Which technologies for the detection and alert in case of fall?

Which recommendations for their good use?

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Abstract. The BiVACS project (BiVACS for "Bien Vivre son Autonomie Chez Soi", Independant Well being at Home) proposes the establishment of exchanges and meetings between people with loss of autonomy, professionals (of health, medical and social, social or industry) and family caregivers. A multidisciplinary working group was set up to establish the needs on the theme of the fall, to show, to manipulate and to "evaluate" existing solutions, and to lead to recommendations for industrialists developing such solutions. This article provides recommendations to support the awareness of issues related to the fall, to accompany the dissemination and implementation of technologies for detecting and warning of falling, and improve existing solutions.

Keywords: Health, Home, Autonomy, Fall, Technologies, Evaluation

1. Introduction

Considering the technology products often poorly suited to the target audience and their needs [Méd12, Dre12] and yet useful [DRR+10], the BiVACS project (BiVACS for "Bien Vivre son Autonomie Chez Soi", Independant Well being at Home), proposes the establishment of exchanges and meetings between people who are losing their autonomy.
professionals (of health, medical and social, social and industry) and family caregivers in an attempt to meet the challenges of promoting good living at home [Fra10, Bou10, GT04, Alc07]. BiVACS’s object is to analyze the needs and conditions of implementation of technological solutions (digital, electronics, etc.) for home support in order to:

– Allow to see, test and evaluate solutions with a technology showcase

– Inform, support and facilitate the choice of users and family caregivers in the selection of technological solutions adapted to their needs

– Help the development of the economic sector of solutions for home support (adapt solution offerings, understand the needs, find ways of financing solutions, etc.).

The process is supervised by the Technopole Alpes Santé à Domicile et Autonomie (TASDA - Technopolis Alps Home Health and Autonomy), the Centre de Prévention des Alpes (CPA, Center for Prevention of Alpes), the association Alertes 38, the AG2R LA MONDIALE Group (Complementary Pensions Institution) and the platform of intermediation of home services associations Vivial-ESP38, in conjunction with local partners. So BiVACS’s goal is to bring "the demand for health and autonomy at home" closer to "technology offers", in addition to human assistance to improve the quality of life on the one hand, and promoting economic development on the other hand.

2. Material and method

The realization of the project BiVACS follows 3 steps, with an inventory, moments of exchange between stakeholders of home support and formalization of documents in order to disseminate the results of this approach. A showcase of "solutions" available to make life easier at home for people in loss of autonomy will gradually include technological solutions considered interesting. The summary diagram of the process is presented below.
After an inventory of needs and solutions related to the fall, a working group requested under BiVACS framework was mounted, consisting of people from different structures: nursing auxiliary of community center (CCAS - Centre Communal d’Action Sociale), associations of home help (ADMR) or nursing Services at Home, social Assistants of CCAS, Carers of CCAS or associations of home help (ADMR, ADPA), nurses coordinators or caregivers in CCAS or liberal, responsible for area, health managers, occupational therapists, beneficiaries, families, researchers, industrialists solution providers, Human Resources Services, Social Action Services, social landlords (SDH), Telealarm Providers.

3 sessions were conducted. The first two have gathered together the professionals of home support, users and family caregivers. Industrialists were added in the last one, in order not to bias the recommendations that were issued to them afterwards. They are distributed as follows:

1. Collection of needs (falls, why, how?)
2. Presentation and handling of technology solutions for detecting and warning in case of fall
3. Synthesis and recommendations with industrialists presence
3. Results

An inventory of hardware for detection or alert has been achieved. It is summarized in the table of product family offered below. A first result concerns the inventory of those products. 26 products [Tas13] were studied, according to the families described below:

– 9 classic telealarm systems: Quiatil (Intervox-Legrand), Life line (Tunstall), Phonevie (Laudren), Assystel, Aveneo (H2AD), Care Secure plus (Doro), ST3 (Solem), Minifone Classic (Astelia), Serviligne;
– 3 family telealarm systems: Care Secure Plus (Doro), ST3 (Solem), Minifone Classic (Astelia);
– 4 products worn for the automatic detection of abrupt / rapid falls: Vital Base Strap (Telecom Design), Fall Detector Case (Tunstall), Z care Strap (Cléode), Vivago watch;
– 2 products worn for the automatic detection of slow or sudden falls: Vigi’Fall Home patch (Vigilio), watch detector (Serviligne);
– 1 home automation product for the automatic detection of fast or slow falls, on demand: Edao (Link Care Services);
– 2 home automation products for automatic detection of fast or slow falls, permanently: Senior Alerte, Salveo (Pervaya);
– 6 products for the mobile telealarm outside the home: Phone easy (Doro), Temo (e-medicis), Mobilassit (Filien ADMR), Minifone Mobile (Astelia), Emporia Life + (Emporia), Bazille Prestige (Bazille Telecom);
– 4 products for the mobile telealarm, off home, with geolocation: Temo (e-Medecis), Mobilassit (Filien ADMR), GPS Tracker (EtiboxLife), GPS Phone (Serviligne).

After three sessions on these devices, all participants (professional of home support, users, industrialists) developed, by workgroup, some recommendations which complement studies such as [Méd12, Fra10, Pic12, ec11, Bro13, Ser12], to support the awareness of issues related to fall, to support the dissemination and implementation of technologies for detecting and warning in case of fall, and make improvements to existing solutions.
3.1. Supporting awareness of issues related to the fall!

3.1.1. Educate users, family caregivers and professionals of issues related to the falls

Information campaigns are deemed necessary in order to help to understand the issues (the statistics related to the fall objectively highlight the importance of the topic!), the causes, the consequences, the actions of prevention, the actors, etc.. All communication channels are good, as they are complementary, large public, regular. Avoiding the use of abbreviations (most often unknown from the public), it is to strengthen the approaches to raise awareness among all, professionals, families and beneficiaries.

3.1.2. Develop tools and organizations to better support

Several suggestions have been proposed to improve the accompanying: to share the professional networks (especially, occupational therapists, psychologists and psychomotor), help to assess the risk of falls (taking into account the environment of the person) to arouse vigilance and better prevent, propose special support after the first fall (considered as a crucial step in the awareness of risk and the decision-making process to be equipped with an alert system), increase coordination among stakeholders professionals working at person’s home to share information and advice on the prevention, the fitting-out of housing, the technical aids ..., to disseminate actions and organizations which can participate in prevention approaches, etc.

3.1.3. Encourage to propose support actions in a progressive approach

This is to allow time in the path of the reflection of users and carers, to propose aid plans with progressive support actions to facilitate the acceptance of change. All professionals may relay this progressiveness to facilitate anticipation.
3.1.4. **Targeting the needs and expectations of users but also of family caregivers and professionals**

With solutions that help (but that do not do "instead of"), it is to consider the needs and expectations of all those concerned by a material (the beneficiaries but also professionals, families, etc.). The technological aids should help recover or maintain their autonomy.

3.1.5. **Respect an ethical framework, from awareness to the use of technological aids**

This is to inform and assist users and families while remaining within an ethical framework: do not knock with too much information, scare, consider the "worst theory" but rather stay in a friendly information that everyone is ready to hear and accept, remain in compliance with the free choice of the level of awareness in supporting the prevention of falls, respect the right to risk, the life priorities of each, starting well from persons’ needs … also a good posture in disseminating solutions. Important work should be undertaken on the "sense of exclusion" of older people, the "fear of disturbing", the guilt feeling of caregivers, the burn out of professionals … and on how the technologies are positioned with respect to these issues.

3.2. **Supporting the dissemination and implementation of technologies for detecting and warning in case of fall!**

3.2.1. **Informing about existing solutions**

It is important to present the diversity of supply and the major elements of information to help to choose: the hardware, its features, the associated service, the initial costs and subscriptions, the commitments, the possible financial support, etc.. It is advisable to use different complementary media: Internet, paper form/catalog, showcase, ambulant showcase, as well as the existing information structures (CERDA, CLIC, Town Hall, etc.) or even relay from dealers of medical equipment, pharmacies, doctors’ offices, etc..
3.2.2. **Facilitating access and test of the solutions**

Facilitate the use of technology, it is also to easy access it, in "normal" stores (non-medical) ... provided to verify the accuracy and objectivity of the advice of the reseller (who is not a professional of home support nor gerontechnology). The making available of equipment (loans, test periods) is very expected, to be able to make an "idea" of the solutions.

3.2.3. **Assisting the advice and the decision making**

Tools for assisting the choice permit an appropriate support if they meet the above principles (including ethical) and adopt a neutral posture, objective, independent, not interested. With summaries of bids, covered needs, technical and economic characteristics ... and classification by product family, it is useful that these tools include systems of tips sharing, exchange forum, in order to help to establish a "specification" of its needs, and enable appropriate support or even a direct purchase from a specialty store, for users or families wishing it. A resource platform for information, documentation, training with conference, showcase, mobile showcase is suggested.

3.2.4. **Training the professionals to assistive technology**

Without making them experts, it is necessary for the home support professionals to be trained to the key features and limitations of the equipment. Through sheets, websites, periodic reminders (simulation tests, passage of a person of reference to regularly test the equipment with the user, etc..), this can also be done by coordinating the installation of the equipment at home the day when the professional is present (along with the user and the family).

3.3. **Making improvements to existing solutions**

3.3.1. **All offers**

The main expectation concerns the aesthetics, design and size of the equipment and their personalization, factors hindering their appropriation. Then, an effort is required about the target (depending on the
degree of autonomy, disability, chronic illness, abilities cognitive, language, visual, auditory, gestures, grasping, etc.) in order to adapt the material to the capabilities of its user. This argument, put forward little, if any, would deserve more attention. In contrast, it is interesting to extend the field of application of these materials. In addition, the scalability of the product is appreciated in order to use the same brand, as its own needs evolve (less ability, systems more simple and automatic, but with the same manufacturer design or even the same product (eg only the telealarm button ended up being used). Regarding dissemination, it is important to argue the value added and the non-competition with the staff, including in nursing homes. It is also useful to assess the "anxiogenic" side of the devices, by their presence and by what is considered "intrusive" in his life (technical aids, human assistance ...). Finally, the prevention and stimulation tracks are too little considered.

3.3.2. "classic" telealarm system or "family" telealarm system (call to a close)

The material is often deemed too stigmatizing, a difficulty of finding the right compromise between a "non-stigmatizing" button but visible enough and at the "right place" on the device. Some straps are too difficult to put (even for a young person), but, except for some devices seeming poorly made, these products seem rather simple, robust, easy to use. Some features can help appropriation, like the small size of the transmitter (and its aesthetic), the ability to change the strap for a standard watch strap, the charging without plugging (by induction). Similarly, the use of different buttons for distinguish the urgency of any other request can limit the fear of "bothering". Moreover, if the telephone number of relatives or family caregivers are required, it is necessary to envisage that there was not (problem of isolation). For a mobile system, the principle of a "real" phone with alarm button is appreciated.

3.3.3. Automatic Fall Detector

Many questions arise for this type of offer: what effectiveness (depending on the type of fall, malaise, loss of consciousness)? How to avoid false alarms (eg by washing teeth)? How to facilitate understanding (and learning by the person) of the audible, visual or vibrating feed-
back to confirm / cancel the alarm? What compatibility with other devices (pacemakers, other home automation equipment ...)? Some recommendations are raised, such as limiting the number of devices installed at home (and the alteration work). Apart from significant cognitive impairment, for which it must be ensured that the device can not be removed in an "unintentional" way, a manual alert button is considered useful (depending on the compromise "non-stigmatizing" but sufficiently visible). It is advantageous to facilitate the interoperability of systems (social alarm standard or home automation standard). Finally, the maintenance by a professional facilitates the acceptance and appropriation.
### 3.4. Families of products for the detection or alert in case of fall

<table>
<thead>
<tr>
<th>Family of solution</th>
<th>Worn/ Home Automation</th>
<th>Monitorin</th>
<th>In/ Out Home</th>
<th>With/ Without assistance service</th>
<th>Type of Trigger</th>
<th>Type of Fall and condition of “good use”</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;classic&quot; Telealarm</td>
<td>Worn</td>
<td>24/7</td>
<td>In</td>
<td>With</td>
<td>Manual</td>
<td>Any, but been able to push</td>
</tr>
<tr>
<td>&quot;family&quot; Telealarm</td>
<td>Worn</td>
<td>24/7</td>
<td>In</td>
<td>Without</td>
<td>Manual</td>
<td>Any, but been able to push</td>
</tr>
<tr>
<td>automatic sensor of abrupt / rapid falls</td>
<td>Worn</td>
<td>24/7</td>
<td>In</td>
<td>With</td>
<td>Automatic</td>
<td>abrupt</td>
</tr>
<tr>
<td>automatic sensor of slow or sudden falls</td>
<td>Worn</td>
<td>24/7</td>
<td>In</td>
<td>With</td>
<td>Automatic</td>
<td>slow or sudden</td>
</tr>
<tr>
<td>home automation product for the automatic detection of risk, on demand</td>
<td>Automation time</td>
<td>In</td>
<td>With</td>
<td>Automatic</td>
<td>Any risk</td>
<td></td>
</tr>
<tr>
<td>home automation products for automatic detection of fast or slow falls, permanently</td>
<td>Automation</td>
<td>24/7</td>
<td>In</td>
<td>With</td>
<td>Automatic</td>
<td>Any risk</td>
</tr>
<tr>
<td>mobile telealarm outside the home</td>
<td>Worn</td>
<td>24/7</td>
<td>Out</td>
<td>With</td>
<td>Manual</td>
<td>Any, but been able to push</td>
</tr>
<tr>
<td>&quot;family&quot; mobile telealarm outside the home</td>
<td>Worn</td>
<td>24/7</td>
<td>Out</td>
<td>Without</td>
<td>Manual</td>
<td>Any, but been able to push</td>
</tr>
<tr>
<td>mobile telealarm off home with geolocation</td>
<td>Worn</td>
<td>24/7</td>
<td>Out</td>
<td>With</td>
<td>Automatic (living area) / Manual</td>
<td>Any, but been able to push</td>
</tr>
</tbody>
</table>

Pendant, strap, brooch, zipper-pull, relay ... with a call button, which triggers a telephone connection with a service platform

Pendant, strap, brooch, zipper-pull, relay ... with a call button, which triggers a telephone connection with a close

Strap with a rapid fall sensor (accelerometer) and, often, a verification system of the fall (loss of verticality, abnormal heartbeat ...)

Strap, patch, pendant with a motion sensor (accelerometer) and a complementary measure (activity, height, motion, ...)

Video system with image analysis software to detect risk situations. The images are not viewed by anybody (excluding risk detected), only the software treats them and alert a telealarm platform.

Sensors system (motion, door opening ...) with analysis of the activity of a person profile. The software establishes an “activity profile” and compares the motion data with the profile, and alert the telealarm platform in case of significant difference.

Mobile or belt phone, strap with SIM card (to call) with a call button that initiates a telephone connection with a service platform

Mobile phone or belt phone, strap with SIM card (to call) with a call button that initiates a telephone connection with a close

Telephone (mobile or belt), strap, with SIM card (to call) with a call button, which triggers a telephone connection with a platform / a close and with a GPS system
4. Conclusion

These recommendations complement the existing work such as [Méd12, Fra10, Pic12, ec11, Bro13, Ser12]. The work of TASDA also led to various tools to implement the recommendations: a catalog, inventory of products; an help support in the selection of products offered; a show case involving most of the products in the catalog in order to manipulate and evaluate yourself or with the help of a relative or a professional, the selected products. These tools will be tested by professionals to be finalized and disseminated. A "reactive" assessment approach of the automatic sensors on the market and accessible is underway, according to three steps: 1) evaluation by experts on record, 2) test in laboratory on life scenarios and fall scenarios, 3) evaluation of appropriation at home. Ultimately, it is to accomplish this approach BiVACS on other topics: social bond, automation, geolocation, serious games, actimetry, etc.. Work is underway at various stages of completion (inventory, work groups, evaluation, etc..). This approach will lead to better information via a showcase presenting adapted solutions.

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References


