

# Utility and feasibility of an electronic tracking system for prevention of wandering in demented elderly patients

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**Abstract**—Wandering and getting lost are one of the main risks induced by cognitive dysfunction suffered by elderly patients. Innovative technologies have provided new electronic tracking devices to help families and care providers cope with this problem. The aim of this study was to evaluate the feasibility, acceptability and the usefulness of an electronic tracking device for demented elderly patients living at home or residing in an institution. Two case studies at home showed that the device was well tolerated by the patient and that the family was satisfied with this technology. In the preliminary phase of the study 7 patients out of 18 (38%) immediately refused to carry the device. By changing the position of the device, 3 of these 7 patients (43%) accepted to carry it while 4 (57%) refused to carry it definitively. According to the questionnaire filled out by 12 healthcare givers at the beginning of the study most estimated that this device could ensure the security of demented elderly patients (9/12: 75%), improve their quality of life (9/12: 75%) and reduce anxiety for healthcare providers (10/12: 83%). This preliminary research suggested that the electronic tracking technology would play a very significant role in managing wandering in demented elderly patients and triggered a very favorable response from healthcare professionals regarding the usefulness and benefits of integration this technology in their daily practice. However, this experimentation was a preliminary stage of a largest study which is still on-going.

## I. INTRODUCTION

Alzheimer's disease and related diseases are a major public health problem but also one for society. A recent consensus study reported that it affected 24.3 million people in 2001 worldwide, and an average of 3.9% of people aged 60 and over. This average is supposed to be multiplied by two every 20 years amounting to 81.1 million people in 2040[1]. In France if the rate of dementia in people 75 years of age or more does not change in the future, there will be 1,152,831 demented patients in this age range in 2020, and in 2050, there will be 2,406,327 [2]. The incurable and progressive nature of Alzheimer's

disease often causes important psychological suffering, both for the patient and close relatives.

Behavioral disorders and their impact on daily life activities, induced by memory disorders, are the essential cause of burnout in family caregivers, but also in healthcare professionals tacking after these patients at a later stage of the disease in institutions. Wandering away is one of these behavioral disorders and is reported in 60% of demented people. Five fundamental components of wandering were defined: checking, trailing somebody, walking with an inappropriate purpose, aimless walking, excessive activity, and attempts at leaving home [3]. Wandering away is often associated with other adverse events such as a falls, accidents, fractures and injuries, hindered eating, weight loss, and untimely death [4-7].

40% of Alzheimer patients get lost at least once in the course of their disease with a 20% risk of death if they are not found within 12 hours which increases to 50% if the delay goes beyond 24 hours [8].

According, looking after patients suffering from Alzheimer's disease appears to go beyond the strict medical domain and affects families and social institutions. The excessive burden caused by such care is readily accepted by most families who refuse to place their relative in an institution. However after a few months or years and the worsening of their cognitive disorders, such patients are at risk in their own homes due to incidents caused by wandering away and the risk of getting lost, which makes staying at home difficult or impossible. This accounts for the terrible anguish suffered by families and justifies their request to transfer their relative to an institution. In this context, several technologies dedicated to personal tele-safety are available to offer a revolutionary solution to the problems families and homes or long-stay institution personnel are confronted with. These new emerging technologies, based on the use of electronic tracking and communication devices of various shapes (bracelet, beacons, and cellular phone), have yet to form part of the daily practice in the socio-medical field.

This study seeks to assess the feasibility and the usefulness of an electronic tracking system for demented elderly patients and its acceptability by healthcare professionals as well as by patients with a view to improving the safety of aged demented people at home and in institutions.

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## II. MATERIALS AND METHODS

### A. Materials

The electronic tracking system used in this study includes a device (figure 1) incorporating all the technologies allowing tracking on earth by the constellation of Global Positioning System (GPS) satellites, as well as transmission of this data by Global System for Mobile communication (GSM) network (figure 2). A battery of the device ensures uninterrupted functioning for at least 24 hours in an active mode, and up to 4 days in hold mode.

The tracking data are available 24h/24 and 7d/7 and may be accessed by two means (figure 2):

- The telephone alert via a vocal server reports the position of the device carrier in a simple, direct, and explicit manner (street number, street name, city, and postal code).
- Internet through a site specially dedicated to this system, with a user-friendly and reactive approach. Several means of information are available on the site to complete the initial data: history of the 7 previous days, tracking of the latest points, maps with various scales.

The system works continuously: this means that it is always tracking and that it identifies the position to react with maximum anticipation depending on the situation. When the system is set up initially, a zone considered as secure (living zone) must be defined by the family or healthcare professionals. If the system records a presence outside of the secure zone, several phone numbers are immediately called until somebody answers and is informed of the situation. These numbers are specific to each customer (family, neighbors, retirement home operator, etc.) and are initially selected by the family or

healthcare professionals.



Fig. 1. Electronic tracking device

### B. Methods

The electronic tracking system was used in two contexts:

- At home where a family member took care of the elderly person and the family subscribed to the system. If the "alert" option was selected, the family received a phone call if the elderly person left the secure zone. If this option was not selected, the family called the telephone service to obtain information from the system tracking data on the device carrier. Subsequently, the family looked for the elderly person on their own or, if required, the police were informed. In this context, the use of the system was strictly personal and secure. Three aged demented persons living at home with their spouses, who were the main caregivers, were equipped with this system. No intervention by the system managers was programmed except when required by the caregivers. Nevertheless, caregivers were asked to provide all information concerning the system's functionality, difficulties met when using it, satisfaction level, tolerance and acceptability of the device by the elderly person.

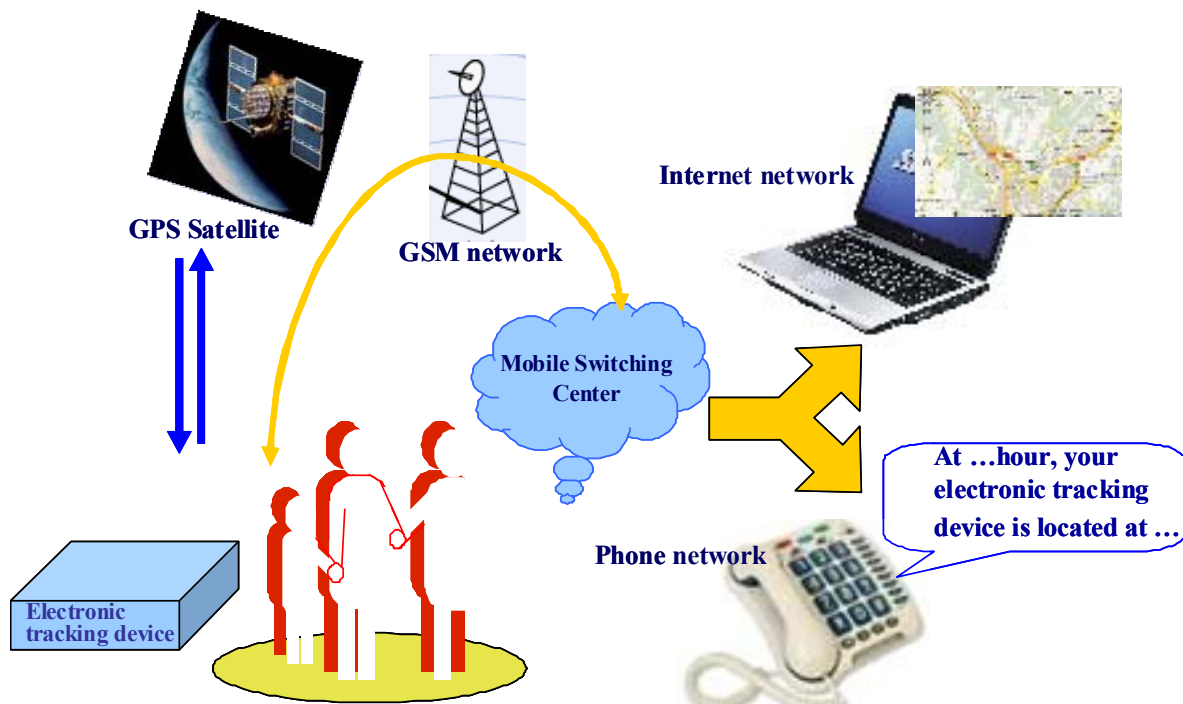


Fig. 2. Electronic tracking system architecture

- In the Grenoble teaching hospital long stay centers (the South gerontology center (CGS) and the Bâtie retirement home). In this context, the healthcare personnel received the phone calls warning them that an elderly person carrying the device had left the institution, and they tried to find the device carrier before he had gone too far. If they were unable to find him, they initiated a search procedure whereby the police, the institutions' administrative, and the family were informed.

We started using the system in the CGS with an initial phase to test the patients' tolerance to the device and identify problems concerning its portability. In that phase, the patient did not leave the institution and remained under the healthcare personnel's supervision. The device was at times fastened to the pants' belt for men or placed in a strap bag for women and sometimes for men. A notebook was given to the healthcare personnel to report all informations and observations concerning the tolerance, reactions, and behavior of patients carrying the device, and all steps taken to improve its portability. Healthcare personnel were asked to fill out a questionnaire for the primary acceptability of the system in their daily practice after presentation of the system and its functionality.

## I. RESULTS

### A. Home use

Three representative cases of home use are reported below (table 1):

#### 1) Case 1

The first case concerned a 70 year-old demented male patient with a history of several attempts to run away. He lived with his 70 years old wife who presented a good cognitive state. Their daughter subscribed to the system for 3 months. The "alert" option was not selected because the patient is accompanied by his wife as often as possible, even for shopping. In this case, the rationale for the system

was to track the patient in case of wandering away from his wife outside of home, or in the daytime in the case that he should try to run away from home. In case of wandering, his wife had to contact the system after 20 minutes of unsuccessful search or call her children and grandchildren for help. The patient carried the device in a waist bag without any problem. One day, this couple was strolling in town when the patient started walking faster and his wife failed to catch up with him. He finally succeeded in running away but was found downtown by his grandson after 1.5 hour due to the system and then went back home with his wife without any problem. The system is still being used by the family.

#### 2) Case 2

The second case concerned a 70 year-old demented male patient with a history of reported wandering. He lived in a town with his 50 year-old wife who was working 40 km away from home. She chose to let him walk freely by subscribing to the electronic tracking system rather than locking him up at home when she was away. At the end of the day when coming back home she would systematically call the phone center to find out whether her husband was home. If this was not the case, she was given her husband's position and with a map of the area she could find him and take him back home. The system allowed this woman to retain her job without any problem concerning her husband's safety. He tolerated the device well and carried it in a small waist bag. Use of the system was terminated when the demented patient died.

#### 3) Case 3

The third case concerned a 75 year-old demented male patient with a history of repeated wandering. He lived with his wife also aged 75. He was in great shape and would often go for a walk outside. He went back to places he remembered: his birth town, his school, and his previous home. An Alzheimer association helped this couple to get the system without any subscription. However the patient

TABLE 1. HOME USE PARTICIPANTS

		Case 1	Case 2	Case 3
<b>Carrier</b>	Sex	M	M	M
	Age	70	70	75
	Level of dementia	S	S	S
	Home environment	T	C	VG
	Device mode of carrying	B	B	B + other
<b>Caregiver</b>	Family link	SP	SP	SP
	Age	70	50	75
	Occupation status	N	Y	N
	Distance from the carrier	CL	F	CL
<b>Subscriber</b>	Knowledge of the system	I	I	NW
	Family link	SP	D	/
<b>Subscription</b>	Length	3 months renewed	12 months	3 months
	Alert Option	N	N	N
	Reason for interruption	Ongoing subscription	Death	Refusal

**Abbreviations:** M: male, S: severe, T: town, C: country, VG: village, B: bag, SP: spouse, N: no, Y: yes, CL: close, F: far, I: Internet, NW: network, D: daught

always refused to carry the device, irrespective the carrying mode suggested by his wife. The use of the system was abandoned due to his consistent refusal.

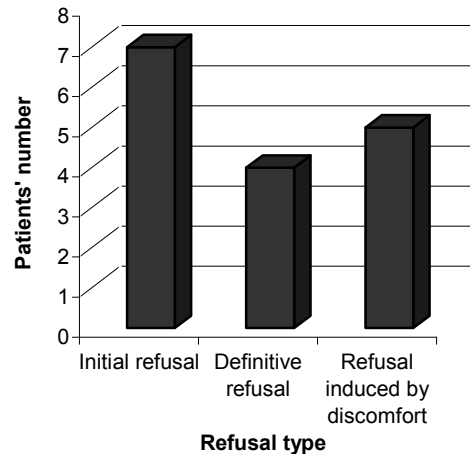
**B. Healthcare institution use**

**1) Tolerance by patients**

The system was tested on 18 patients: 7 men and 11 women, with an average age of 71 years (65 – 90). They were severely demented, potentially run-aways, and 60 % (11/18) presented psychobehavioral disorders. The number of tests made with each patient ranged from 1 to 16 lasting less than two hours, half a day, or a whole day. The test was repeated depending on the patient's general state, fluctuation of his psychobehavioral disorder and his reaction to the device. 22% (4/18) of the patients definitively refused to carry the device. 38% (7/18) first refused to carry the device, 57% (4/7) of these completely rejected the system and 43% (3/7) finally accepted it when repeating the test after hiding the device and changing its position. 28% (5/18) of the patients reacted negatively to carrying the device by aggressively tearing it away or asking healthcare personnel to remove it (graph 1).

**2) Healthcare personnel's initial acceptability of the device**

12 healthcare providers in the psycho-geriatric unit of the Grenoble CGS and Bâtie retirement home filled out the initial acceptability questionnaire for the device (graph 2). 75% (9/12) of the responders thought that the electronic tracking technology would be very useful to prevent the risk of getting lost for institutionalized demented old people while 25% (3/12) did not find it useful. 83% (10/12) considered that this technology may reduce worrying and stress induced by the need to permanently watching such elderly people when they are in an open unit. On one hand, 67% (8/12) of the healthcare providers found the system used cumbersome for the patient. On the other hand, 75% (9/12) found that it may help improve the quality of life for aged

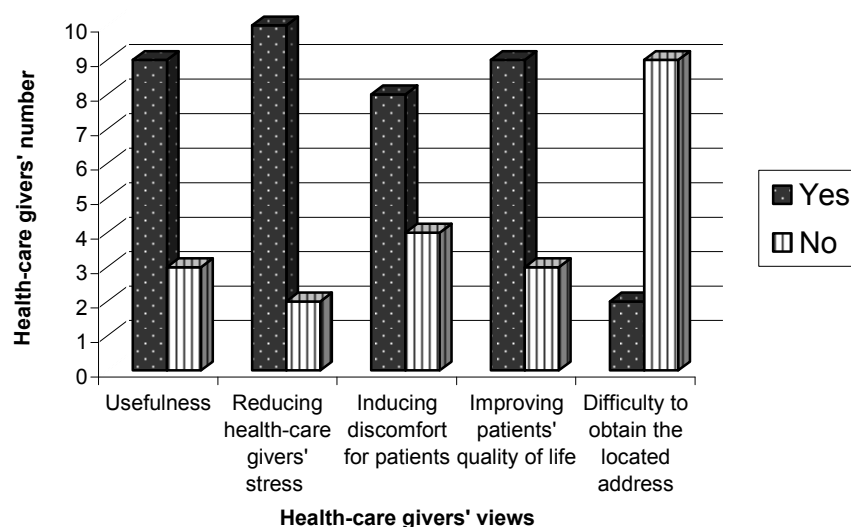


Graph. 1. Patients' tolerance to the device

demented patients locked up in an institution by giving them more freedom. After presentation of the device and the functioning of the electronic tracking system, 75% (9/12) said that obtaining the system-detected address which identifies the location of the elderly patient carrying the device was easy, 16.6% (2/12) said that it was complicated, and one person did not answer.

**II. DISCUSSION**

This paper reviews the feasibility, acceptability, and usefulness of electronic tracking technology used for demented elderly persons at risk of wandering [9-18]. Despite the acknowledged importance of these technologies confronted to the inefficiency of medical treatment and its adverse effects for some types of dementia, their use in age people remains an ethical and social issue [10-14].



Graph. 2. Initial health-care givers' view of electronic tracking system

In the three cases of home use in our study, privacy was completely respected because the spouses took care of the device and there was no need for intervention by system managers except when the users asked them to do so. Given the good technical functionality of currently available devices, the refusal by demented people to carry the device remain the main reason for the failure of these technologies[18].

In our home use experience, 2 people tolerated the device well for a period of 10 months for the first and for 4 months for the second who is still using it without any problem of technology rejection. The third person completely rejected the device despite all attempts to make it acceptable made by his wife: changing the position of the device, putting it in an invisible pocket, or even hiding it in the coat's hood lining.

In the initial phase of the study in an institution, carrying the device almost immediately induced aggressive behavior (verbally or physically) in 2 patients (11%), which was not justified by the lack of comfort of the device but maybe rather by the feeling of having a alien object on the body. In this case, much care is mandatory to prevent endangering these patients by trying to give them a little supposed freedom with this technology. 43% of the patients who refused to carry the device initially finally accepted it after changing its position. This could be linked to constraint induced by the device. Furthermore, lack of comfort linked to the device was directly demonstrated (request to remove it) or indirect (aggressively and/or the attempts to rip it off) by 28% (5) of the participants. These different types of behavior show the importance of initial assessment of portability which allows planning the best possible conditions of patient tolerance to the device. This tolerance is a key to the success of this technology and the safety of elderly people [18]. The initial responses of healthcare providers on the usefulness of these technologies in institutions, the impact on healthcare professionals' concerns, and the improvement of quality of life for demented aged people correlate to results of other studies made in the same field [14-15, 17, 18]. Most care providers found the device heavy and cumbersome, which was the main reason why patients refused to carry the device. Several improvements of the device user-friendliness are under consideration regarding weight, size, and carrying mode.

## I. CONCLUSION

This initial study showed the important role of electronic tracking technologies in increasing the safety of demented aged people, decreasing worry of relative caregivers, and helping healthcare professionals to improve their work conditions and decreasing their concerns. The portability of these technologies by demented patients is a key to the success of its implementation. Further studies on the behavior of demented aged people confronted to this technology are necessary.

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