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Frédéric Noublanche, Cécile Jaglin-Grimonprez, Guillaume Sacco, Nicolas Lerolle, Philippe Allain, Cédric Annweiler

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## Highlights

- Gerontechnology aims to improve the daily lives of older people.
  - Living labs are an open innovation research method for the development of new products and services.
  - ALLEGRO is a hospital-based geriatric living lab designed to promote open gerontechnology innovation within hospitals.
  - ALLEGRO bridges the gap between gerontechnology developers and hospitalized frail elderly people and carers.
  - Gerontechnology developed in ALLEGRO should improve hospital care for older inpatients.
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## The development of gerontechnology for hospitalized frail elderly people:

### The ALLEGRO hospital-based geriatric living lab

Frédéric Noublanche, MS <sup>1,2</sup>

Cécile Jaglin-Grimonprez <sup>3</sup>

Guillaume Sacco, MD, PhD <sup>1,4,5</sup>

Nicolas Lerolle, MD, PhD <sup>6</sup>

Philippe Allain, PhD <sup>2</sup>

Cédric Annweiler, MD, PhD <sup>1,2,6,7</sup>

1: Department of Geriatric Medicine and Memory Clinic, Research Center on Autonomy and Longevity, University Hospital, Angers, France; 2: UPRES EA 4638, University of Angers, France; 3: General direction, University Hospital, Angers, France; 4: Center for Healthcare Innovation and Uses (CIU-santé), University Hospital, Nice, France; 5: CoBTek Cognition

Behaviour Technology EA 7276, Research Center Edmond and Lily Safra, Nice Sophia-Antipolis University, Nice, France; 6: Direction, Health Faculty, University of Angers, Angers, France; 7: Robarts Research Institute, Department of Medical Biophysics, Schulich School of Medicine and Dentistry, the University of Western Ontario, London, ON, Canada

**Corresponding author:** Cedric Annweiler, MD, PhD, Department of Geriatric Medicine, Angers University Hospital, 49933 Angers cedex 9, France; E-mail: Cedric.Annweiler@chu-angers.fr; Phone: ++33 2 41 35 47 25; Fax: ++33 2 41 35 48 94

## **Abstract**

Our objective was to bridge the gap between gerontechnology developers and hospitalized frail elderly people, in order to promote open gerontechnology innovation in hospitals. We designed a hospital-based living lab that provides reflexive "idea incubator" workshops that gather together both the users and the developers of technology, supplemented with an experimental hospital room for the testing of devices by older inpatients. The ALLEGRO living lab was delivered in 2018 at the Geriatric Department of Angers University Hospital, France. The workshops and experimental hospital room should help frail older inpatients to participate in the co-design and co-development of new technologies to improve hospital care and promote successful aging.

**Keywords:** gerontechnology; hospital; innovation; living lab; older adults

## **INTRODUCTION**

Gerontechnology is expected to help the challenges of aging populations to be met [1]. An unprecedented effort is being made around the world to innovate and to invent the technological solutions that will help seniors in the future. Gerontechnology is thus developing on a large scale. The principal aims are to improve the living environment, compensate for the loss of independence among older adults, and ultimately to allow older people to live at home for as long as possible [1]. These goals, although legitimate, fail to

address all seniors' needs. In particular, they do not focus on a crucial moment in the life of frail older adults when their chronic diseases lead to urgent hospitalization. Hospitalized frail elderly people experience functional problems, but the main concern is acute disease [2]. Additionally, it is recognized that most hospitals are not well adapted to older inpatients, and this may lead to them facing specific functional difficulties, known as iatrogenic disability [3]. Despite these observations, the hospital has received little attention in the field of gerontechnological development. It is clear that innovations in the design of the hospital environment are not only few, but also often inappropriate with regard to the needs of older inpatients [2]. This suggests that the developers of gerontechnology, although possessing the capacity for innovation, do not apprehend the real needs and expectations of hospitalized frail elderly end-users. This problem could be related to (i) the difficulty gerontechnology developers have in accessing the hospital and their lack of knowledge of the hospital environment, and (ii) the lack of connection between gerontechnology developers and hospitalized frail elderly people, which prevents the former from directly asking the latter about their actual needs and opinions. Our objective was to propose an operational solution to promote communication between gerontechnology developers and hospitalized frail elderly patients.

## **METHODS**

A preliminary reflection revealed that a real-world laboratory, such as a hospital-based geriatric living lab, would meet our goal [2,4,5]. Living labs are realistic environments designed to create links between technology developers and end-users. Living labs enable end-users to communicate their needs and expectations directly to technology developers (co-design) and to participate in prototype testing (co-development) [4]. To meet our goal, the hospital-based geriatric living lab would be expected (i) to connect hospital users and gerontechnology developers in order to facilitate upward (needs expression) and downward

(expression of technological possibilities) exchanges, and (ii) to be a place of care in which to test, with actual older inpatients, the feasibility, acceptability, efficiency, reliability, reproducibility and safety of devices under development [2]. We identified three main types of device or innovation to be tested: (i) prototypes (i.e., tools under development/not yet marketed), (ii) new services and/or new care organizations, and (iii) potential adoption of tools that are marketed either in non-hospital settings or for a non-senior population. Finally, regarding the technology developers, we chose to promote open hospital innovation and to open the living lab not only to the public sector, higher education and citizens, but also to associations and potential partners from the private and industrial sectors.

## **RESULTS**

The ALLEGRO (Angers Living Lab En GéRiatrie hOspitalière) hospital-based geriatric living lab was finally delivered in November 2018 at the Geriatric Department of the University Hospital of Angers, France.

ALLEGRO offers two types of services. The first is the organization of "idea incubator workshops", which gather around the table both the developers of gerontechnology and the hospital end-users. Selected end-users are hospitalized frail elderly inpatients, but also informal carers and/or professional hospital caregivers, depending on the developer's expertise. Workshops can be offered so that, for example, users can explain clearly their daily in-hospital needs, which will guide developers in the creation of projects that meet real expectations, or developers can ask users for their opinions on devices being developed, or even ask them about possible new uses.

The second service is an "experimental hospital room" within the geriatric acute care unit (Figure 1). The spacious room (24m<sup>2</sup>) is equipped with devices for measuring vital signs (temperature, blood pressure, pulse, weight) and has an electronic floor that can record all

movements in the room and track any falls. These measures allow the diagnostic efficacy of prototypes to be tested in the room, for example those designed to detect falls. Each test is conducted according to quality standards for biomedical research, and can begin only after authorization from the ethics committees. The room is intended to accommodate one older inpatient at a time, normally a person with a severe acute medical condition. No patient selection is planned at admission, to ensure no recruitment bias. After receiving clear, fair and appropriate information, the patients and/or their legal representatives if mental capacity is impaired may agree or refuse to participate in one or all protocols. All test results are promptly fed back to the gerontechnology developer.

## **DISCUSSION**

We have set up the first hospital-based geriatric living lab equipped with an experimental room. It receives in the one space both seriously ill older inpatients and gerontechnology prototypes. This model should help frail older inpatients to meet researchers within industry and public institutions with whom they are usually not in touch, and to participate in the co-design and co-development of new technologies to improve hospital care. It is possible to explore patient requirements, to test and develop in new designs and uses, and finally to identify promising markets [2,4]. Also, in terms of its value to industry, the living lab should reduce the development and marketing cycles of products and services, reduce development risks, enrich the innovation process by promoting a richer connection with users, facilitate the appropriation of products and services by users, and help with the identification of hospital applications [2,4,5]. This new and unprecedented hospital-based geriatric living lab is about promoting open hospital innovation to improve hospital care for older inpatients and ultimately to promote successful aging through gerontechnology.

## **Contributors**

Cédric Annweiler has full access to all of the data in the study, takes responsibility for the data, the analyses and interpretation and has the right to publish any and all data, separate and apart from the attitudes of the sponsor.

All authors contributed to the conception and design of the study, or analysis and interpretation of the data, and drafting the article and revising it critically for important intellectual content. All authors saw and approved the final version of the paper.

## **Conflict of interest**

The authors declare that they have no conflict of interest.

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The sponsors had no role in the design and conduct of the study, in the collection, management, analysis, and interpretation of the data, or in the preparation, review, or approval of the manuscript.

## **Ethical approval**

All projects conducted in the ALLEGRO hospital-based geriatric living lab are approved by the local ethics committee. Participants are included after giving their written informed consent for research, or their legal representatives' consent if mental capacity is impaired. The studies are conducted in accordance with the ethical standards set forth in the Helsinki Declaration (1983).

## **Provenance and peer review**



Peer review was directed by Professor Margaret Rees independently of Cedric Annweiler, one of the authors and an Editor of *Maturitas*, who was blinded to the process.

**Research data (data sharing and collaboration)**

There are no linked research data sets for this paper. No data were used for the research described in the article.

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*Figure 1. ALLEGRO experimental room.*