

# Improving adult day services through technology: a user-based approach

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Adult day services (ADS) are receiving increased attention due to shifts in health and social policies encouraging home and community-based services for an aging population. However, some issues hinder ADS effectiveness such as the need of diversification of interventions focused on elderly people (with different needs and dependency levels) or the undertrained staff. This work presents an analysis of current ADS gaps from interviews to Spanish geriatric experts and scientific literature. An innovative user-based technology implementation is approached to address the most relevant missing gaps identified: formal assessment of user's skills and status before joining the ADS, establishment of personalised interventions for each user, user classification on groups according to characteristics of user members etc. This approach allows to assess elderly over time to generate knowledge about his/her psychological and physical conditions and about the general factors that accelerate/delay deterioration caused by age.

**1. Introduction:** The rise of dependency and ageing population are leading to the increase of people with care needs. Elderly care often means a highly demanding task with a level of stress experienced by family caregivers that influences changes in their health and well-being [1]. Nursing homes, as an alternative to family caregivers, have a long tradition on elderly care but the adequate social care for elderly and disabled people is not always a residential resource [2]. Between family and institutionalisation there are intermediary resources such as adult day service (ADS). ADS programmes offer out-of-home supervised activities and socialisation for older persons or other adults [3]. The goals of ADS programmes have two population targets: individuals and families. On one hand, ADS programmes aim both to support the different needs (i.e. health, nutritional, social and daily living) of individuals with/out functional limitations during the day time hours and to enhance their functional independence and quality of life. On the other hand, they offer families with relief from day-to-day care responsibilities of disabled relatives, improving the quality of life of all family members [4].

Although ADS benefits (e.g. delay/avoidance of hospitalisations and institutionalisations) are widely accepted, the evidence is still limited in the scientific literature [5–7]. A recent review states that although ADS was effective in certain domains of individual well-being, it did not seem to be successful in addressing physical functioning outcomes such as health, activity daily living dependency and behavioural problems [8]. Furthermore, the ADS positive impact on caregiver's well-being when it is used regularly over the course of time was confirmed, but the effect on participants remains unclear [9]. Thus, without longitudinal evaluations of ADS interventions on elderly (and how their skills and autonomy levels vary), it is difficult to generate evidences of ADS ability to delay or avoid institutionalisation.

The low (or unknown) effectiveness of ADS programmes hinders the deployment and proper exploitation of this kind of resources. For example, in Spain, only 4% of elderly currently using social services are involved in ADS programmes [10]. So, Spanish ADS are underused resources, mainly due to the misunderstanding of their crucial objective on the maintenance of elderly skills and the delay of institutionalisation.

This work presents an analysis of current ADS gaps from interviews to Spanish geriatric experts and the scientific literature. An innovative user-based technology implementation is approached to address the most relevant missing gaps identified. Results are framed on the research project ID3AM [11] developed by the authors in close collaboration with geriatric professionals as well as technology experts. The platform developed for assisting elderly care on ADS covers a set of tools: formal assessment of user's skills and status before joining the ADS, establishment of personalised interventions for each user, user classification on groups according to characteristics of user members, periodic assessment of user's skills and status, performance evaluation to monitor evolution of users and staff training. The system ID3AM has been validated in controlled settings and currently it is under evaluation in real scenarios.

**2. Material and methods:** The gathering of missing gaps on ADS was performed through both a set of semi-structured interviews to geriatricians and a literature review. Ten elderly care experts were interviewed about the current Spanish ADS practice and possibilities of improvement. A key question of these interviews was: *What are the biggest challenges that ADS should address to improve effectiveness?* In parallel, a literature review was performed to contextualise answers of Spanish professionals into the situation of ADS in developed countries. Several papers in scientific journals and directives and guidelines from elderly organisations have been analysed in this stage [1–9, 12–15].

From requirements gathered, the aim was to develop an IT system addressing missing gaps and strongly aligned to real needs of end-users (i.e. ADS professionals, caregivers and families), by maximising the efficiency in design and development processes. This objective motivated the adoption of a methodological approach based on user centred design [16] and agile development practices [17]. User participation on design and development eased the product final to be flexible enough to adapt itself to the needs, uses and preferences of each user no matter his/her characteristics (i.e. accessibility). Furthermore, a continuous evaluation based on user was assumed from the beginning of the development process as an integral part of it. It provided a valuable source of information

**Table 1** Answers of surveyed ADS professionals to the challenges to be addressed

Concerns	Answers (% , N = 10)
unattended particular needs of users	80
adoption of generalist interventions	70
not to review periodically user evolution	70
undertrained staff	60
changes in demographics	40
not provide family counselling	40
lack of public education	30
imbalanced ratios	30
inadequate physical facilities	20
lack of ADS quality assessment	20
funding	10
transportation	0

about the context of use and how users prefer interact with the system during its development. Continuous evaluation also improves system robustness since experience about system failures and how solving them leads to a special prevision of suitable alternatives when the failure can have consequences over the patient care.

**3. Missing gaps of ADS programmes:** Semi-structured interviews were performed to a set of ten ADS professionals (geriatricians and ADS managers) to understand which needs are more relevant in the current practice according their viewpoint and experience. Table 1 summarises the respondents' opinion to the main challenges that should be addressed to improve ADS effectiveness. Each respondent had to choose three to five concerns from a list of 12.

The most agreed challenges were: the need of meeting care needs (8/10) and establishing a personalised care plan for each user (7/10), the periodical assessment of user condition and evolution (7/10) and staff training (6/10). Other concerns such as the provision of counselling services for families (4/10), imbalanced ratios user/staff (3/10) or the quality assessment of ADS programmes (2/10) were considered less prioritised.

The most repeated challenge was the need of meeting care needs. This demands to perform a formal assessment of user's skills and status prior joining the ADS to understand current needs of the user. Thus, the efficiency of ADS programmes relies on the proper assessment of users' status such as cognitive level, degree of autonomy, psychosocial skills etc. Well-known assessment tools allow formally evaluating different fields of the user (e.g. health needs [18], independence in activities of daily living [19] or cognitive level [20]). The use of formal assessment tools is essential to ease the assignment of activities and interventions according to the particular characteristics of each user, to compare and classify users on groups (establishing a formal framework to establish similarities among users) and to have indicators of improvement (or deterioration) of users' status.

Since there is a wide variety of dependency levels requiring different and heterogeneous responses, the diversification of interventions focused on elderly people is needed. From a proper assessment of skills and needs of each user, a personalised intervention plan should be performed.

Activities in this plan must be adjusted to the user status to maintain (even improve) his/her physical and cognitive conditions. Seven of interviewed professionals stated that ADS cannot adopt a single intervention plan for all its users with no matter of their differences of status. A wrong user intervention leads to a quick deterioration of users' skills and the uselessness of ADS.

Respondents also indicated that, as part of the personalised care plan, often ADS users participate on activities based on groups. Each user must be grouped with peers of similar characteristics. Thus, for example, users with similar cognitive level can participate

together on socialisation activities showing a uniform level of performance. On the contrary, it is well known that a user in an advanced deterioration status can influence badly to a user with a moderate deterioration condition. So, the proper classification of users on groups according to similar characteristics is a key of user evolution.

Due to deterioration by ageing or issues (e.g. falls), skills and status of ADS users can decrease. Such reduction can mean new needs and even different interventions that what were originally planned for the user. So, besides the initial assessment before joining the ADS (what allows to establish the initial intervention plan), seven interviewed professionals stated that other assessments should be performed periodically or when an issue changes the user's conditions. These assessments may allow to identify early user needs to adjust interventions to conditions and capacities of each user.

Furthermore, the performance degree of each user in his/her planned activities (e.g. physical rehabilitation exercises, board games and interaction with peers) should be continuously evaluated. Deterioration of physical and psychological conditions caused by ageing is often subtle and hardly recognisable. Furthermore, there is a general lack of understanding of how ageing affect physical and psychological deterioration. A continuous evaluation of performance may allow identify the worsening of user condition when this data is analysed over time. Not only the decrease of user performance degree but also the observations that professionals can register about situations may be keys to identify an accelerated deterioration process originated by ageing.

Finally, another relevant concern of respondents was undertrained staff. The knowledge on the ageing process and the interventions to delay it is more and more specialised and requires trained and up-to-date professionals. ADS interventions need to be driven by professionals trained to understand the objective of each one, to ease its accomplishment for each ADS user, and to evaluate the performance degree of them. Auxiliary staff also contributes to the mobilisation and assistance of dependent users. Every staff member should be rightly trained not only for developing their tasks but also to understand the objectives of the ADS interventions. Inadequate trained staff will perform their tasks with no understanding or commitment on the maintenance of ADS users' skills and status.

**4. Technology tools for ADS missing gaps:** A general business process for ADS has been designed using business process model and notation (BPMN, Fig. 1). BPMN allows depicting the end-to-end flow of a business process and coordinating the sequence of processes and messages that flow between different participants in a related set of activities [21]. This model has been used to design and develop the software tools (i.e. the system ID3AM) with the objective of improving the social and healthcare of the ADS programmes while allowing managing their daily functioning.

The system is designed to address the three main areas of geriatric intervention (i.e. health, social and physical) and it involves four user roles: managers, geriatricians, professionals and auxiliary staff. Fig. 2 shows the main modules of the system: assessment, intervention, activity performance and e-learning. The four modules use ADS and user information stored in the dedicated database.

**4.1. Assessment module:** The proper care of elderly demands a personalised plan aligned to capabilities of each person to reduce aging deterioration and promote his/her skills. Capabilities assessment is required to efficiently tailor a general intervention plan to each user. In ID3AM, the assessment is performed at the admission stage and periodically while the user participates of the ADS programme. Three geriatric dimensions are assessed (i.e. functional, cognitive and nursing needs) to properly identify user limitations and care demands.

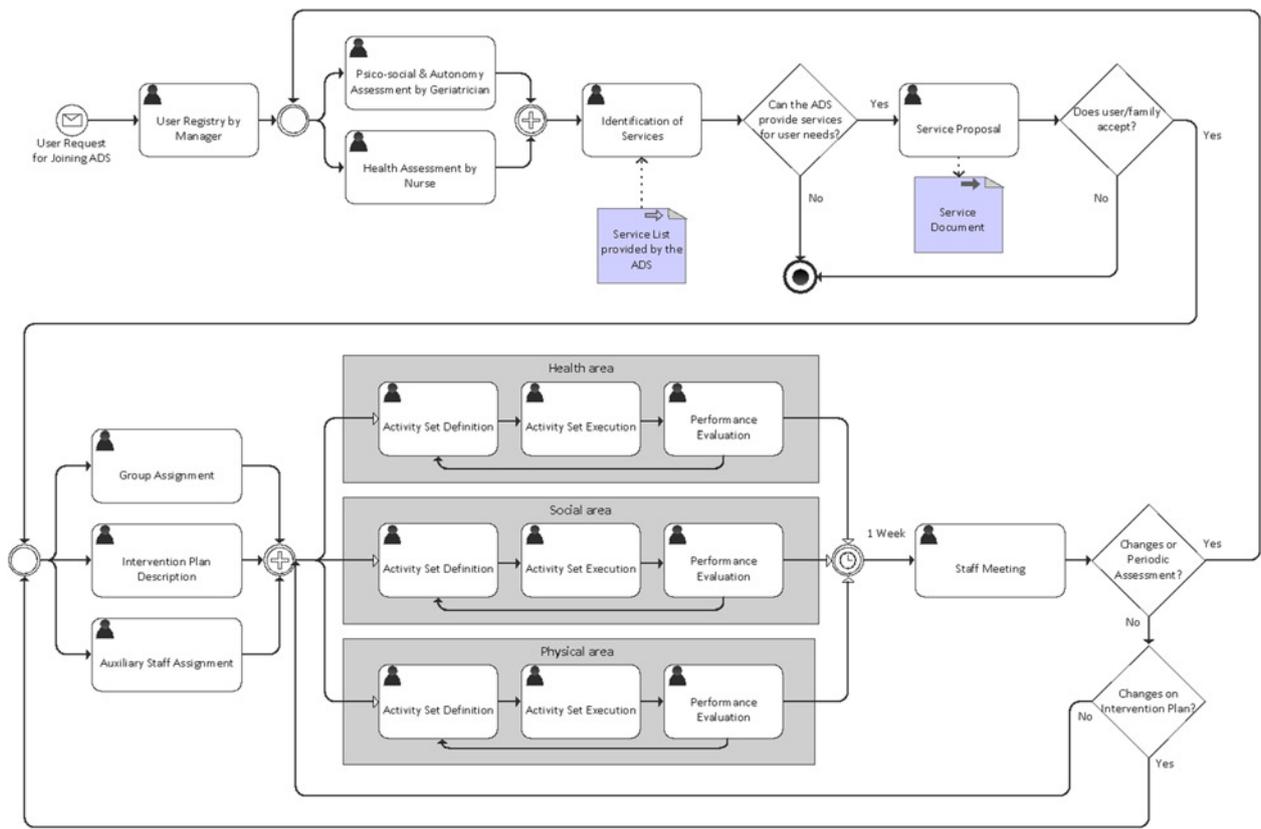


Fig. 1 General ADS business process from requirements formalised using BPMN

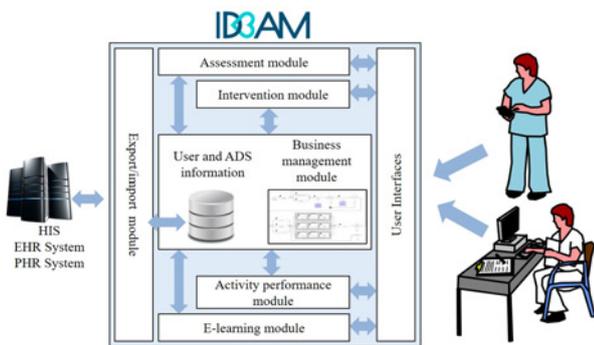


Fig. 2 Overview of the modules composing the system ID3AM

ID3AM incorporates widely used geriatric tests (i.e. Katz, Pfeiffer, Lobo and Barthel indices) and nursing tests (Henderson test), although it is possible to edit them or add others to adapt the assessment to the particular practice of each ADS programme. Figs. 3 and 4 show the initial evaluation performed by the geriatrician and the nurse at the admission stage.

4.2. Intervention module: The aim of this module is to allow geriatricians to define a comprehensive and personalised care plan for each user pertaining to the ADS. Interventions are comprehensive since they are defined for the three common areas (i.e. health, social and physical) and driven by professionals through work intervention groups composed by users with similar needs. Interventions may also be personalised by geriatricians to special requirements of individuals (e.g. specific diet, physical limitations etc.) to pave the way for a tailored care plan. Thus,

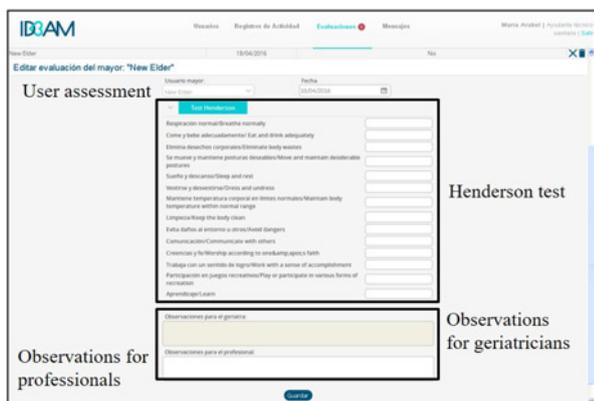


Fig. 3 Assessment of user needs in the assessment module

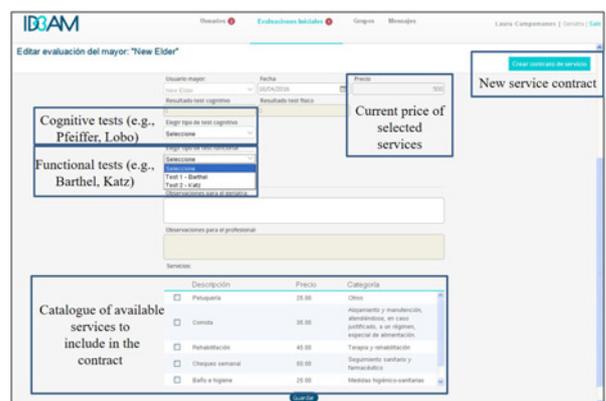


Fig. 4 Selection of services for a user regarding her/his condition



Fig. 5 Group administration in the intervention module

each user will be assigned a comprehensive care plan that includes daily activities (conducted individually or within groups) aimed at maintaining his/her psychomotor skills and adapted to his/her physical and cognitive capacities.

Fig. 5 shows the geriatrician screen of ID3AM to configure work groups, assign users and define/schedule activities to be performed. Intervention groups integrate users with similar capabilities and they are defined through: intervention area, responsible professional (physiotherapist, socio-cultural worker, nurse etc.), min/max number of users and thresholds for functional and cognitive classification. The system automatically assigns users to groups according to their assessments, supporting the geriatrician. In any case s/he can manually reassign users to other groups when required.

Besides work groups, individual activities can be ordered by geriatricians tailored to the need of each user. Such activities are classified in four main categories (food and diet, medication intake, appointments, images and monitoring of physiological measurements) and can be scheduled, as is shown in Fig. 6.

4.3. Activity performance module: During the execution of the intervention plan, ID3AM allows assessing the activity performance of each user. The professional responsible of the activity has a specific activity register module where the performance can be assessed assigning a punctuation from 1 to 5 (Fig. 7). In addition, s/he can assign a customisable descriptor (e.g. irritability, memory failure, dysfunction etc.) and a descriptive comment to the corresponding activity if needed. The aim of that information is to provide further insight about the individual to be considered in his/her periodic assessments.

Anytime geriatricians can access to historical information about the performance of the users to assess their evolution in the ADS programme. Fig. 8 shows a sample of the graphs depicted by ID3AM for a single user.

4.4. E-learning module: Several kinds of professionals work in a single ADS programme and they are supported by auxiliary staff that performs secondary tasks such as mobilisation or assistance

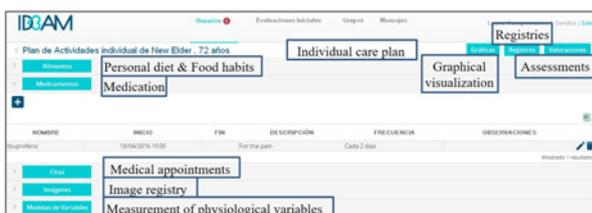


Fig. 6 Planning of individual care activities for a user in the intervention module

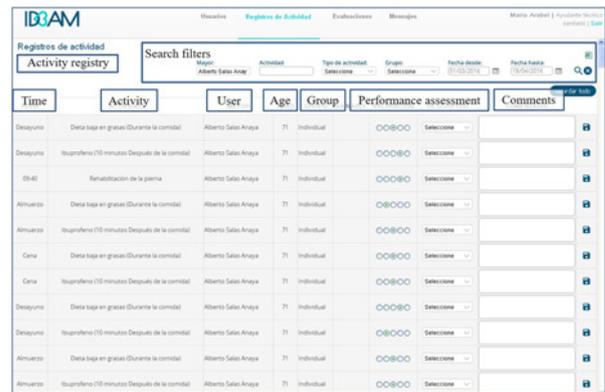


Fig. 7 Evaluation of activity performance by professionals



Fig. 8 Graphical view of activity performance for a user

of users. Staff undertraining is one of the main gaps of current ADS programmes. To overcome this limitation, ID3AM allows the geriatrician upload documents with a summary of their content and assign them to assistants. Once auxiliary staff accesses the system, they can check and download the training documents.

4.5. Export/import module: The system ID3AM also includes a communication module to export information stored in the database to external systems such as Hospital Information Systems or Electronic Health Records to ease the continuity of care. Different health information exchange standards such as ISO/EN1 3606 [22] have been considered. In addition, it is possible to import information from external systems to the ADS database. Thus, health or social information generated on previous encounters among the end user and professionals from other organisations (e.g. GP in primary care) can be included in the ADS to tailor the intervention care plan.

**5. Conclusion:** ADS programmes are often underused social resources, serving as respite for families but without impacting on the social and health skills of the users. It is well known that wrong or inadequate interventions on elderly can accelerate deterioration caused by age. ADS programmes should be enhanced to achieve the aim of delivering interventions tailored to the particular cognitive, health and physical conditions of each user. The application of technology on ADS can ease such enhancement and improve the efficiency and sustainability of this kind of resources. However, technology should be applied not only on administration and business management but also in every process of ADS. In this work, a set of tools have been designed and developed to satisfy specific gaps of current ADS

such as formal user assessment, work group management and follow-up of activity performance by users.

Although the system ID3AM is currently under evaluation on real settings, the tools provided mean a set of innovative features to raise the quality of care in ADS programmes. This work shows how elderly care can be improved on ADS by deploying technology systems providing advanced capabilities. For instance, user assessment over time can be a crucial feature to generate knowledge about the user's psychological and physical conditions and the general factors that accelerate/delay deterioration caused by age (and of which few information is currently known). Finally, although this work is focused on the Spanish situation and law, the contributions described can be applied to any ADS since the care requirements collected are not exclusive for the Spanish elderly population.

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