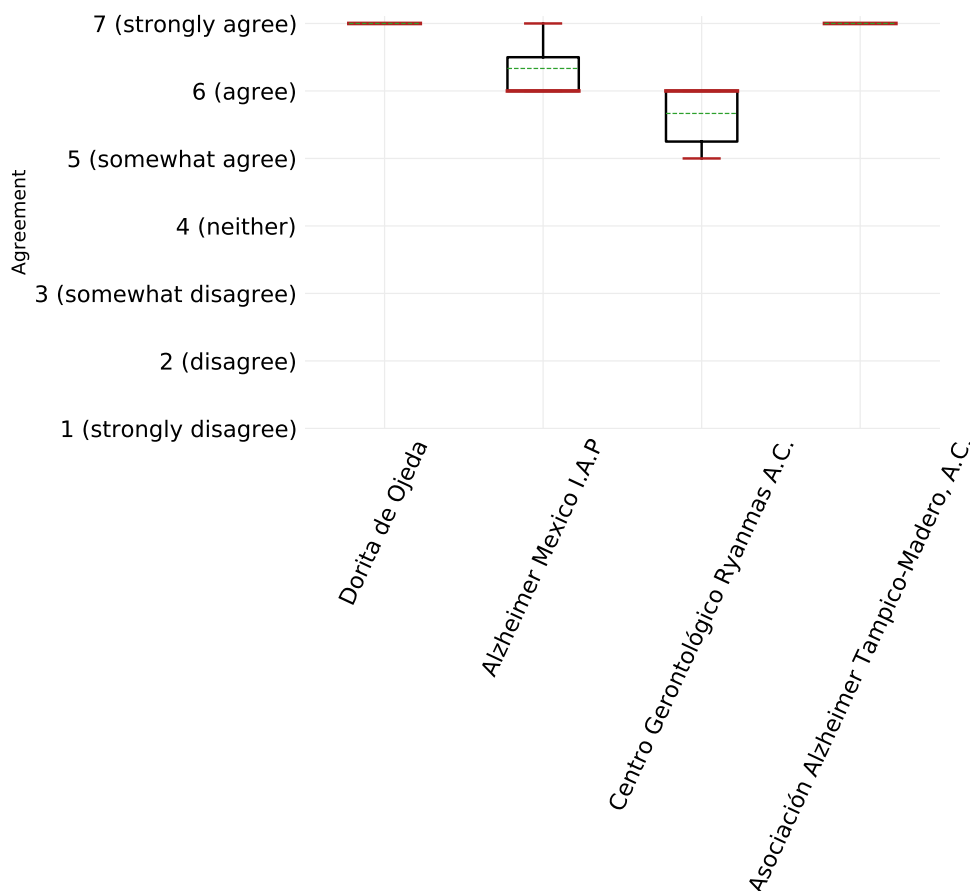**Fig. 7** Day centers' level of agreement on the unification of requirements

Table 9 Areas according to each day center

ID	Requirement description	Requirement category
Nutrition era		
ARQ1	Record caregivers' observations regarding swallowing problems of patients during meals.	In conflict with the original version
ARQ2	Record any type of disease that may affect patient nutrition.	New
ARQ3	Record patients' special diets (if any).	In conflict with the original version
ARQ4	Record patients' ability to use flatware during meals.	In conflict with the original version
ARQ5	Record whether the type of food ingested by patients was liquid or solid.	In conflict with the original version
ARQ6	Record any type of abnormal behavior of patients during meals.	In conflict with the original version
ARQ7	Record patients' daily water consumption in milliliters.	New and in conflict with RRQ2
RRQ1	Record whether patients eat.	In conflict with the original version
RRQ2	Record the number of glasses of water consumed by patients during the day.	New and in conflict with ARQ7
TRQ1	Record patients' special diets (if any).	In conflict with the original version
TRQ2	Record patients' daily meal menus.	Complementary
TRQ3	Record whether the type of food ingested by patients was regular or pap.	In conflict with the original version
Nursing era		
ARQ8	Record patients' medication regimen.	New
ARQ9	Record patients' medication intake during the day.	New
ARQ10	Record patients' vital signs.	Already in the original version
ARQ11	Record patients' medical history.	New
RRQ3	Record patients' medication regimen.	New
RRQ4	Record patients' medication intake during the day.	New
RRQ5	Record schedules for medication administration for each patient.	New
RRQ6	Record history of patients' medical consultations.	New
RRQ7	Record patients' skin lesions or wounds (e.g., ulcers).	Complementary
RRQ8	Record patients' vital signs related to temperature and respiratory rate.	Complementary
TRQ4	Record patients' medication regimen.	New
TRQ5	Record patients' body temperature.	Complementary
TRQ6	Record patients' Covid-19 symptoms (if any).	New
Physiotheraphy era		
ARQ12	Record patients' performance on physiotherapy.	Already in the original version
ARQ13	Record whether patients were drowsy during physiotherapy.	New
Phase area (therapeutic intervention)		
ARQ14	Record patients' time and space awareness using standard instruments.	Already in the original version
ARQ15	Record observations regarding cognitive activities performed by patients.	Already in the original version
RRQ9	Record therapy types carried out by patients.	Complementary
Hygiene area		
ARQ16	Record observations regarding patients' personal hygiene.	Already in the original version
ARQ17	Record patients' emotional state during hygiene activities (e.g., sad).	New
ARQ18	Record patients' behavior during tooth brushing.	New
RRQ10	Record observations regarding patients' personal hygiene.	Already in the original version
RRQ11	Record the number of times a patient goes to the restroom.	In conflict with the original version
TRQ7	Record the number of times a patient goes to the restroom.	In conflict with the original version
TRQ8	Record observations regarding patients' personal hygiene.	Already in the original version
Family area		
ARQ19	Record patients' progression as perceived by family members.	New
ARQ20	Record patients' vital signs while they are at home.	New
ARQ21	Record foods ingested by patients while they are at home.	New
RRQ12	Record patients' abnormal behaviors while they are at home.	Already in the original version
RRQ13	Record patients' progression as perceived by family members.	New

Table 9 (continued)

ID	Requirement description	Requirement category
Nutrition era		

Initial assessment area		
ARQ22	Record whether patients have suffered from Covid-19.	New
ARQ23	Record whether patients have vision impairments.	New
ARQ24	Record whether patients suffer from muscle atrophy.	New
ARQ25	Record patients' previous surgical interventions.	New
ARQ26	Record patients' allergies (if any).	Already in the original version
ARQ27	Record patients' body composition (e.g., weight).	New
RRQ14	Record the type of dementia suffered by patients.	Already in the original version
RRQ15	Record patients' physical limitations (if any).	Already in the original version
RRQ16	Record patients' physical problems.	Already in the original version
RRQ17	Record patients' abnormal behaviors.	Already in the original version
RRQ18	Record information about patients' family environment.	New
TRQ9	Record patients' nutritional issues.	New
TRQ10	Record patients' allergies (if any).	Already in the original version
TRQ11	Record patients' special diets (if any).	In conflict with the original version
TRQ12	Record the type of food that patients usually consume.	New
TRQ13	Record patients' previous hobbies.	New
TRQ14	Record patients' previous jobs.	New
TRQ15	Record information about the closest relatives of patients.	New
Psychology area		
ARQ28	Record Mini-Mental State Examination (MMSE) results.	New
ARQ29	Record Montreal Cognitive Assessment (MoCA) results.	New

The requirements elicited were analyzed and grouped by area, which were defined by common agreement among the participant day centers (see the first column of Table 11).

As shown in Table 9, requirements were categorized according to the day center from which they were elicited and reorganized into: i) *new requirement*, i.e., requirements absent from the original version of *Alzaid*; ii) *complementary requirement*, i.e., requirements present in the original version of *Alzaid*, but that need to be adjusted; iii) *requirement in conflict with the original version and/or another requirement*; and iv) *requirement already in the original version* of Alzaid. Overall, 31 new requirements were elicited. In addition, only five original requirements required adjustments, which were mostly related to complementing information. Regarding the conflicts in requirements, these were related to metric scales and terminology.

Conflicting requirements were discussed in a remote session by all the involved day centers, which were asked for feasible conflict resolutions with the aim of unifying requirements. The mutually agreed resolutions are reported in Table 10. There was a myriad of resolutions ranging from using standard metric scales to agreeing on terminology. However, in several cases, the involved day centers requested to add a free-text field, so they can have freedom of choice as to what and how to record certain information.

The mutually agreed resolutions were validated by participants holding management-level positions in each of the involved day centers. As shown in Fig. 7, the overall median was 6 indicating that the involved day centers agreed on the unification of requirements. The results of one-sample Wilcoxon signed-rank tests revealed that such median of 6 (*agree*) is significantly greater than a specified median of 5 (*somewhat agree*), which confirmed its significance.

Results of the construction and evaluation of the high-fidelity prototype of the redesigned version of *Alzaid*

Figure 8 presents screens of the high-fidelity prototype of the redesigned version of *Alzaid* developed from the unified requirements reported in Table 12. This prototype was evaluated by 14 participants using the TAM-3.

The results of one-sample Wilcoxon signed-rank tests indicate that the medians of the *perceived usefulness* construct ($\mu_{1/2} = 6$) and of the *perceived ease of use* construct ($\mu_{1/2} = 6$) are significantly greater than a specified median of 5. This confirms that the redesigned version of *Alzaid* was perceived as quite likely to be useful and as quite likely to be usable (Fig. 9).

Table 10 Resolution to conflicting requirements

Conflicting requirements	Description of conflicts	Conflict resolution
ARQ7/RRQ2	Daily water consumption by patients is recorded by day center *Alzheimer México I.A.P.* in milliliters, whereas day center *Centro Gerontológico Ryanmas, A.C.* records it in number of glasses per day.	It was agreed to measure daily water consumption in milliliters.
TRQ2	In the original version of *Alzaid*, a general meal menu is recorded for all patients. However, day center *Asociación Alzheimer Tampico-Madero, A.C.* may record different daily meal menus for each patient.	It was agreed to include a free-text field to add comments on the menu of each patient.
RRQ8/TRQ5	In the original version of *Alzaid*, patients' vital signs are recorded based on a predefined list that includes *blood pressure, blood glucose, oxygen saturation,* and *heart rate*. However, day center *Centro Gerontológico Ryanmas, A.C.* suggested including *temperature and respiratory rate,* while day center *Asociación Alzheimer Tampico-Madero, A.C.* also suggested including *temperature*.	It was agreed to include *temperature and respiratory rate* in the list of vital signs.
RRQ7	In the original version of *Alzaid*, incidents are recorded based on a predefined list. However, day center *Centro Gerontológico Ryanmas, A.C.* suggested not restricting incident types to a predefined set.	It was agreed to include an additional free-text field to describe any other relevant incident.
RRQ9	In the original version of *Alzaid*, therapies carried out by patients are selected from a predefined list. However, day center *Centro Gerontológico Ryanmas, A.C.* suggested not restricting therapies to a predefined set since these may vary across day centers.	It was agreed to incorporate a free-text field to record other therapies not included in the predefined list.
ARQ1	In the original version of *Alzaid*, the severity of swallowing problems is measured using a 0 to 5 scale. However, day center *Alzheimer México I.A.P.* indicated that the severity of swallowing problems could be measured according to other scales.	It was agreed to keep the scale included in the original version of *Alzaid* in addition to including a free-text field for observations.
ARQ1	In the original version of *Alzaid*, swallowing problems are referred to as *deglutition*, while in day center *Alzheimer México I.A.P.* as *dysphagia*.	It was agreed to use the term *degree of dysphagia* to refer to swallowing problems.
ARQ5/TRQ3	In the original version of *Alzaid*, the physical state of foods ingested by patients is categorized into *regular, pap,* and *shredded.* However, day center *Alzheimer México I.A.P.* makes use of the terms *liquid and solid,* and day center *Asociación Alzheimer Tampico-Madero, A.C.* makes use of the terms *regular and pap.*	It was agreed to keep the food categories included in the original version of *Alzaid.*
ARQ6	In the original version of *Alzaid*, the degree of abnormal behavior exhibited by patients is measured using a 0 to 5 scale. However, day center *Alzheimer México I.A.P.* uses free descriptions for recording abnormal behaviors.	It was agreed to keep the scale included in the original version of *Alzaid* in addition to including a free-text field for observations.
RRQ1	In the original version of *Alzaid*, the amount of food ingested by patients is categorized into *too little, regular,* and *too much.* However, day center *Centro Gerontológico Ryanmas, A.C.* suggested recording only whether patients eat or do not eat.	It was agreed to keep the scale included in the original version of *Alzaid* in addition to including a free-text field for observations.
ARQ4	In the original version of *Alzaid*, the performance of patients in the use of flatware during meals is referred to as *independence during meals.* However, day center *Alzheimer México I.A.P.* refers to the same aspect as *mobility during meals.*	It was agreed to keep the terminology of the original version of *Alzaid*, namely, *independence during meals.*
ARQ4	In the original version of *Alzaid*, the performance of patients in the use of flatware during meals is measured using a 0 to 5 scale. However, day center *Alzheimer México I.A.P.* makes use of free descriptions to record observations about the use of flatware.	It was agreed to keep the scale included in the original version of *Alzaid* in addition to including a free-text field for observations.
ARQ3/TRQ1/TRQ11	In the original version of *Alzaid*, a general meal menu is recorded for all patients. However, day centers *Asociación Alzheimer Tampico-Madero, A.C., Alzheimer México I.A.P.,* and *Centro Gerontológico Ryanmas, A.C.* record personalized menus for each patient.	It was agreed to keep a general menu in addition to including a free-text field for comments related to personalized menus.
RRQ11/TRQ7	In the original version of *Alzaid*, the number of times and the reason a patient goes to the restroom is recorded. However, day centers *Centro Gerontológico Ryanmas, A.C.* and *Asociación Alzheimer Tampico-Madero, A.C.* only record the number of times a patient goes to the restroom.	It was agreed to record the number of times and the reason a patient goes to the restroom in addition to including a free-text field for observations.

Table 11 Resolution to conflicting requirements

Alzaid areas	Alzheimer México I.A.P.	Asociación Alzheimer Tampico-Madero, A.C.	Centro Gerontológico Ryanmas, A.C.
Nursing	Nursing	Medical	Nursing
Hygiene	Geriatric	Medical	Geriatric
Physiotherapy	Physiotherapy	Rehabilitation	Therapy
Nutrition	Nutrition	(External) Nutrition	Nutrition
Phase	Geriatric	Medical	(External) Geriatric
Psychology	Psychology	(External) Psychology	(External) Geriatric
Family	Family	Family	Family
Initial assessment	Initial assessment	Initial assessment	Initial assessment

Moreover, regarding *Alzaid*'s relevance and the participants' intention to use it, the results of one-sample Wilcoxon signed-rank tests revealed that the medians of the *job relevance* construct ($\mu_{1/2} = 7$) and the *behavioral intention* construct ($\mu_{1/2} = 7$) are significantly greater than a specified median of 5. These results suggest that the high-fidelity prototype was perceived as (at least) quite likely to be relevant in the job of monitoring PwD and as (at least) quite likely to be used by the participants (Fig. 9).

Furthermore, regarding the quality of *Alzaid*'s output, the result of an one-sample Wilcoxon signed-rank test suggests that the median of the *output quality* construct ($\mu_{1/2} = 6$) is significantly greater than a specified median of 5. This indicates that the participants perceived that it was quite likely that the quality of *Alzaid*'s output is high (Fig. 9).

Based on the evaluation constructs' medians of the TAM-3, other relevant results presented in Fig. 9 indicate that the participants:

- Perceived that it is quite likely that senior management of their corresponding day center support the use of *Alzaid*.
- Could complete the job using *Alzaid*.
- Would find the use of *Alzaid* between slightly and quite likely to be enjoyable.
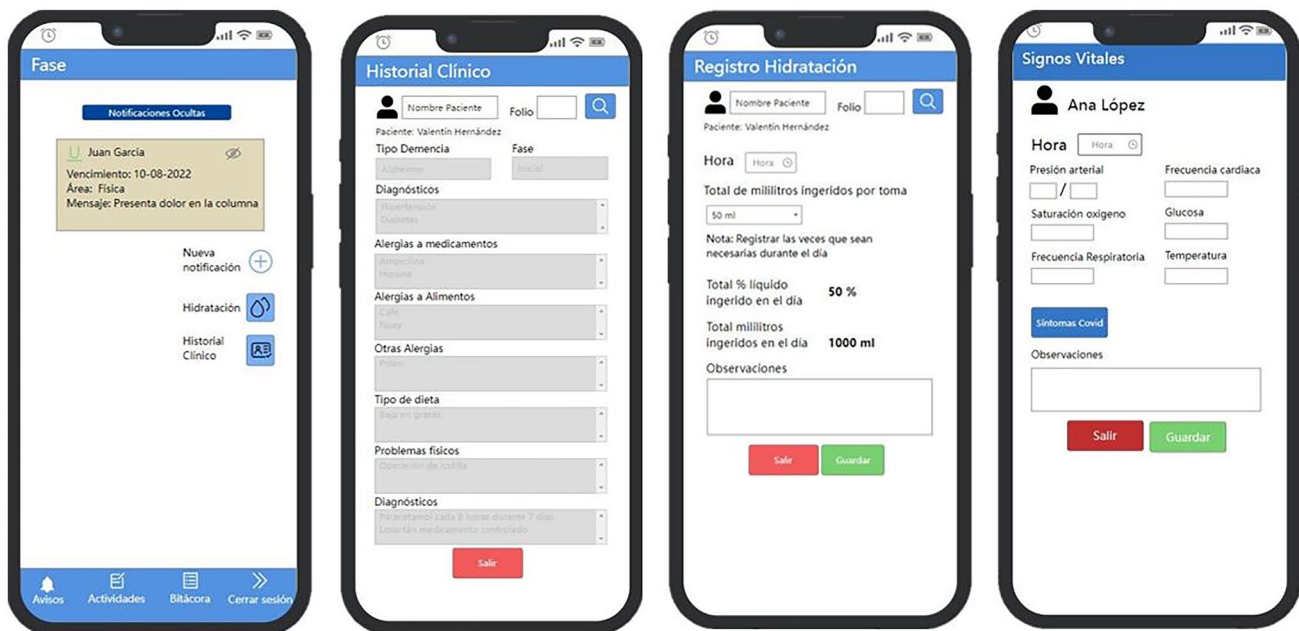- Found that it is extremely likely that the results of using *Alzaid* are apparent to them.

**Fig. 8** High-fidelity prototype of the redesigned version of *Alzaid*

Table 12 Summary of unified requirements validated by the participant day centers

Requirement description	Input type
Daily assessment area	
Record patient attendance at the day center.	Attended/Absent
Record patients' time and space awareness using standard instruments.	Aware/Unaware
Nutrition area	
Record the amount of food ingested by patients.	Too little/Regular/Too much
Record the type of food ingested by patients.	Regular/Pap/Shredded
Record patients' independence during meals.	0 to 5 scale
Record patients' degree of dysphagia.	0 to 5 scale
Record observations regarding patients' swallowing problems.	Text
Record patients' general meal menu.	Text
Record observations regarding patients' special diets (if any).	Text
Record patients' allergies (if any)	Text
Record patients' body composition (e.g., weight).	Text
Record water consumption by patients.	Daily water consumption in milliliters
Record any type of disease that may affect patient nutrition.	Text
Nursing area	
Record patients' medical history.	Text
Record history of patients' medical consultations.	Text
Record patients' medication regimen.	Text
Record patients' skin lesions or wounds (e.g., ulcers).	Text
Record patients' blood pressure.	Standard blood pressure values in older adults
Record patients' blood glucose.	Standard blood glucose values in older adults
Record patients' oxygen saturation.	Standard oxygen saturation values in older adults
Record patients' heart rate.	Standard heart rate values in older adults
Record patients' respiratory rate.	Standard respiratory rate values in older adults
Record patients' body temperature.	Standard temperature values in older adults
Record patients' Covid-19 symptoms (if any).	Text
Record patients' medication intake during the day.	Medication regimen adherence
Record schedules for medication administration for each patient.	Medication regimen adherence
Physiotherapy area	
Record patients' performance on physiotherapy.	0 to 5 scale
Record whether patients were drowsy during physiotherapy.	0 to 5 scale
Record patients' emotional state before, during and after physiotherapy.	Sad/Neutral/Happy
Record observations related to patients' physiotherapy.	Text
Record the type of physiotherapy performed by patients.	Type of physiotherapy
Phase area (therapeutic intervention)	
Record patients' performance on cognitive therapies.	0 to 5 scale
Record the type of therapy carried out by patients.	Text
Hygiene area	
Record the number of times a patient goes to the restroom.	Number of times
Record the reason a patient goes to the restroom.	Text
Record the number of patients' clothing changes due to hygiene incidences.	Number of times
Record observations related to constipation in patients.	Number of times a patient goes to the restroom
Record patients' perceived bowel movements.	Text
Record observations regarding patients' personal hygiene.	Text
Record patients' emotional state during hygiene activities.	Sad/Neutral/Happy
Record patients' behavior during tooth brushing.	0 to 5 scale
Family area	
Record the number of bowel evacuations of patients at home.	Number of times
Record the number of times a patient urinates at home.	Number of times

Table 12 (continued)

Requirement description	Input type
Record the number of hours of sleep of patients at home.	Number of hours
Record perceived patients' incontinence.	Text
Record patients' abnormal behaviors at home.	Text
Record patients' relevant incidents at home.	Text
Record patients' mood at home.	Text
Record patients' unusual visits.	Text
Record patients' unusual phone calls from family members.	Text
Record the type of food ingested by patients at home.	Regular/Pap/Shredded
Record the amount of food ingested by patients at home.	Too little/Regular/Too much
Record patients' progression as perceived by family members.	Text
Record patients' vital signs at home.	Standard metrics
Initial assessment area	
Record whether patients have suffered from Covid-19.	Yes/No
Record patients' Covid-19 symptoms.	Text
Record whether patients have vision impairments.	Yes/No
Record whether patients suffer from muscle atrophy.	Yes/No
Record patients' previous surgical interventions.	Text
Record patients' allergies (if any).	Text
Record patients' body composition (e.g., weight).	According to standard metrics
Record patients' physical limitations (if any).	Text
Record patients' physical disabilities (if any).	Text
Record patients' official dementia diagnosis.	Type of dementia
Record patients' abnormal behaviors.	Text
Record information about patients' family environment.	Text
Record patients' previous jobs.	Text
Record patients' nutritional issues.	Text
Record patients' special diets (if any).	Text
Record the type of food that patients usually consume.	Text
Record patients' favorite food.	Text
Record patients' life history.	Text
Record patients' previous hobbies.	Text
Record information about the closest relatives of patients.	Text
Psychology area	
Record patients' progression from the perspective of a psychologist.	Text
Record patients' level of independence.	Text
Record Mini-Mental State Examination (MMSE) results.	According to standard metrics
Record Montreal Cognitive Assessment (MoCA) results.	According to standard metrics

Fig. 9 Evaluation of the high-fidelity prototype of the redesigned version of *Alzaid* using the TAM-3
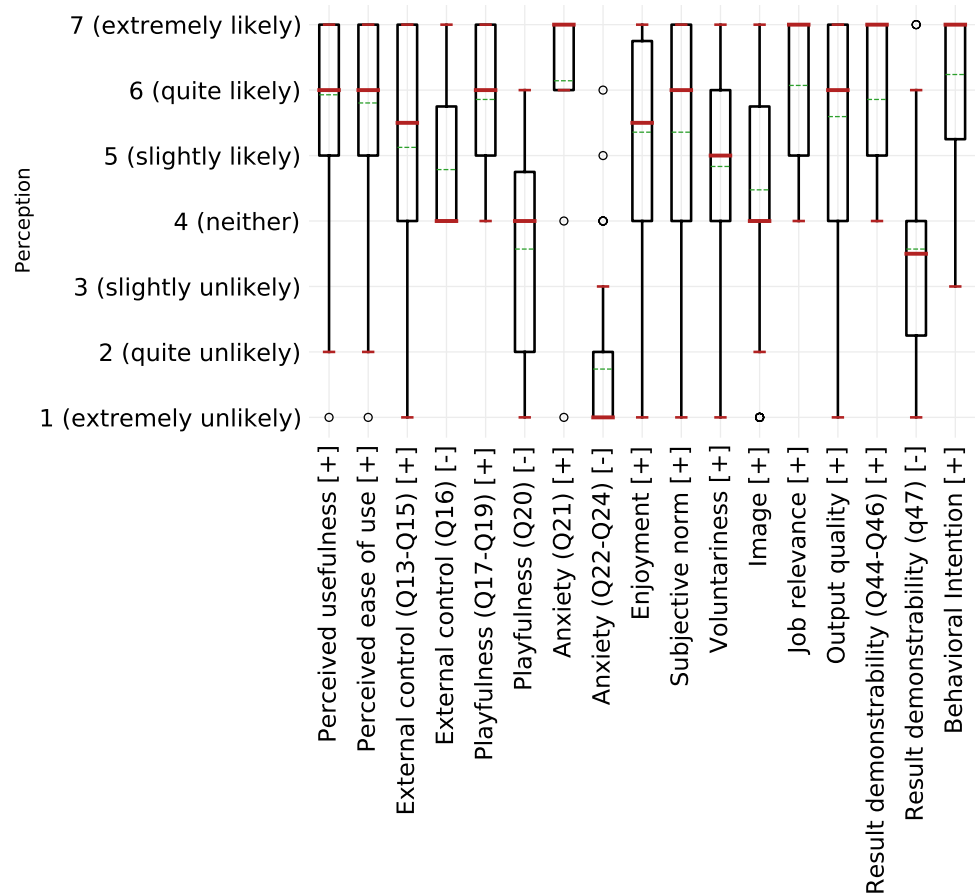
Conclusions

The relevance of this work is that (to the best of the authors' knowledge) it is the first effort towards a standard monitoring process of PwD in the context of day centers of the Mexican Federation of Alzheimer (FEDMA). This resulted from unifying their requirements for monitoring patients, which were implemented in the redesign of *Alzaid*, a technological platform for assisting formal caregivers in monitoring PwD.

Overall, the participant day centers agreed on the unification of requirements. The resultant redesign of *Alzaid* was perceived by personnel of four participant day centers as quite likely to be useful, quite likely to be usable, and quite likely to be relevant in the job of monitoring PwD. Furthermore, in general, the participants considered the output of the redesigned version of *Alzaid* to be of high quality.

It is acknowledged that some participants interacted with and evaluated both the original version of Alzaid and the redesigned version of Alzaid, which may have induced a bias in the evaluation of the redesign version of Alzaid. Another limitation of this study is that only members of FEDMA participated in the redesign of Alzaid, which is an effort towards a standard monitoring process of PwD.

The implementation of the redesigned version of *Alzaid* based on the unified requirements is in progress. Hence, future work involves analyzing its actual adoption by the formal caregivers of the participant day centers.

Appendix A: Business process models

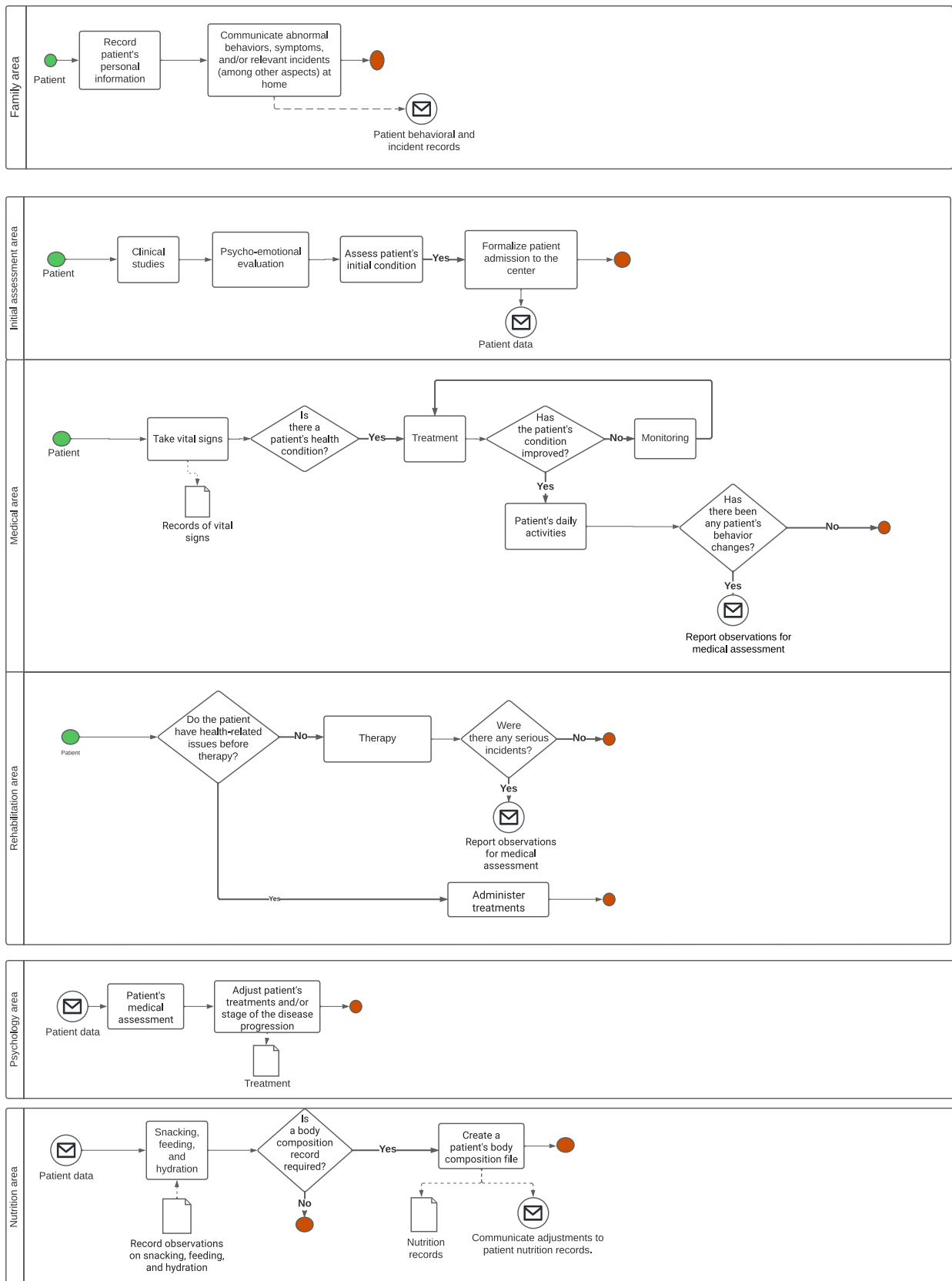**Fig. 10** Business process models of day center *Alzheimer México I.A.P.*
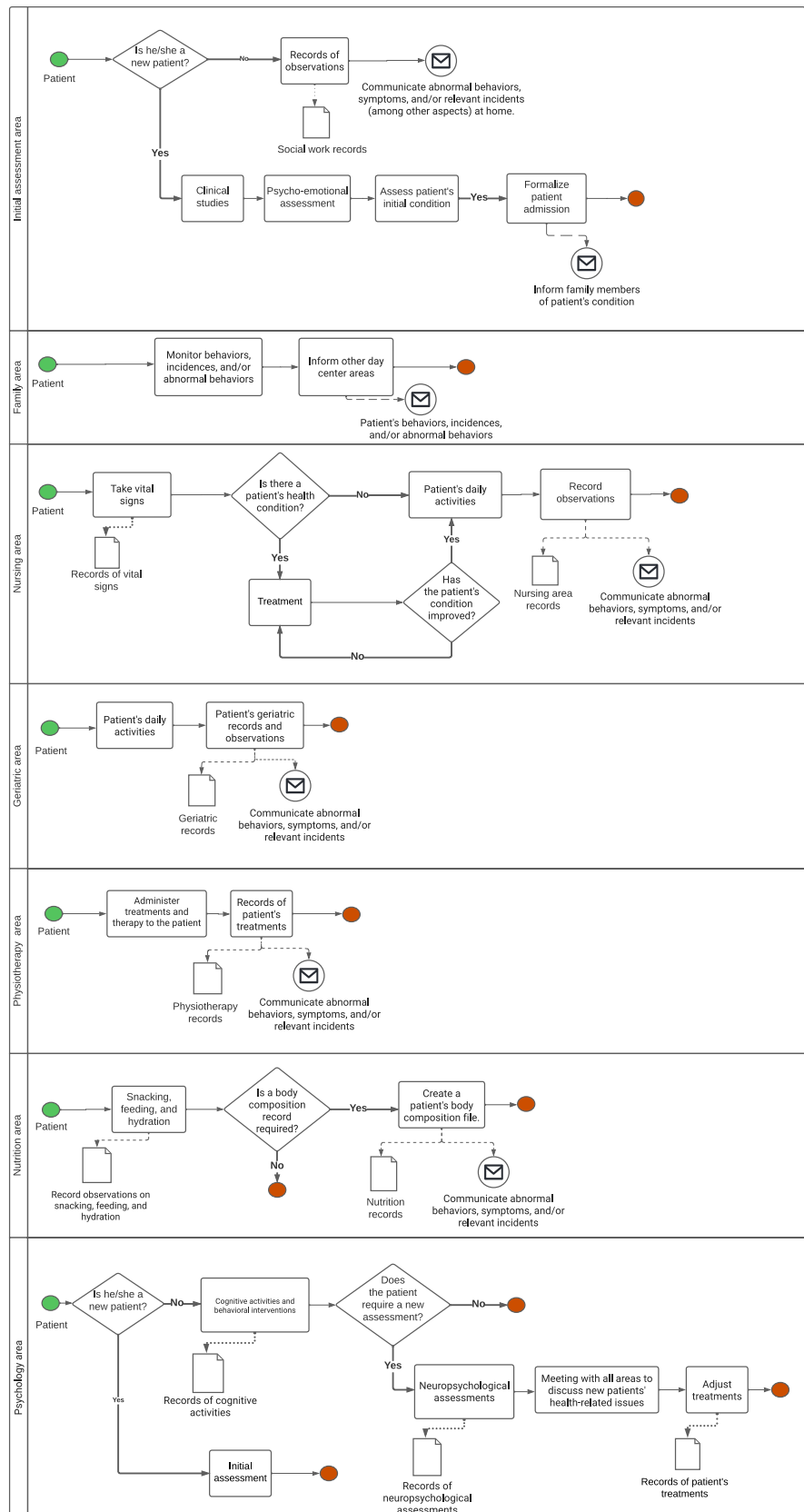
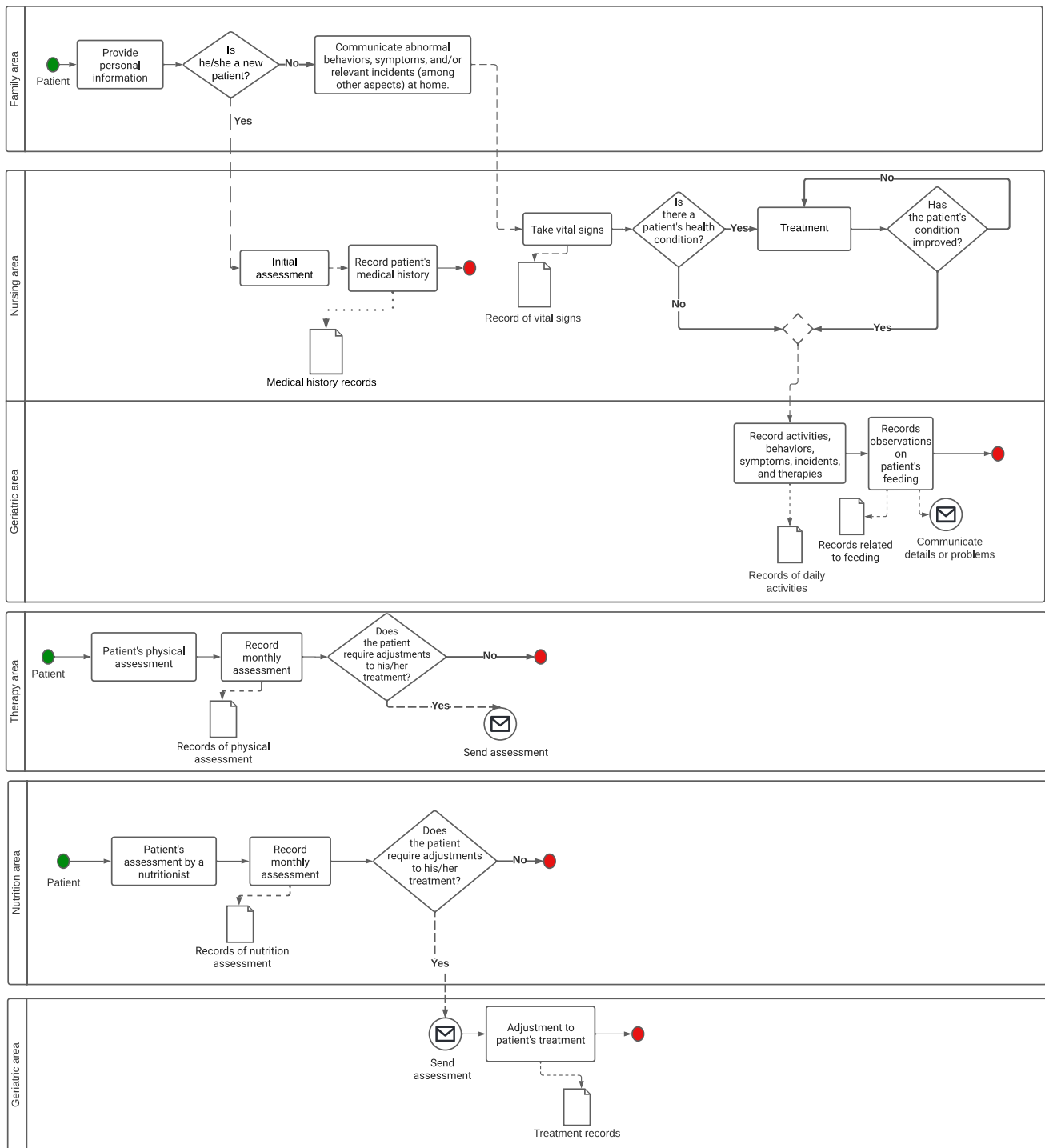**Fig. 11** Business process models of day center *Asociación Alzheimer Tampico-Madero A.C.*

Fig. 12 Business process models of day center *Centro Gerontológico Ryanmas A.C.*

Table 13 Questionnaire (based on the TAM-3) to evaluate the redesigned version of *Alzaid*

ID	Question
Perceived usefulness	
Q_1	Using *Alzaid* improves my performance in my job.
Q_2	Using *Alzaid* in my job increases my productivity.
Q_3	Using *Alzaid* enhances my effectiveness in my job.
Q_4	I find *Alzaid* to be useful in my job.
Perceived ease of use	
Q_5	My interaction with *Alzaid* is clear and understandable.
Q_6	Interacting with *Alzaid* does not require a lot of my mental effort.
Q_7	I find *Alzaid* to be easy to use.
Q_8	I find it easy to get *Alzaid* to do what I want it to do.
Computer self-efficacy	
	I could complete the job using *Alzaid*.
Q_9	If there was no one around to tell me what to do as I go.
Q_{10}	If I had just the built-in help facility for assistance.
Q_{11}	If someone showed me how to do it first.
Q_{12}	If I had used similar packages before this one to do the same job.
Perceptions of external control	
Q_{13}	I have control over using *Alzaid*.
Q_{14}	I have the resources necessary to use *Alzaid*.
Q_{15}	Given the resources, opportunities and knowledge it takes to use *Alzaid*, it would be easy for me to use *Alzaid*.
Q_{16}	*Alzaid* is not compatible with other systems I use.
Computer playfulness	
	How you would characterize yourself when you use computers:
Q_{17}	Spontaneous.
Q_{18}	Creative.
Q_{19}	Playful.
Q_{20}	Unoriginal.
Computer anxiety	
Q_{21}	Computers do not scare me at all.
Q_{22}	Working with a computer makes me nervous.
Q_{23}	Computers make me feel uncomfortable.
Q_{24}	Computers make me feel uneasy.
Perceived enjoyment	
Q_{25}	I find using *Alzaid* to be enjoyable.
Q_{26}	The actual process of using *Alzaid* is pleasant.
Q_{27}	I have fun using *Alzaid*.
Objective usability	
	No specific items were used. It was measured as a ratio of time spent by the subject to the time spent by an expert on the same set of tasks.
Subjective norm	
Q_{28}	People who influence my behavior think that I should use *Alzaid*.
Q_{29}	People who are important to me think that I should use *Alzaid*.
Q_{30}	The senior management of this business has been helpful in the use of *Alzaid*.
Q_{31}	In general, the organization has supported the use of *Alzaid*.
Voluntariness	
Q_{32}	My use of *Alzaid* is voluntary.
Q_{33}	My supervisor does not require me to use *Alzaid*.
Q_{34}	Although it might be helpful, using *Alzaid* is certainly not compulsory in my job.
Image	
Q_{35}	People in my organization who use *Alzaid* have more prestige than those who do not.

Table 13 (continued)

ID	Question
Q$_{36}$	People in my organization who use *Alzaid* have a high profile.
Q$_{37}$	Having *Alzaid* is a status symbol in my organization.
Job relevance	
Q$_{38}$	In my job, usage of *Alzaid* is important.
Q$_{39}$	In my job, usage of *Alzaid* is relevant.
Q$_{40}$	The use of *Alzaid* is pertinent to my various job-related tasks.
Output quality	
Q$_{41}$	The quality of the output I get from *Alzaid* is high.
Q$_{42}$	I have no problem with the quality of *Alzaid*'s output.
Q$_{43}$	I rate the results from *Alzaid* to be excellent.
Result demonstrability	
Q$_{44}$	I have no difficulty telling others about the results of using *Alzaid*.
Q$_{45}$	I believe I could communicate to others the consequences of using *Alzaid*.
Q$_{46}$	The results of using *Alzaid* are apparent to me.
Q$_{47}$	I would have difficulty explaining why using *Alzaid* may or may not be beneficial.
Behavioral intention	
Q$_{48}$	Assuming I had access to *Alzaid*, I intend to use it.
Q$_{49}$	Given that I had access to *Alzaid*, I predict that I would use it.
Q$_{50}$	I plan to use *Alzaid* in the next months.
Use	
Q$_{51}$	On average, how much time do you spend on *Alzaid* each day?

TAM-3 questionnaire

Data Availability The raw data analyzed in this article can be downloaded from https://github.com/octavio-gutierrez/raw_data_evaluation_alzaid_jms.

Declarations

Ethics Approval According to our Research Ethics Committee's policies, no ethical approval is required for this project as the study was not conducted on patients and participants were only involved in the design and evaluation of a technological platform.

Informed Consent Informed consent was obtained from all participants.

Conflicts of Interest The authors declare that no competing interests exist.

References

1. Bari Antor, M., Jamil, A., Mamtaz, M., Monirujjaman Khan, M., Aljahdali, S., Kaur, M., Singh, P., Masud, M.: A comparative analysis of machine learning algorithms to predict alzheimer's disease. Journal of Healthcare Engineering **2021**, 9917919 (2021). https://doi.org/10.1155/2021/9917919

2. Maki, Y., Sakurai, T., Okochi, J., Yamaguchi, H., Toba, K.: Rehabilitation to live better with dementia. Geriatrics & gerontology international **18**(11), 1529–1536 (2018). https://doi.org/10.1111/ggi.13517

3. Rokstad, A.M.M., Engedal, K., Kirkevold, Ø., Benth, J.Š., Selbæk, G.: The impact of attending day care designed for home-dwelling people with dementia on nursing home admission: a 24-month controlled study. BMC health services research **18**(1), 1–11 (2018). https://doi.org/10.1186/s12913-018-3686-5

4. Chávez, A., Borrego, G., Gutierrez-Garcia, J.O., Rodríguez, L.-F.: Design and evaluation of a mobile application for monitoring patients with alzheimer's disease: A day center case study. International journal of medical informatics **131**, 103972 (2019). https://doi.org/10.1016/j.ijmedinf.2019.103972

5. Lin, C.-F., Wu, J.-J., Huang, Y.-H., Ju, L.-Y., Lin, S.-Y., Chou, Y.-C., Lin, C.-S.: Impact of day care services on physical and cognitive functions in old people with dementia in a medical center in central Taiwan. Health and Quality of Life Outcomes **19**(1), 1–8 (2021). https://doi.org/10.1186/s12955-021-01806-9

6. Kim, D.: The effects of a recollection-based occupational therapy program of alzheimer's disease: a randomized controlled trial. Occupational Therapy International **2020**, 6305727 (2020). https://doi.org/10.1155/2020/6305727

7. Park, E., Park, H., Kim, E.K.: The effect of a comprehensive mobile application program (cmap) for family caregivers of home-dwelling patients with dementia: a preliminary research. Japan Journal of Nursing Science **17**(4), 12343 (2020). https://doi.org/10.1111/jjns.12343

8. Reichold, M., Heß, M., Kolominsky-Rabas, P., Gräßel, E., Prokosch, H.-U., *et al.*: Usability evaluation of an offline electronic data capture app in a prospective multicenter dementia registry (digidem bayern): Mixed method study. JMIR formative research **5**(11), 31649 (2021). https://doi.org/10.2196/31649

9. Moshnyaga, V., Koyanagi, M., Hirayama, F., Takahama, A., Hashimoto, K.: A medication adherence monitoring system for people with dementia. In: (2016 IEEE International Conference on Systems, Man, and Cybernetics (SMC), pp. 194–199 (2016). https://doi.org/10.1109/SMC.2016.7844240. IEEE

10. Malmgren Fänge, A., Schmidt, S.M., Nilsson, M.H., Carlsson, G., Liwander, A., Dahlgren Bergström, C., Olivetti, P., Johansson, P., Chiatti, C.: The tech@ home study, a technological intervention to reduce caregiver burden for informal caregivers of people with dementia: study protocol for a randomized controlled trial. Trials **18**(1), 1–10 (2017). https://doi.org/10.1186/s13063-017-1796-8

11. Malmgren Fänge, A., Carlsson, G., Chiatti, C., Lethin, C.: Using sensor-based technology for safety and independence–the experiences of people with dementia and their families. Scandinavian Journal of Caring Sciences **34**(3), 648–657 (2020). https://doi.org/10.1111/scs.12766

12. Finnanger Garshol, B., Ellingsen-Dalskau, L.H., Pedersen, I.: Physical activity in people with dementia attending farm-based dementia day care–a comparative actigraphy study. BMC geriatrics **20**(1), 1–10 (2020). https://doi.org/10.1186/s12877-020-01618-4

13. Hassandra, M., Galanis, E., Hatzigeorgiadis, A., Goudas, M., Mouzakidis, C., Karathanasi, E.M., Petridou, N., Tsolaki, M., Zikas, P., Evangelou, G., : A virtual reality app for physical and cognitive training of older people with mild cognitive impairment: mixed methods feasibility study. JMIR serious games **9**(1), 24170 (2021). https://doi.org/10.2196/24170

14. Wang, G., Albayrak, A., Kortuem, G., van der Cammen, T.J., *et al.*, : A digital platform for facilitating personalized dementia care in nursing homes: formative evaluation study. JMIR Formative Research **5**(5), 25705 (2021). https://doi.org/10.2196/25705

15. Shiotani, M., Yamaguchi, K.: Research on an anomaly detection method for physical condition change of elderly people in care facilities. Advanced Biomedical Engineering **11**, 10–15 (2022). https://doi.org/10.14326/abe.11.10

16. Atee, M., Hoti, K., Hughes, J.D.: A technical note on the painchek™ system: a web portal and mobile medical device for assessing pain in people with dementia. Frontiers in aging neuroscience **10**, 117 (2018). https://doi.org/10.3389/fnagi.2018.00117

17. Rochin, M.A.E., Gutierrez-Garcia, J.O., Rosales, J.-H., Rodriguez, L.-F.: Design and evaluation of a dashboard to support the comprehension of the progression of patients with dementia in day centers. International Journal of Medical Informatics **156**, 104617 (2021). https://doi.org/10.1016/j.ijmedinf.2021.104617

18. Leante-Castellanos, J.L., Mañas-Uxó, M.I., Garnica-Martínez, B., Tomás-Lizcano, A., Muñoz-Soto, A.: Implementation of a regional standardised model for perinatal electronic medical records **46**, 103 (2022)

19. Venkatesh, V., Bala, H.: Technology acceptance model 3 and a research agenda on interventions. Decision sciences **39**(2), 273–315 (2008). https://doi.org/10.1111/j.1540-5915.2008.00192.x

20. Davis, F.D.: A technology acceptance model for empirically testing new end-user information systems: Theory and results. PhD thesis, Massachusetts Institute of Technology (1985)

21. Chun Tie, Y., Birks, M., Francis, K.: Grounded theory research: A design framework for novice researchers. SAGE open medicine **7** (2019). https://doi.org/10.1177/2050312118822927

22. Walker, D., Myrick, F.: Grounded theory: An exploration of process and procedure. Qualitative Health Research **16**(4), 547–559 (2006)

23. Chitchyan, R., Bird, C.: Theory as a source of software requirements. In: (2020 IEEE 28th International Requirements Engineering Conference (RE), pp. 227–237 (2020). https://doi.org/10.1109/RE48521.2020.00033. IEEE