

# Measuring the effectiveness of 'CARIMO', an ICT-supported fitness and entertainment app for home care recipients

*Study protocol and survey data collection*

<b>Author(s):</b>	Birgit Trukeschitz, Marlene Blüher
<b>Organization(s):</b>	Vienna University of Economics and Business (WU), Research Institute for Economics of Aging
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# 1 Introduction

**Provision of adequate and reliable long-term care** for older people and for people with chronic conditions faces **severe challenges** (Colombo and Mercier 2012, Mosca et al. 2017). On the demand side, aging societies are confronted with an increase in the need for formal and informal long-term care. On the supply side, almost all care systems expect and already experience shortages of formal and informal carers (Fernández et al. 2009, Simonazzi 2009). Thus, there is a need for innovative solutions that address both supply and demand of care provision for older adults.

Approaches to balance or increase **care supply** are two-fold, addressing the number, types, and tasks of care workers and knowledge increase on the one hand, and collaboration between different actors within a care network – care recipients, informal carers and care workers – on the other hand. Both approaches aim to increase efficiency of care processes and the effectiveness of care work.

Solutions for balancing or reducing future **care demand** relate to influencing people's lifestyles. Physical activities contribute to improving people's health (Endes et al. 2016, Martinez-Gomez et al. 2018) and thus may postpone long-term care needs in the long run. However, even people already depending on long-term care and personal support may benefit from improving their lifestyles. Daily or weekly exercises adjusted to their abilities and needs could help to maintain or even enhance their health and mobility (Manini et al. 2017), may enhance their abilities to cope with activities of daily living (Ku et al. 2016) and thus keep care needs contained. Therefore, early and adequate support to increase physical abilities and mobility of older people with moderate and increasing impairments is essential but often lacks systematic support from care organizations.

**New technologies** are assumed to contribute to solving societal problems by providing new opportunities to cope with societal challenges. For policymakers and developers, they also, promisingly, carry the potential to address both the issues affecting demand as well as the supply side in long-term care (Mosca et al. 2017).

Nowadays, thousands of mobile and smart applications aim to support and provide incentives for increased levels of physical activities (e.g. running or cycling apps, exercise apps, smartphone activity trackers). Hardly any of them address older or even care-dependent people though. With adjustments according to their needs and challenges, such apps, however, may also be beneficial for care-dependent older adults, increasing and supporting healthy physical activity in this group (Geraedts et al. 2014). Such apps may be especially beneficial for older people already experiencing limitations, because many of these apps do not cost much, do not require much equipment, and crucially, enable users to exercise in their own homes. However, evidence on the effects of apps aiming to enhance physical activities in older and care dependent people is limited.

The international collaborative AAL-project 'Care in Movement – (CiM)' aimed to develop and test a system, called CARIMO, to improve physical activities of care-dependent people and to support the care network (<https://www.careinmovement.eu/>). The field trial of CARIMO lasted for eight months. CARIMO was tested in Austria and in Italy.

This paper aims to describe the study design for the field trial of CARIMO used for measuring the effects of CARIMO. It addresses the definition of the target group, the recruitment process

and sampling, and describes the data collection and the sample used for the field trial. For results on the effectiveness analyses using survey data see Trukeschitz et al. (2018) and Ring-Dimitriou et al. (2018). For results of the usability analyses see Blüher and Trukeschitz (2018) and Trukeschitz and Blüher (2018). For the analysis of CARIMO usage data see Schneider and Rieser (2018).

In Chapter 2, we explain the aims and features of CARIMO. In Chapter 3, we lay out our research aims and concepts framing the survey-based effectiveness analysis and evaluation of CARIMO. Chapter 4 provides insight about the target group, addressing first the definition of target group criteria for the CiM trial, and then a more detailed description of the size and characteristics of the actual target population served by the LTC providers involved in CiM. In Chapter 5, we address any potential risks that were associated with participation in the trial and the precautions taken to avoid those risks. In Chapter 6, we describe our approach towards recruitment and sampling. Chapter 7 contains the timetable for data collection during the trial. In Chapter 8, we give a description of the CiM sample, including important participant characteristics as well as a short account of the people who signed up as participants but dropped out before the end of the trial phase. Chapter 9 concludes with the considerations and measures taken in the context of conducting the trial according to ethical standards and requirements.

## 2 Features and aims of CARIMO

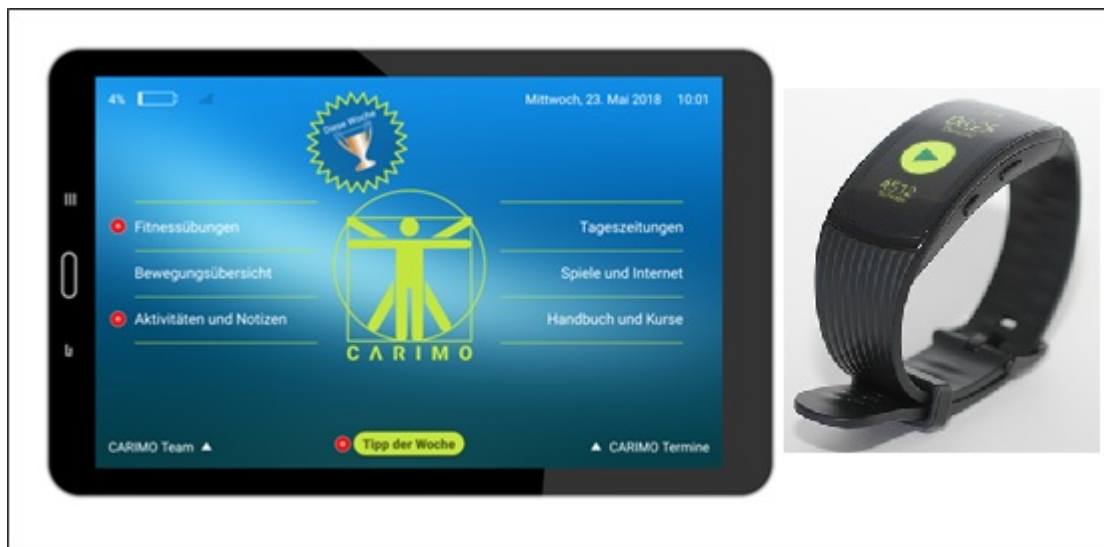
The aim of the AAL project “Care in Movement (CiM)” was to develop and test a software system, CARIMO, which supported all members of a care network (home care service users, informal carers, care workers, and volunteers). The effectiveness analysis focused on assessing the impact of CARIMO on home care service users, particularly on their lives and fitness-related outcomes ( for effects on fitness literacy, levels of physical activities and activity-related outcomes, see Trukeschitz et al. 2018, for effects on physical activities, see Ring-Dimitriou et al. 2018). The approach and results of the usability and user experience evaluation of CARIMO from the perspective of home care service users are presented in Trukeschitz and Blüher (2018).

CARIMO comprised – and combined – two mobile devices: a commercially available tablet computer and a wrist-worn fitness and activity tracker (fitness bracelet) (for details on CARIMO see also Schneider and Rieser 2018, Trukeschitz and Blüher 2018). The CARIMO app was installed on the tablet as the main home screen (as a launcher). The fitness bracelet was linked to the tablet and had a customized user interface focusing on the display of time as well as a step count, and providing shortcuts to the CARIMO-functions (tracking activities such as walking outside). Together with the CARIMO devices, participants also received a sticker they could put up in their homes (e.g. next to the door), reminding them to turn on the GPS on the CARIMO fitness bracelet if they wanted to track their routes when walking outside.

A step-by-step training protocol was devised for the care workers involved in the project to introduce CARIMO to the participants over the course of the first six weeks of the trial. It included asking the participants whether they had already tried out specific features, using CARIMO together and prompting them to explore the app by suggesting different tasks. Ultimately, the step-by-step training protocol was implemented in Austria, but not in Italy.

In an integrated approach to physical health and well-being, CARIMO aimed to address the 'body' as well as the 'mind' of older home care service users. Figure 1 displays the CARIMO home screen on the tablet with the main CARIMO features (left column, downwards): fitness exercises ('Fitnessübungen'), activity and exercise overview ('Bewegungsübersicht'), activities and notes ('Aktivitäten und Notizen'); (right column, downwards): newspapers ('Tageszeitungen'), games and internet ('Spiele und Internet'), a system manual ('Handbuch und Kurse'). At the bottom of the screen were: the 'CARIMO-Team' button, which allowed members of the CARIMO care team (care workers, informal carers, volunteers) to log on to CARIMO (e.g. to enter finished tasks or future appointments), the tip of the week ('Tipp der Woche'), and the CARIMO appointments button, which showed the dates of planned visits from the CARIMO team in the future.

**Figure 1: CARIMO tablet (CARIMO home screen – Austrian version) and fitness bracelet**



Source: CiM project (<https://www.careinmovement.eu/carimo/>)

## 2.1 'Body' – fitness function

The CARIMO features aiming to enhance physical fitness and health (i.e., the 'body aspect') were the fitness exercises, the activity overview (including the fitness bracelet), as well as the tip of the week.

The CARIMO fitness exercises, as the core feature of CARIMO, were conceptualized and prepared by the University of Salzburg and Salzburg Research, designed by Eichenberger Szenographie, and technically implemented by ilogs and Salzburg Research (see Figure 2). The fitness exercise feature was a compilation of daily alternating exercise videos to be played on the tablet. After an initial assessment with care workers of the two care organizations involved in the CiM project at the beginning of the CARIMO trial period, each participant was assigned to one of two difficulty levels. As a general rule, the selected exercises should be simple to perform and appropriate for an older, potentially mobility-restricted target group (no exercises to be performed kneeling or lying on the floor). Except sometimes for a normal chair and an empty wall, doing the exercises required no additional equipment. The exercises aimed to improve the participants' strength, flexibility, and balance. The daily alternating exercise program always comprised six different exercises (with two exercises focusing on strength,

flexibility and balance respectively), repeated once, resulting in a total of 12 videos per daily exercise program.

**Figure 2: CARIMO fitness exercises**



Source: CiM project

Several ideas were implemented in the exercise feature intending to motivate the participants to complete the exercises. Also, they tried to make exercising with CARIMO as convenient as possible.

- CARIMO offered a variety of different exercises (drawing from a pool of around 150 exercises), and a changing routine of delivering exercises via a countdown (different durations, between 20 and 40 seconds) or via a varying number of repetitions (e.g. 8 repetitions, 12 repetitions) in order to keep participants from being bored by the same routine of exercises.
- The exercises in the videos were performed by three different older adults (two male, one female) to further encourage and help participants identify with the models.
- If someone did not want to or felt unable to do a certain exercise, it was also possible to skip one or several exercises (in this case, CARIMO did not count the exercise as being completed).
- A progress bar indicated how far along in the exercise program the individual user was.
- After finishing the exercises, CARIMO gave praise or encouraging feedback based on the number of completed exercises.

With the activity and exercise overview, particularly in combination with the CARIMO fitness bracelet, participants could keep track of their activities, looking at the number of completed exercises, the number of minutes spent doing physical activities, and the number of steps collected during the day (see Figure 3). They could choose between a daily or weekly display. A more detailed illustration of the individual activities was also available (e.g. time of the day when the exercises were completed, the route on a map when GPS tracking was activated, or the distribution of steps collected during the day or week). CARIMO exercises were counted automatically, as well as steps and some activities such as walking or cycling for longer than 10 minutes when wearing the fitness bracelet. Participants could also enter activities manually into CARIMO. The trophies at the top of the activity and exercise overview filled up with a bronze, silver or gold color, depending on how many of their goals participants were able to reach daily (or weekly) activity goals (thresholds were contributed by the University of

Salzburg). Similarly, the trophy on the CARIMO home screen indicated the users' progress for the week. By clicking on the trophies or the info button next to the trophies, participants could check how many steps or exercises in total were necessary to reach the next trophy color, and how many they still needed at the moment to 'level up'.

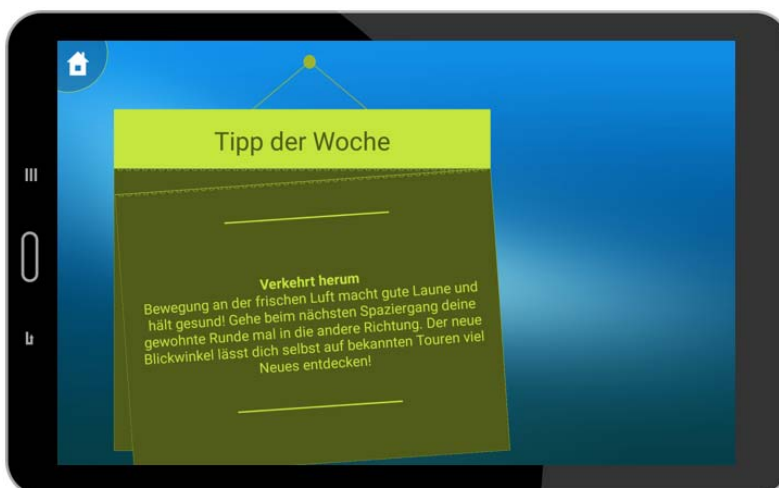
**Figure 3: CARIMO activity overview (main screen)**



Source: CiM project

The third aspect of CARIMO's focus on physical activity was the tip of the week, devised by sports scientists in the CiM Consortium (see Figure 4). Every Monday, participants received a new tip of the week, i.e. ideas and suggestions on how to incorporate physical activities and exercises into their daily lives and particularly on how to make outdoor activities, such as simple walks, more interesting.

**Figure 4: CARIMO tip of the week**



Source: CiM project

## 2.2 'Mind' – information and entertainment functions

The CARIMO features focusing on the provision of information and entertainment (i.e. the 'mind' aspect of CARIMO), were the activities and notes feature, the newspapers, the internet and games feature, the CARIMO system manual, and the CARIMO appointments feature. The aim of these features was to contribute to the participants' mental health and well-being by helping them keep informed, entertained, and in control of their everyday lives.

The purpose of the '**activities and notes' feature** was, on the one hand, to allow users to enter certain activities that included any kind of healthy exercise (counted together in the activity overview). On the other hand, they were also able to check up on activities in the context of their care, entered by the members of their care network. With this feature, they long-term care service users also exchange virtual notes with the members of their care network.

The **newspapers feature** provided electronic access to a selection of articles from six different national and regional newspapers in each country. This feature had the particular advantage of providing information in writing larger than in traditional newspapers, and a variety of different newspapers available on a single device.

The **internet and games feature** provided a button for opening a web browser for simple access to the internet. Furthermore, the feature offered different, preselected games that could be interesting and entertaining for an older target group (e.g. guessing the meaning of a sequence of pictures, a mathematics game, solitaire).

The **interactive CARIMO system tutorial** offered a step-by-step explanation of the CARIMO app and the different features, including descriptions of individual buttons and prompts to try clicking on a button to see what happens.

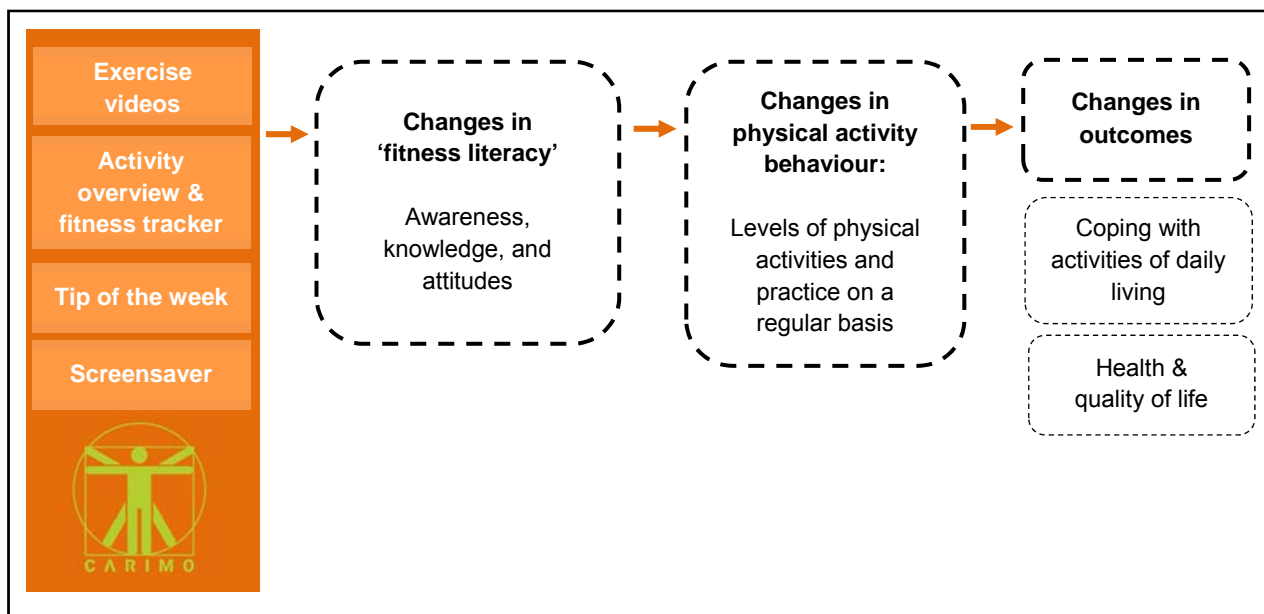
By clicking on the **CARIMO appointments field** on the CARIMO home screen, CARIMO users could see the dates and times of future planned visits, entered by members of the care network.

### 3 Research aims for the survey-based effectiveness analysis of CARIMO

Accounting for the characteristics of CARIMO and the target group to be involved in the field trial, the evaluation of the effectiveness of CARIMO using survey data aimed to address potential effects of CARIMO on (i) fitness-related outcomes, (ii) communication and entertainment related outcomes and (iii) participants' ICT-savviness, attitudes and use of new technologies.

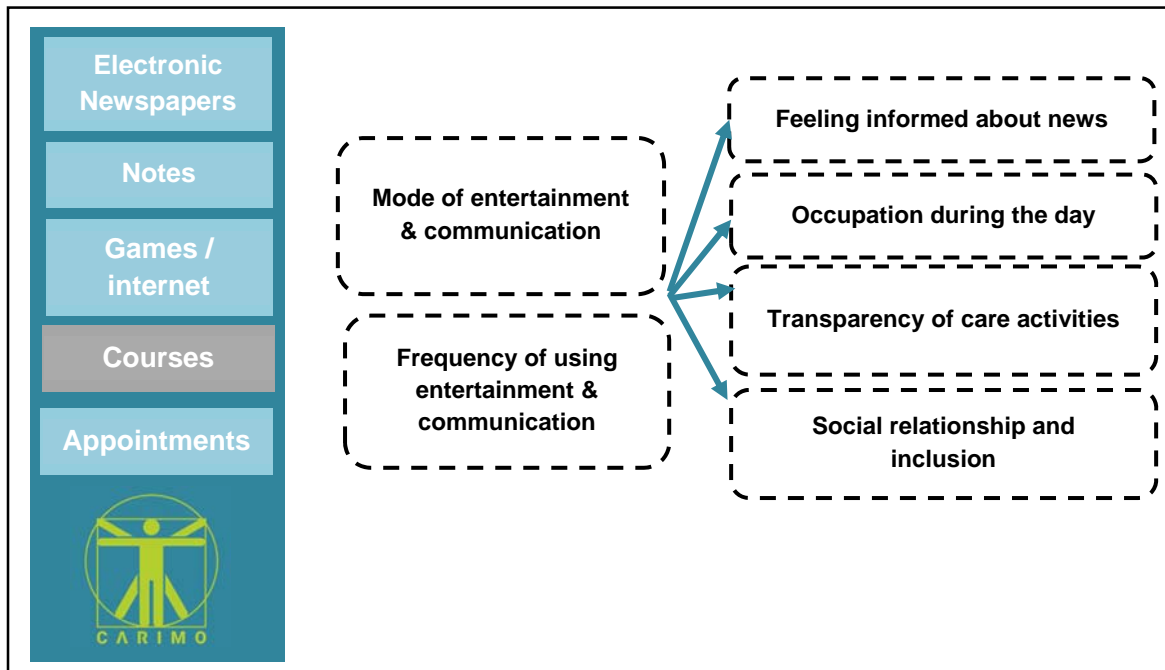
Figure 5 gives an overview of the **expected outcomes of the CARIMO fitness app** (consisting of exercise videos, activity overview, a fitness bracelet to count steps, an activity-related tip of the week and a screensaver providing information on physical activities and health). Fitness-related outcome indicators thus comprise fitness literacy (i.e. awareness, knowledge and attitudes towards an active lifestyle), physical activity behavior (i.e. levels of physical activities and regular practice of physical activities) and further fitness-related outcomes, such as changes in abilities to cope with activities of daily living and health or quality of life outcomes. For results see Trukeschitz et al. (2018), and Ring-Dimitriou et al. (2018).

**Figure 5: Expected outcomes of the CARIMO fitness app addressed by the effectiveness survey**



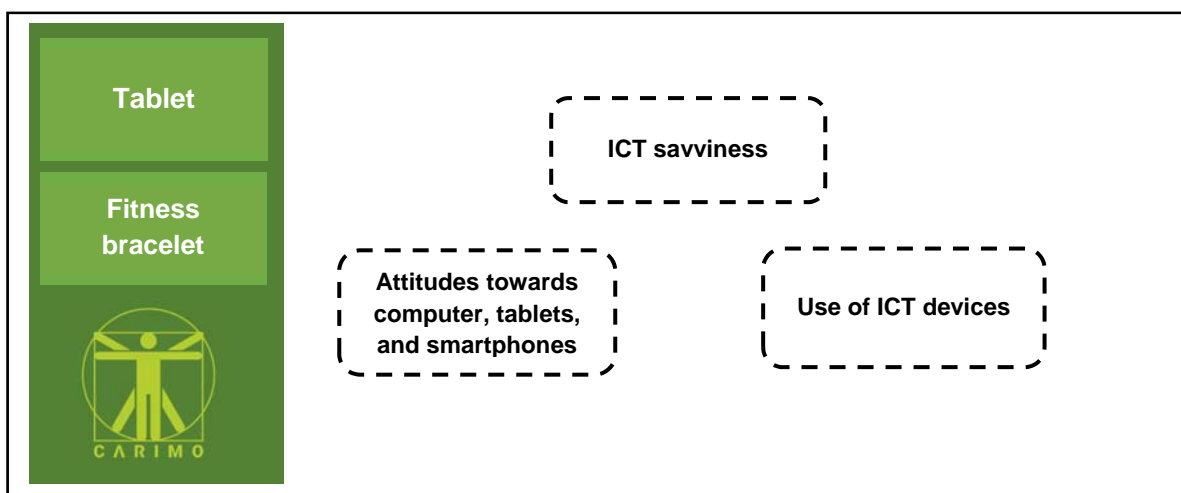
CARIMO also provided entertainment and communication functions, such as access to online newspapers, games and an internet [browser] as well as the opportunity to write notes to other members of the care network and to log appointments. We aimed to also offer e-learning courses accessible on the tablet, however, did not implement them into the final CARIMO app. CARIMO thus was **expected to change the mode and frequency of entertainment and related outcomes**, such as the feeling of being informed about news and care activities provided, contact with other people, and occupation during the day (see Figure 6). For results see Trukeschitz et al. (2018), and Ring-Dimitriou et al. (2018).

**Figure 6: Expected outcomes of the CARIMO entertainment and communication features addressed by the effectiveness survey**



Finally, Figure 7 shows expected potential effects of using CARIMO on older people’s **ICT-savviness, their attitudes towards new technologies and the use of ICT devices**.

**Figure 7: Expected outcomes of using CARIMO addressed by the effectiveness survey**





## 4 Target groups

### 4.1 Definition of the target group for the field trial

CARIMO was intended support LTC networks. Thus, the target group for the CiM field trial comprised four groups of people that may be involved in such networks: (i) LTC service users, (ii) their relatives/informal carers, (iii) professional carers and (iv) volunteers. We sought to involve these four groups in the treatment group, testing CARIMO for a period of 8 months. To enable the measurement of effects, we established a comparison group, which also consisted of members of such LTC networks. As volunteers were not part of the effectiveness analysis, we did not need to include volunteers in the comparison group.

CARIMO was developed to support LTC service recipients. It was designed to improve or maintain their health by offering physical exercises and overviews of activities within different time frames. In addition, CARIMO also had the goal of supporting the care network by offering tools for communication and exchange as well as education. Thus, a corresponding set of inclusion and exclusion criteria was established (e.g. regarding age, cognitive abilities) to recruit the relevant group of people for the field trial.

#### 4.1.1 Target group data

Two LTC service user organizations were involved in the CiM project – Hilfswerk Salzburg (Austria) and ALDIA (Italy)<sup>1</sup>. The care service user organizations were responsible for the acquisition of home care service user data (for an assessment of the client base), the definition of the target group, and contacting potential project participants. Required information included most importantly the data on the clients, such as age, sex, region, types of services received, levels of disabilities, mobility and mental state, diseases, the availability of an informal carer. In case an informal carer was available, we collected some sociodemographic information on the informal carers, such as age, sex and relationship to the home care service user.

Initial datasets were compiled by both LTC providers and submitted to WU for screening by the end of 2015/beginning of 2016. A preliminary analysis revealed the need for a larger number of clients. Thus, the WU team suggested including additional service regions or to approach other providers to ensure meeting the target numbers of 60+ clients (and their relatives) each for the test and control groups. Both care providers managed to include additional regions in Austria and Italy, and to involve other care providers (Italy only). In Austria, during recruitment, the care organization also invited a few people who did not receive any home care to meet the target numbers of trial participants.

Final datasets on the population for the field trial were completed in December 2016. Hilfswerk Salzburg also provided an updated version of the initially submitted dataset, accounting for changes in client numbers and characteristics, e.g., clients' health status. ALDIA expanded beyond organizational boundaries to cooperate with local municipalities and include service users outside their own client pool.<sup>2</sup>

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<sup>1</sup> ALDIA topped up the number of people potentially being included in the field trial by involving service users from other Italian organizations in the project.

<sup>2</sup> As the provided datasets were at times incomplete and submitted in fragments (including e.g. double counting of clients, missing or unclear information), WU dedicated an extensive amount of time to the preparation of the dataset before beginning the analysis. Because of missing data and the amount of

## 4.1.2 Target group criteria

According to the objectives of CARIMO, physical and cognitive criteria were established to define possible target groups. Different compositions of target group criteria were examined. Ultimately, target group criteria were determined by the following characteristics.

### *Home care service user characteristics*

Ideally, home care service users considered for recruitment were between 55 and 85 years old, either received no long-term care allowance or up to level 3 (this information is only available in Austria), had no or low visual or hearing impairment, and were either fully mobile, or mobile with moderate or some limitations. Only participants without cognitive impairments should be included (see Table 1).

**Table 1: Overview of home care service user characteristics**

<b>Selection criteria</b>	<b>Definition</b>
Age	55-85 years
Level of care allowance (only in Austria)	0 to 3
Disabilities	no disabilities OR low visual/hearing impairment
Mobility	fully mobile: (can walk without help more than 6 min. continuously); OR with moderate limitations (can walk with (simple) walking aids 6 min. or more (e.g. cane, crutches, used to one (lower or upper leg) prosthesis for years)); OR with limitations (can walk a few meters/minutes (<6 min & <200m) with walking aids (e.g. walking frame, whole artificial limb, crutches)
Mental state	without cognitive impairments

### *Characteristics of relatives/informal carers*

Informal carers of participating clients were also given the opportunity to participate in the project, if they were between 18 and 90 years old, with no disabilities or only low visual/hearing impairment, and with no or limited mobility restrictions and no cognitive impairments.

### *Characteristics of volunteers*

The CiM trial phase also aimed to include volunteers in the intervention group, working with the service users and communicating with formal and informal carers. This included people who had previously been volunteering for Hilfswerk Salzburg or ALDIA as well as persons with no previous volunteering experience. Criteria for inclusion comprised their age (between 18 and 90 years), no disabilities or low visual/hearing impairment, and no or limited mobility restrictions and no cognitive impairments.

### *Characteristics of care workers*

Care workers involved in the CiM project had to be employed with one of the two participating care organizations. 'CiM Assistants' were care workers who visit clients participating in the

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time necessary to gather all information, it was not possible to give a complete overview of all clients whose information was submitted (e.g. when clients whose information was not complete did not fall into the defined age brackets or had severe cognitive impairments, they were preliminarily excluded from further analysis).

project to assist them using CARIMO. ‘CiM Mentors’ were employees of the care organizations who coordinate CiM Assistants. While each participating Austrian region had a CiM Mentor, there was just one CiM Mentor in Italy.

## 4.2 Size and description of the target group: LTC service users

Of the 1,412 cases in total submitted by the two participating organizations Hilfswerk Salzburg and ALDIA, 533 (37.7%) matched the target group criteria (see Table 2). This target group will be described in more detail to get an idea about the service users’ home region, age distribution, sex, mobility, disability patterns, their health issues, and the availability of an informal carer.

**Table 2: Break-down of target group size**

	<b>Assessed for eligibility</b>	<b>Target group (meeting all inclusion criteria)</b>
<b>Hilfswerk Salzburg</b>	1127	414
	100.0%	36.7%
<b>ALDIA and others</b>	285	119
	100.0%	41.8%
<b>Total</b>	<b>1412</b>	<b>533</b>
	<b>100.0%</b>	<b>37.7%</b>

Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis

### 4.2.1 Targeted regions

The CiM field trial took place in several regions within the Austrian province of Salzburg as well as the Italian regions Piedmont (P) and, mainly, Lombardy (L). It included cities and villages situated in both urban and more rural areas. Table 3 lists the regions included in the field trial and the distribution of service users living in the respective regions.

**Table 3: Regions for the field trial**

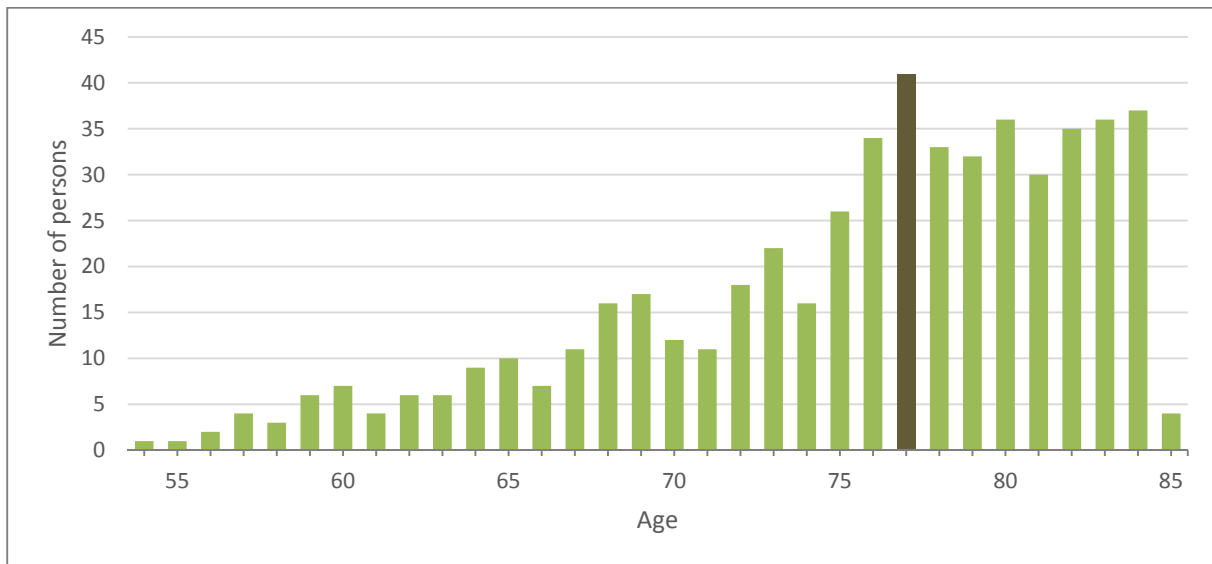
<b>LTC provider</b>	<b>Region</b>	<b>Service users in target group</b>	<b>% (per LTC provider)</b>
<b>Hilfswerk Salzburg</b>	Flachgau	162	39.1%
	Tennengau	27	6.5%
	Pinzgau	95	22.9%
	Pongau	130	31.4%
	<b>Total</b>	<b>414</b>	<b>100.0%</b>
<b>ALDIA and other Italian organizations</b>	Pavia/Milano (L)	81	68.1%
	Como (L)	28	23.5%
	Alessandria (P)	10	8.4%
	<b>Total</b>	<b>119</b>	<b>100.0%</b>
<b>Total</b>		<b>533</b>	

Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis

## 4.2.2 Age of LTC service users (target group)

The age range of the target population was determined to be between 55 and 85 years at the beginning of 2017.<sup>3</sup> Although the allowed range spanned 30 years, half of the target population was 77 years or older, indicating an overall older client base. The median age was consistent at 77 years in the total target population as well as separately in the client data provided by both LTC providers. (see Figure 8 and Figure 9).

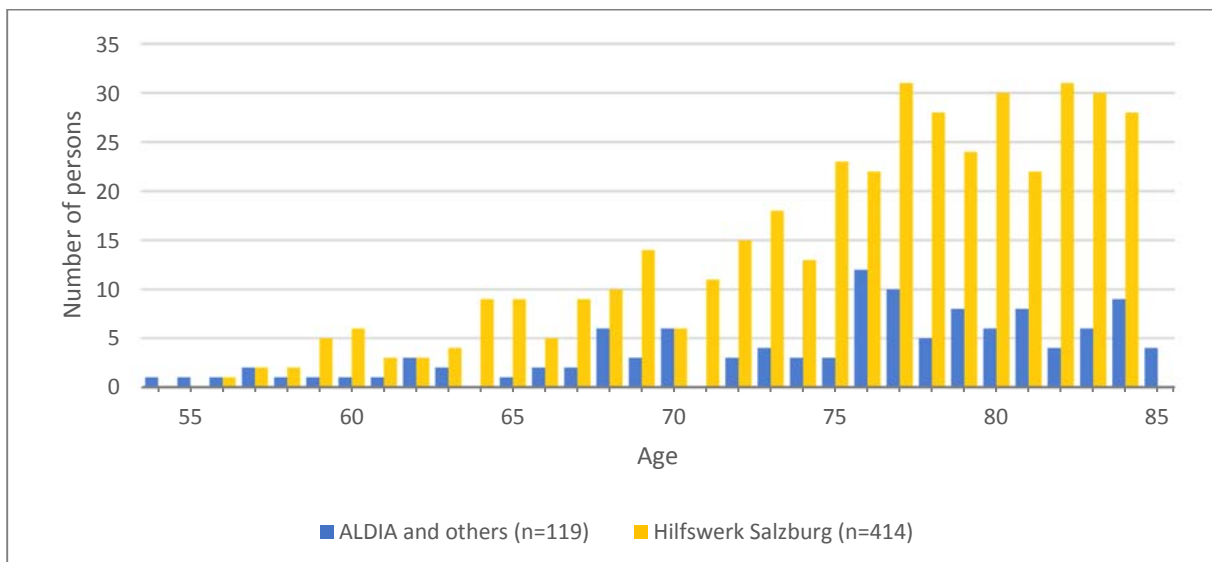
**Figure 8: Age distribution in total target group**



Note: dark bar indicates the median age

Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis, n=533

**Figure 9: Age distribution in target group, by LTC provider**



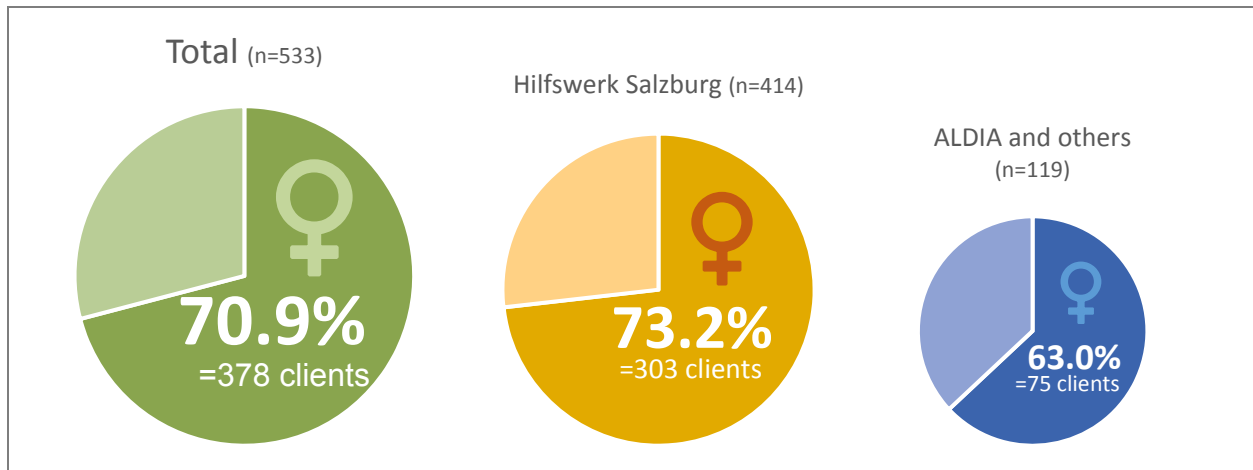
Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis, n=533

<sup>3</sup> Because of the small size of the dataset and consequently the target population, age restrictions were loosened for ALDIA, resulting in the inclusion of one person younger than 55 years.

### 4.2.3 Sex of LTC service users (target group)

Overall and in both LTC providers, the majority of the target population were women; their share ranging between 63% for “ALDIA and others” and 73.2% for “Hilfswerk Salzburg” (see Figure 10):

**Figure 10: Share of female LTC service users**

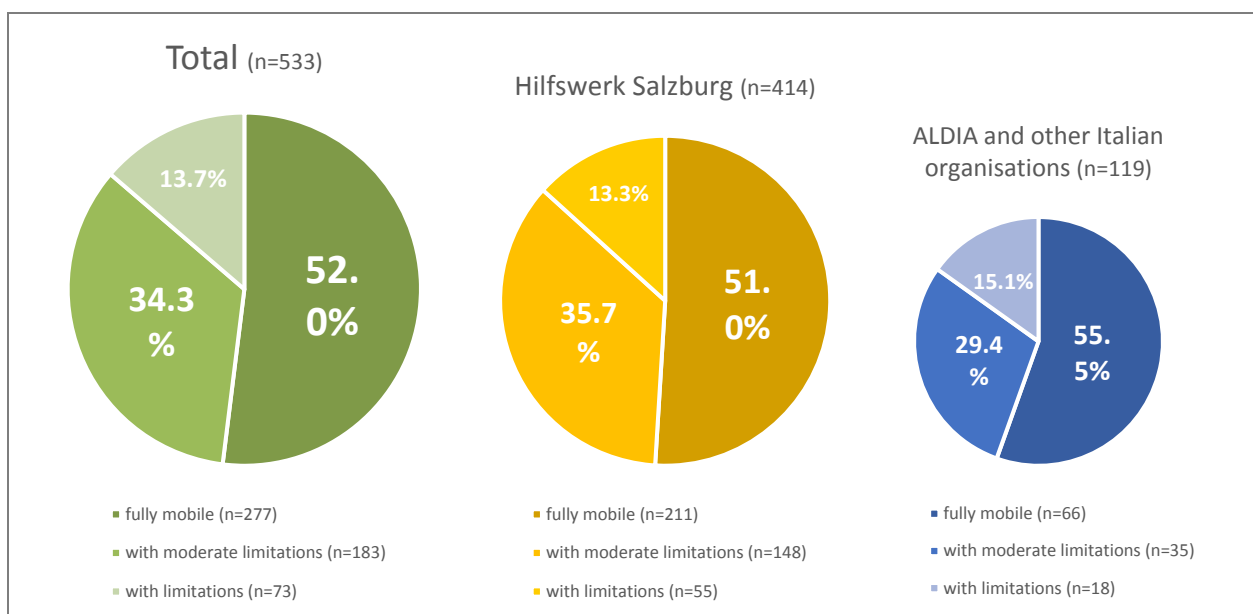


Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis, n=533

### 4.2.4 Mobility of LTC service users (target group)

More than half of the target population had been assessed as “fully mobile”. The distribution across mobility levels was similar for both organizations (see Figure 11).

**Figure 11: Mobility of LTC service users – overview**

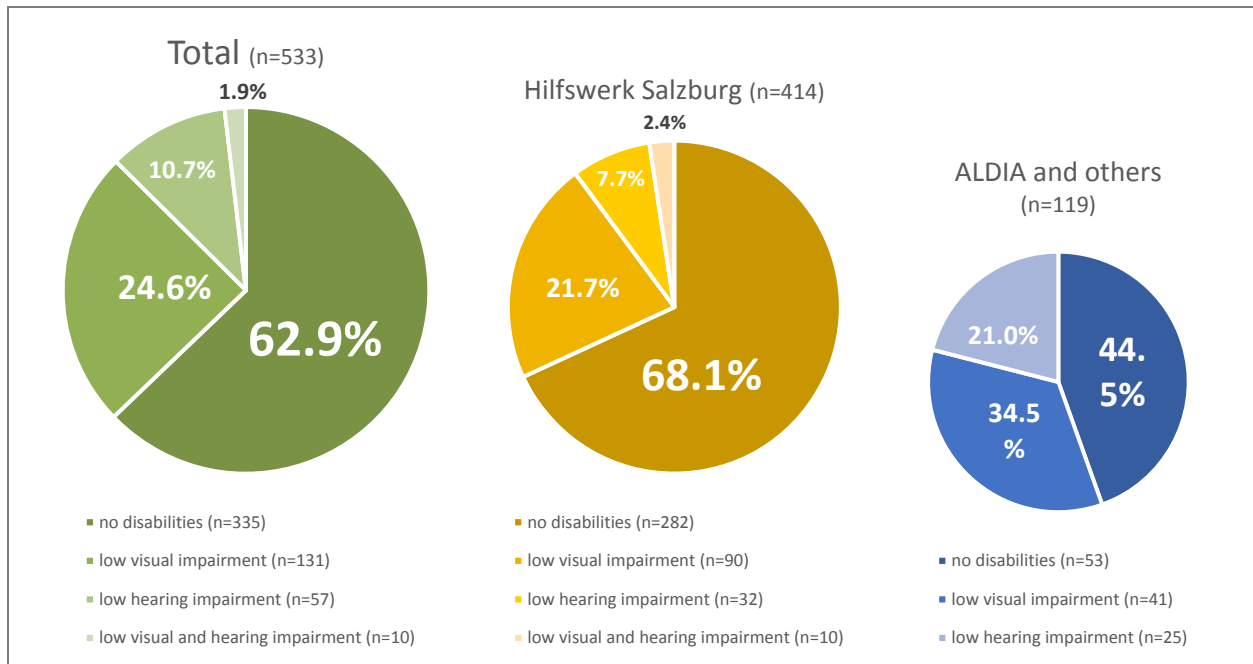


Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis, n=533

## 4.2.5 Disabilities of LTC service users (target group)

Overall, more than 60% of the target group had no disabilities; however, there was a difference between the two participating organizations. Whereas less than a third of Hilfswerk clients (31.7%) had low visual or/and hearing impairment, more than half of the LTC service users named by ALDIA (55.5%) had either visual or hearing impairment (see Figure 12).

Figure 12: Disabilities of LTC service users – overview



Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis, n=533

## 4.2.6 Health issues of LTC service users (target group)

The WHO “International Statistical Classification of Diseases and Related Health Problems” ICD-10 served to categorize the health issues and diseases of clients listed by both LTC providers.<sup>4</sup> From the overall number of 22 categories, 14 relevant head categories concerning typical diseases of older adults were selected, excluding categories related to pregnancy and childbirth, short-term diseases, infections, congenital malformations and external causes of morbidity and mortality. Each listed disease was assigned to a single category, and each category was counted once per person even when there were multiple conditions pertaining to one category, as the objective was to determine the number of persons afflicted by each category.

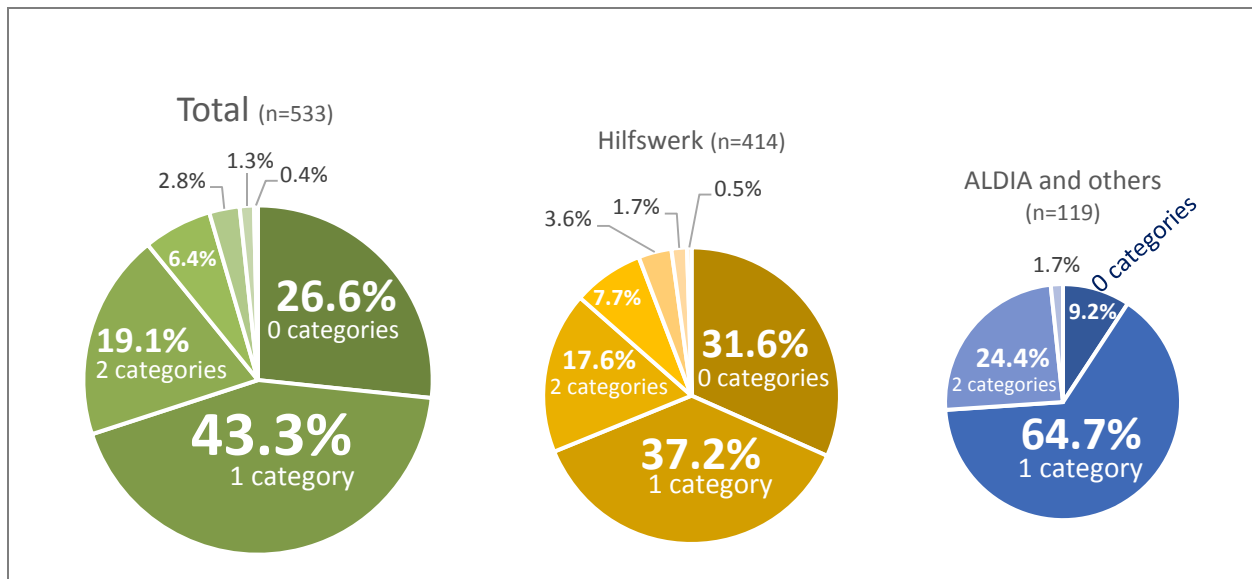
### ***Number of different diseases per LTC service user***

The analysis showed that among the target group population, LTC service users may have been afflicted by a number of conditions within 6 different, age-related disease categories (see Figure 13, numbers starting with 0 in the darkest section and increasing by 1 in each lighter section). Overall, more than a quarter of the target group population (26.6%) had no disease

<sup>4</sup> The classification ensures international comparability and is used in Austrian medical institutions and hospitals.

that falls within any of the selected categories, 43.3% had diseases within one category and 30% had diseases in two or more of the selected age-related categories (see Figure 13).

**Figure 13: Number of different disease categories per LTC service user**

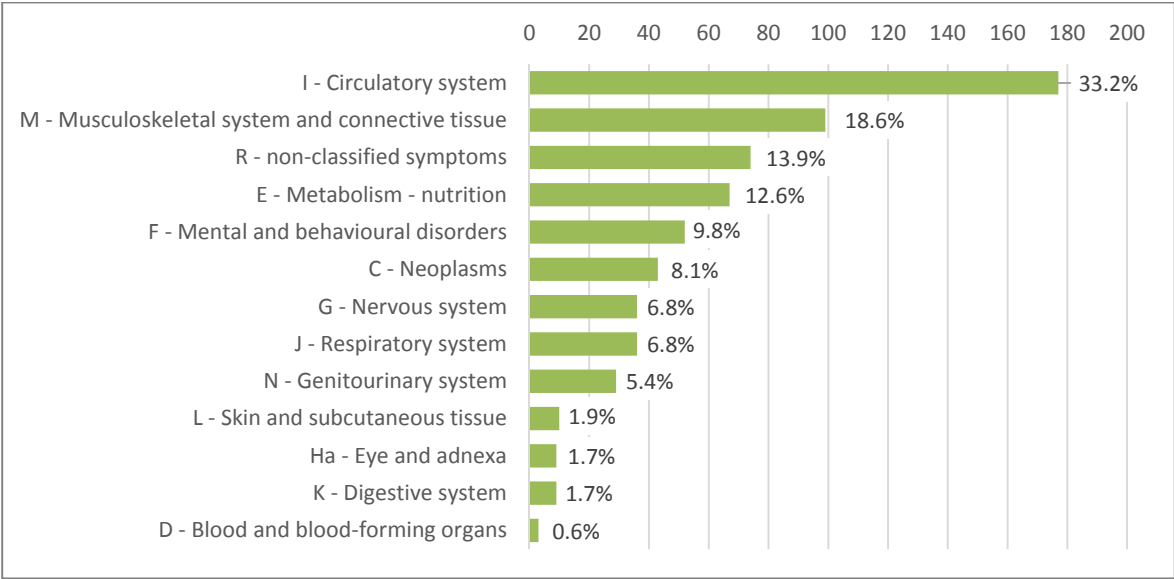


Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis, n=533

### **Types of diseases prevalent among LTC service users**

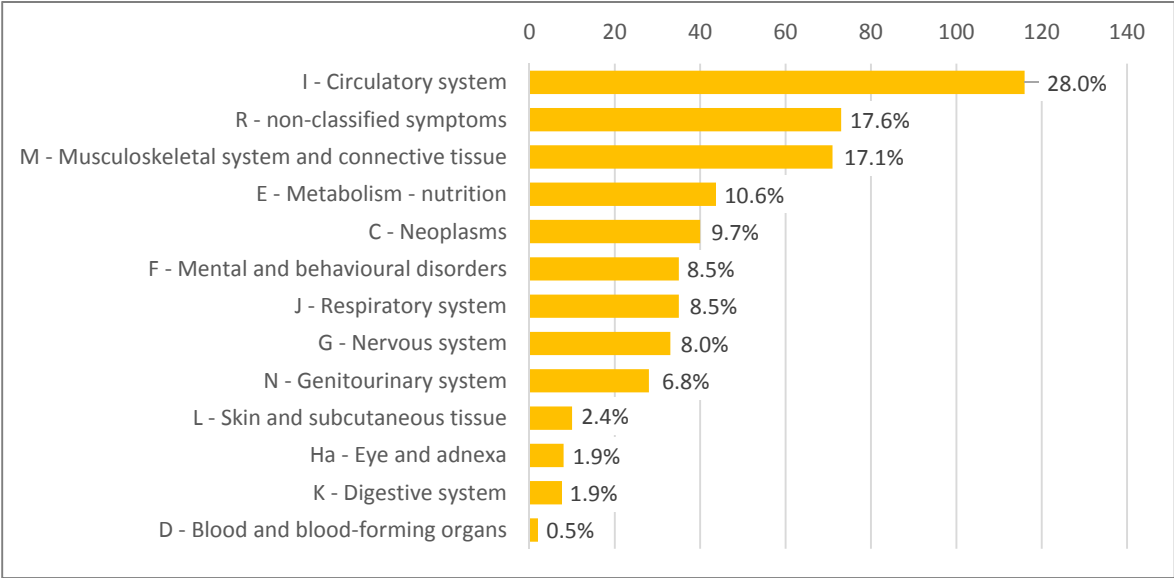
33.2% of the target group population suffer from conditions affecting the circulatory system, followed by 18.6% with issues regarding the musculoskeletal system and connective tissues, and 12.6% with diseases affecting the metabolism and nutrition (mostly diabetes). These categories are most prevalent among the clients of both LTC service providers. Less than 10% of the total target group population suffer from neoplasms (often cancer), of the nervous system, the respiratory system or the genitourinary system respectively. Diseases of the skin and subcutaneous tissue, the eye, the digestive system, or the blood and blood-forming organs affect less than 2% of the target group population. The variety and frequency of occurrences within the different categories are more evenly spread among Hilfswerk Salzburg clients, while the majority of ALDIA clients suffer from conditions of the circulatory system (51.3%), the musculoskeletal system (23.5%), metabolism (19.3%), and/or from mental and behavioral disorders (14.3%). For more detail, see Figure 14, Figure 15, and Figure 16.

**Figure 14: Types of diseases prevalent among LTC service users – Hilfswerk Salzburg, ALDIA and other Italian organizations**



Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis, n=533

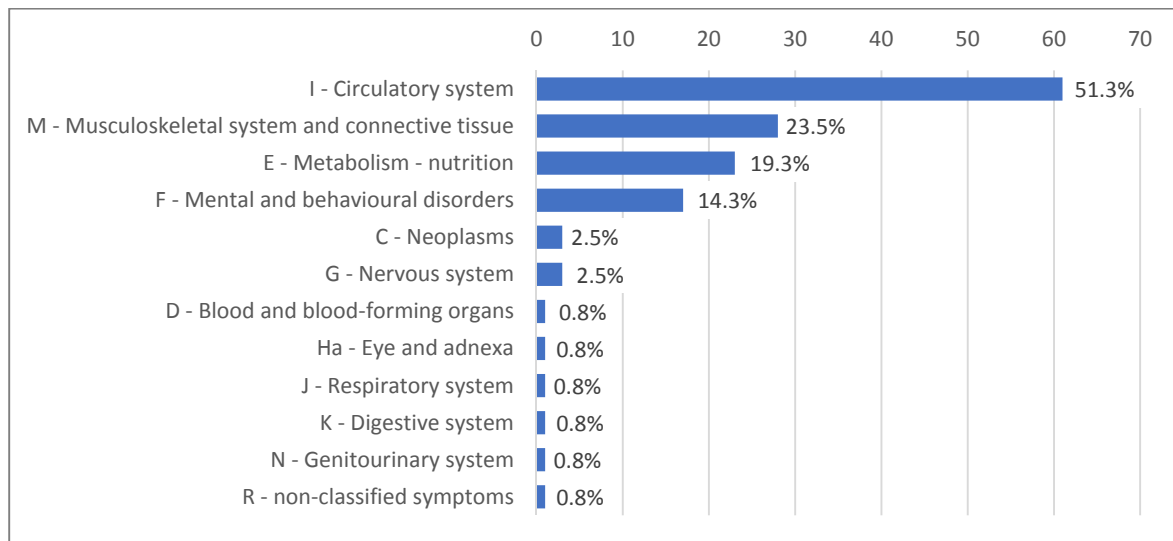
**Figure 15: Types of diseases prevalent among LTC service users – Hilfswerk Salzburg**



Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis, n=414



**Figure 16: Types of diseases prevalent among LTC service users – ALDIA and other Italian organizations**

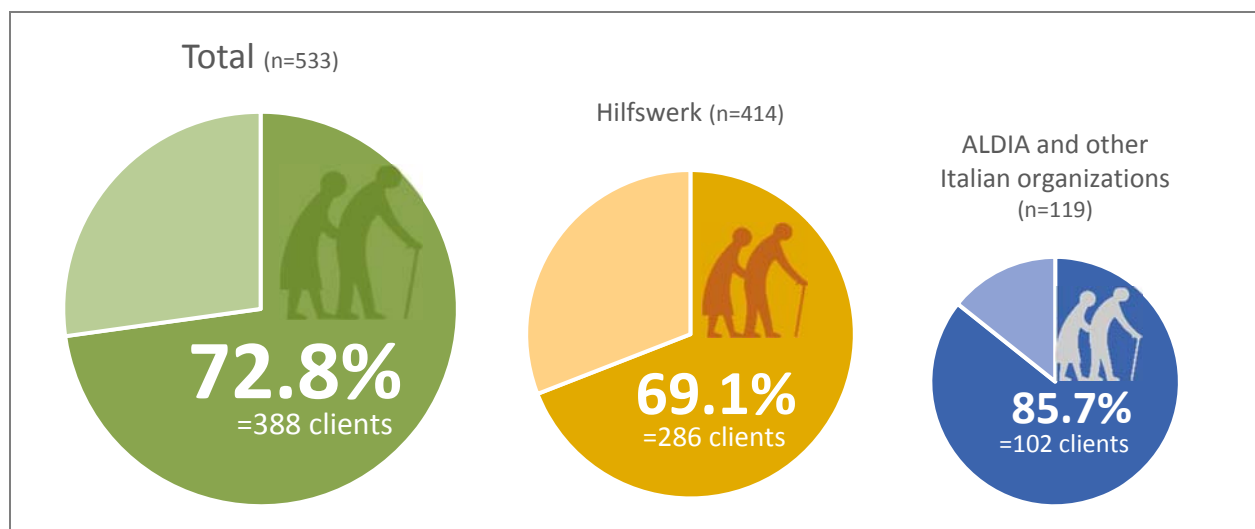


Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis, n=119

#### 4.2.7 Availability of an informal carer (target group)

An informal carer was available for almost three quarters of the target population, although the share was considerably higher for ‘ALDIA and other Italian organizations’ clients than for those of Hilfswerk Salzburg.

**Figure 17: Availability of an informal carer**



Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis, n=533

## 5 Risk assessment

### 5.1 Reasonably foreseeable risks

Given the difficulties of long-term care organizations in providing data about the target group on the one hand, and the drop in the number of people (from more than 500 to more than 1,000) eligible for the field trial on the other hand, there was an increased risk of not meeting the proposed number of participants in the test and control groups.

During active participation and usage of CARIMO, there was a risk of suffering physical injuries when exercises are not followed correctly.

There was also a chance that trial participants would become attached and used to the system, resulting in negative psychological reactions upon removal of the system at the end of the trial period.

There was a risk of drop-out among CARIMO users (treatment group) and members of the control group.

### 5.2 Precautions taken to minimize risks/harms

Despite providing information, the CiM consortium did not have many levers to appropriately influence recruitment. Recruitment success depended on the effort of the care organizations involved in the project. As recruitment turned out to be challenging, it was suggested to involve clients from other regions and other care organizations to increase the size of the target population and decrease the expected drop-out rate.

To minimize physical risk and harm to trial participants, only exercises with no/low risk of injury were selected for the daily training programs. Exercise plans were compiled for two different difficulty levels (participants were assigned to one of the plans following a fitness check assessing basic levels of mobility, endurance and flexibility at the beginning of the trial period).

With the consent form, which they read and signed before the trial started, trial participants were also informed that they could terminate their participation and request the deletion of all their data at any given time without explanation. If a participant changed his or her mind about the trial or disclosing any kind of information via questionnaires or their usage of the system, they were aware of their right to drop out of the trial.

Several pre-tests of the CARIMO system should ensure that the system worked well and was ready for a large field trial. This should prevent CARIMO users from quitting due to bugs of the AAL-system.

To give participants in the treatment group an incentive and something 'to keep' from CARIMO, every participant who completed the trial period was offered the possibility to keep the fitness bracelet for free. For members of the control group, we provided incentives paid at the end of the trial phase after completing all questionnaires. They received shopping vouchers that were distributed by the end user organizations.

## 6 Recruitment process and sampling

### 6.1 Randomization and matching procedures

Small target group sizes and limited personnel resources for recruitment in both Austria and Italy forced a comprehensive approach towards sampling and a focused recruitment strategy. In fact, the target population was so small that a successful drawing of a random sample, including matching partners in the control group, was unlikely. For this reason, the decision was made that not all persons in the target group should be approached about participation in the project but initially only a random selection of persons from the target group population.

We thus randomly select potential CARIMO users and also already assigned matching control partners. This way, in case a supposed test person declined participation in the CARIMO trial period, their control group partner could be approached for the test group while the first person would be asked to participate in the control group. Accordingly, equivalency and stratification of test and control group would still remain stable and important steps during sampling would not have to be repeated.

“Randomization” of a supposed test group and individual matching of an in specific criteria equal control group were thus conducted before the recruitment process, using SPSS software. Individual matching refers to the effort of drawing one ‘partner’ for each person in the test group who is a close equivalent in terms of relevant evaluation criteria (Rossi, Lipsey, and Freeman 2004, 276). Age (in a range of +/- 5 years), sex, and home region served as matching variables for the selection of the control group.

The sampling and matching procedure for the target group population of each LTC provider comprised the following steps:

- 1. Creation of a separate dataset containing only cases meeting the target group criteria.**
- 2. Random assignment of cases to the CARIMO treatment group and the control group.**  
Preconditions for the random assignment due to organizational issues and project objectives:  
ALDIA: By request of ALDIA, the clients in the city of Poglio Milanese were excluded from random assignment to a potential intervention group (they were available as matching partners, i.e. “control group”)  
Hilfswerk Salzburg: To involve as many informal carers as possible, only those Hilfswerk Salzburg clients for whom an informal carer was potentially available were included in the random sample
- 3. Matching process using different sets of criteria to achieve the highest possible number of matches for the random sample.**  
Outline of the procedure:  
After matching criteria and tolerances (see Table 4) were entered in SPSS, cases not from the random sample were checked for matches to the defined intervention group (random samples). In a separate variable for the control group cases, the matching “intervention group” cases were identified via their ID. To reach a sufficient number of matches, matching criteria had to be adjusted and run with different samples.

**Table 4: Matching criteria**

	<b>Target group criteria</b>	<b>Variable</b>	<b>Tolerance/description</b>
<b>ALDIA</b>	55-85	<b>Age</b>	+/- 5 years
	m/w	<b>Sex</b>	0
	Provinces	<b>Provinces</b>	0 3 Provinces: Pavia/Milan, Como, Alessandria.  The target group population living in the city of Pogliano Milanese (in the province of Milan) was matched as a control group with the province of Pavia (by request of ALDIA)
<b>Hilfswerk Salzburg</b>	55-85	<b>Age</b>	+/- 5 years
	m/w	<b>Sex</b>	0
	Regions	<b>Regions</b>	0 4 Regions: Flachgau, Pinzgau, Tennengau, Pongau
	yes/no	<b>Informal carer*</b>	1
	* The tolerance implies that the availability of an active informal carer is a preference, but not a conditional criteria for matching		

#### **4. Determination of target and control group by examination of selected matching sets.**

Via a separate procedure, datasets containing only the cases of large matches (random sample and matched cases) were created. They were then analyzed regarding the equivalence of the random sample and the matched cases in terms of age, male-female ratio, level of disability and mobility, and regional distribution. After equivalence was confirmed, the sets were assessed regarding their correspondence to overall target group characteristics, looking for those most fitting for the project (i.e. overall high mobility, few disabilities).

#### **Final number of matches:**

**ALDIA:** 51 matches (102 clients designated to test group and comparison group)

**Hilfswerk Salzburg:** 68 matches (FSZ 1, 3, 5, 7, 8, 9)

+ 48 (FSZ 2)

+ 54 (FSZ 6)

= 170 matches (340 clients designated to test group and control group).

Initially, Hilfswerk Salzburg only provided client data from FSZ 1, 3, 5, 7, 8 and 9, yielding a target group population of 199 and 68 matches. After client data from two more FSZ (2 and 6) was provided by Hilfswerk Salzburg and screened and matched by the WU, these sets were added to the recruitment pool.

## 6.2 Guidelines for recruiting and allocation of field trial participants to the trial and control group

The concept for recruitment was developed by the Vienna University of Economics and Business (WU) in cooperation with two long-term care organizations, Hilfswerk Salzburg (Austria) and ALDIA (Italy). The WU team held a recruitment workshop in Salzburg to inform regional care managers of the Austrian care organization on the process of recruiting participants. Salzburg Research and WU provided an update on the project status and the CARIMO system and discussed the proposed recruiting strategy with staff members of the Hilfswerk Salzburg who were responsible for the recruitment of project participants ('CiM-Mentors').

CiM-Mentors were responsible for the recruitment of project participants (clients, informal caregivers, volunteers) in both the test group as well as the comparison group. This included:

- selecting and training/preparing recruiters (selected from the organizations' employees) how to approach clients and informal carers;
- arranging meetings with clients and informal carers and
- collecting and submitting signed informed consent forms of participants.

For the recruitment of the test group, both LTC providers were equipped with information folders explaining the functions of the CiM system as well as a short video produced by SFRG, demonstrating some features of CARIMO to be shown on tablets to clients.

## 6.3 Recruitment of clients and informal carers for the treatment and control group

After the matching of potential participants by the WU team, recruitment lists containing the names of clients in the planned test and control groups were compiled and forwarded to the respective LTC providers.

Although different target group sizes and organizational resources implied distinct recruitment approaches by both LTC providers, they were asked to adhere to a basic common recruitment strategy:

### 1. Approaching clients designated to the test group and if available, their main informal carer.

As a priority, clients assigned to the test group and their informal carers were approached first and recruited for the test group. If a client and their informal carer could not be recruited for the test group, they were asked to alternatively participate in the comparison group. Ideally, the matched person formerly designated to the comparison group would later participate in the test group.

### 2. Completing the recruitment of test group participants.

The test group was completed when the target number of participants (clients) was achieved (in the case of Hilfswerk Salzburg, 70 – including a margin for dropouts between recruitment and beginning of test phase) or all potential participants had been approached (in the case of ALDIA). Besides an exchange in test-comparison pairs, additional test persons were recruited based on suggestions from recruiters.

### 3. Recruiting of comparison group participants based on the characteristics of those who participate in the test group.

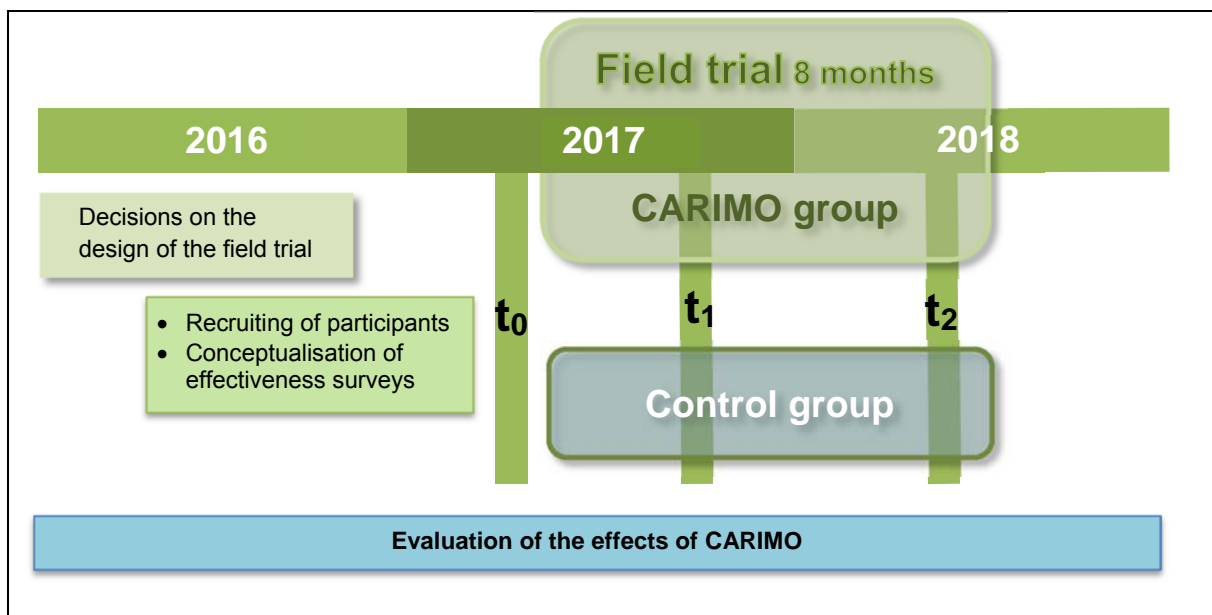
For all test group members missing comparison group partners, matches were drawn from the reserve pools of the LTC providers' clients. Those clients were then approached and asked to participate in the comparison group project.

The recruitment phase for the test group started at the beginning of January 2017 and finished in mid-March 2017. The recruitment phase for the comparison group started in mid-March 2017 and finished in mid-April 2017.

## 7 Data collection, questionnaire and data set

We collected survey data for the effectiveness analysis three times during the CiM-project period for both the trial and control groups. The first wave of questionnaires (baseline or  $t_0$ ) was administered to the trial and the control groups before the beginning of the field trial, in May/June 2017, the second questionnaire ( $t_1$ ) was delivered in October/November 2017, and the third ( $t_2$ ) in February/March 2018 (see Figure 18).

Figure 18: Timetable of the effectiveness evaluation study – working steps and data collection



Finalizing of the questionnaires comprised three steps. First, the length, wording, and layout of the questionnaire draft were pre-tested in three cognitive interviews with persons from the target population in Salzburg. Second, the final questionnaires were prepared by the WU team and translated into Italian by a translation institute (and submitted to ALDIA for feedback). Third, at the beginning of the trial, each participant received an individual participant code which was printed on the respective questionnaires to ensure traceability of the questionnaire data for the longitudinal study.

After printing, the questionnaires, including return envelopes, were packed in larger envelopes. All envelopes carried the logos of the respective LTC organizations and an indicator for treatment and control group.

The questionnaires were sent to the LTC organizations that were in charge of distributing and later collecting the questionnaires. In addition to the questionnaires, the LTC organizations received lists from WU with participant names to help facilitate and document the distribution and collection process.

On the last page of each questionnaire, respondents were instructed to put the questionnaire into the return envelope, to seal it and to give it to their respective CiM Assistants. The CiM Assistants were asked to forward the sealed envelopes to the WU for data entry and analysis.

The questionnaires to measure the effectiveness of CARIMO addressed various topics related to physical activity behavior, daily activities, use of and attitudes towards new technologies etc., and sociodemographic characteristics. The questionnaire was developed by the evaluation team of the CiM consortium, consisting of Salzburg Research (research partner), Hilfswerk Salzburg (end user partner), University of Salzburg (research partner) and WU (evaluation lead). For a description of the measures, see Trukeschitz et al. (2018) and Ring-Dimitriou et al. (2018). Final data set included participants who completed the questionnaires of all three waves. The data were labelled 'WU, CiM Effectiveness survey 2017/2018'.

## 8 Sample description: LTC service users

Initially, a total of 226 participants were recruited for participation in CiM and submitted the effectiveness questionnaires at baseline, 114 in the test group and 112 in the control group. Out of 114 participants, who answered the baseline questionnaire in the test group, 104 effectively received the CARIMO system and started the trial.

However, not all participants in the test and control group actually completed the trial period. Ultimately, 85 participants remained in the test group and 93 in the control group at the end of the trial. Over the course of the trial, participants dropped out due to lack of interest, declining health status, or the feeling that the CARIMO technology was too difficult for them (for more detail, see 8.2).

The following sample description refers to those participants in the intervention and control groups who participated until the end of the CiM trial period and answered at least two out of three effectiveness questionnaires. The data provided in the following subchapters refer to the values at baseline (before the trial started).

### 8.1 Participant characteristics

#### 8.1.1 Regions in the sample

The majority of participants lived in Austria (62%). The national shares of people in the treatment and control groups are fairly similar (see Table 5).

**Table 5: Distribution of CiM-participants according to countries (LTC-providers)**

Region (care organization)		Total	Treatment group	Control group	Sig.
Austria (Hilfswerk Salzburg)	n	111	54	57	n.s.
	%	62.36%	63.53%	61.29%	
Italy (ALDIA and others)	n	67	31	36	
	%	37.64%	36.47%	38.71%	
<b>Total</b>		178	85	93	

Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis

Table 6 provides the regional distribution of participants, indicating a good regional balance between treatment and control group in Austria, a weaker balance in Italy.

**Table 6: Regional distribution of CiM-participants**

			<b>Total</b>	<b>Treatment group</b>	<b>Control group</b>	<b>Sig.</b>
<b>Austria</b>	<b>Pongau</b>	n	46	23	23	0.013
		%	25.84%	27.06%	24.73%	
	<b>Flachgau</b>	n	39	23	16	
		%	21.91%	27.06%	17.20%	
	<b>Tennengau</b>	n	10	5	5	
		%	5.62%	5.88%	5.38%	
	<b>Pinzgau</b>	n	16	3	13	
		%	8.99%	3.53%	13.98%	
<b>Italy</b>	<b>Pavia</b>	n	49	18	31	
		%	27.53%	21.18%	33.33%	
	<b>Como</b>	n	18	13	5	
		%	10.11%	15.29%	5.38%	
<b>Total</b>			178	85	93	

Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis

### 8.1.2 Age of CiM participants

While the predefined age of the CiM target group ranged between 55 and 85 years, the mean age of CiM participants was 74.9 years, with half of the participants being 75 (treatment group) or 76 (control group) years or older. Thus, the whole group of CiM participants was slightly younger than the overall eligible target group (with a median age of 77 years). The difference in the distribution of age among both groups was not significant (see Table 7 and Figure 19, Figure 20, and Figure 21).

The participants, who were younger or older than the target group criteria (55 – 85 years), were included in the trial based on the recommendations of the LTC providers in charge of recruitment and because otherwise the sample would have been too small.

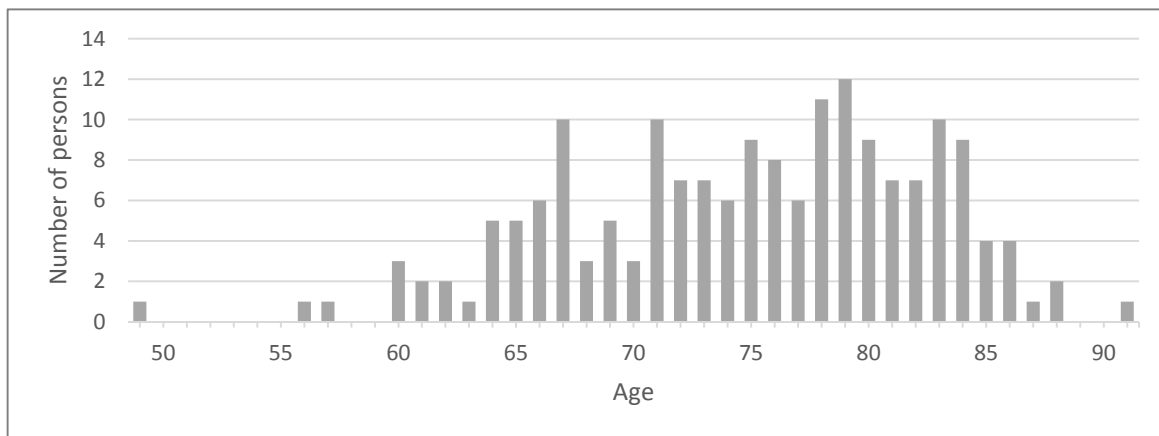
**Table 7: Age of CiM participants**

<b>Age in years</b>	<b>Total</b>	<b>Treatment group</b>	<b>Control group</b>	<b>Sig.</b>
<b>Mean</b>	74.87	74.32	75.35	n.s
<b>Median</b>	76	75	76	
<b>Min – max</b>	49 – 91	49 – 91	56 – 88	
<b>Range</b>	42	42	32	
<b>n</b>	178	85	93	

Source: WU, CiM Effectiveness survey 2017 (baseline)

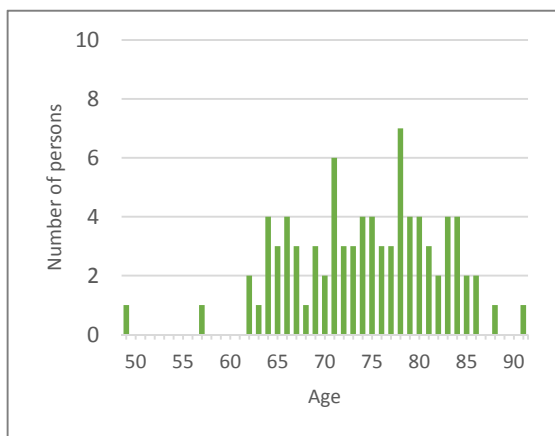


**Figure 19: Age distribution across all CiM-participants**



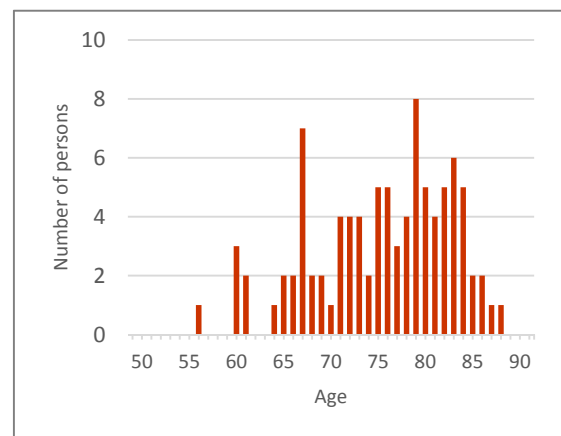
Source: WU, CiM Effectiveness survey 2017 (baseline), n=178

**Figure 20: Age distribution across treatment group**



Source: WU, CiM Effectiveness survey 2017 (baseline), n=85

**Figure 21: Age distribution across control group**



Source: WU, CiM Effectiveness survey 2017 (baseline), n=93

### 8.1.3 Sex distribution among CiM participants

The majority of participants in the CiM trial, between two thirds and three quarters, were women. This reflected the sex distribution in the target group and the higher share of women in this age group of the population. There was no significant difference in the sex distribution between the treatment group and the control group at baseline (see Table 8).

**Table 8: Sex distribution among CiM-participants**

		Total	Treatment group	Control group	Sig.
<b>Female</b>	n	124	63	61	n.s.
	%	69.66%	74.12%	65.59%	
<b>Male</b>	n	54	22	32	
	%	30.34%	25.88%	34.41%	
<b>Total</b>		178	85	93	

Source: WU, CiM Effectiveness survey 2017 (baseline)

### 8.1.4 Education of CiM participants

The majority of CiM participants had completed either basic compulsory education (38.37%) or an apprenticeship (29.07%). A smaller share completed vocational school (20.35%) and only 12.21% had completed high school or any kind of higher education. There was no significant difference between the distribution of education levels in the treatment group and in the control group (see Table 9)

**Table 9: Education levels of CiM-participants**

		Total	Treatment group	Control group	Sig.
<b>Compulsory education</b>	n	66	32	34	n.s.
	%	38.37%	38.55%	38.20%	
<b>Apprenticeship</b>	n	50	21	29	
	%	29.07%	25.30%	32.58%	
<b>Vocational school</b>	n	35	22	13	
	%	20.35%	26.51%	14.61%	
<b>High school diploma or tertiary education</b>	n	21	8	13	
	%	12.21%	9.64%	14.61%	
<b>Total</b>		172	83	89	

Source: WU, CiM Effectiveness survey 2017 (baseline), excluding 6 missing values (TG: 2 missing values, CG: 4 missing values)

### 8.1.5 Mobility of CiM participants

Overall, half of the CiM participants were fully mobile (52.25%). The other half had either mostly moderate mobility limitations (39.89%) or were more limited (7.87%). There was a significant difference between the treatment and the control group, with the participants in the CARIMO group being more mobile than in the control group at baseline (see Table 10).

**Table 10: Mobility levels of CiM-participants**

Mobility levels		Total	Treatment group	Control group	Sig.
<b>Fully mobile<sup>1</sup></b>	n	93	54	39	0.007
	%	52.25%	63.53%	41.94%	
<b>Moderate limitations<sup>2</sup></b>	n	71	28	43	
	%	39.89%	32.94%	46.24%	
<b>Limitations<sup>3</sup></b>	n	14	3	11	
	%	7.87%	3.53%	11.83%	
<b>Total</b>		178	85	93	

<sup>1</sup> can walk without help more than 6 min. continuously  
<sup>2</sup> can walk with (simple) walking aids (e.g. cane, crutches, used to one (lower or upper leg) prosthesis for years) 6 min. or more  
<sup>3</sup> can walk a few meters/minutes (< 6 min, < 200m) with walking aids (e.g. walking frame, whole artificial lower limb, crutches)

Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis

### 8.1.6 Disabilities of CiM participants

The majority of CiM participants, around two thirds, had no visual or hearing disabilities. Most of the people who did have some disabilities generally suffered from a low level of visual impairment (23.73%) or a low level of hearing impairment (6.21%) or a combination of both

(2.26%). Only 3 participants suffered from moderate or severe visual or hearing impairment. With regard to levels and types of disability, there was no significant difference between the treatment group and the control group at baseline (see Table 11).

**Table 11: Disabilities of CiM-participants**

Disability levels		Total	Treatment group	Control group	Sig.
No disabilities	n	117	57	60	n.s.
	%	66.10%	67.86%	64.52%	
Low visual impairment	n	42	15	27	
	%	23.73%	17.86%	29.03%	
Low hearing impairment	n	11	6	5	
	%	6.21%	7.14%	5.38%	
Low visual or hearing impairment	n	4	4	0	
	%	2.26%	4.76%	0%	
Moderate or severe visual or hearing impairment	n	3	2	1	
	%	1.69%	2.38%	1.08%	
<b>Total</b>		177	84	93	

Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis

### 8.1.7 Health issues of CiM participants

In line with the general description of an older, care-dependent target group, a number of age-related health issues afflicted the participants in the CiM project. As illustrated in Table 12, most CiM participants suffered from one (50.56%) or two or more (23.6%) types of diseases according to the WHO-ICD-10. Around one quarter of participants did not have any of the typical age-related diagnoses. There was also no significant difference in the number of different disease types affecting participants in the treatment group and in the control group.

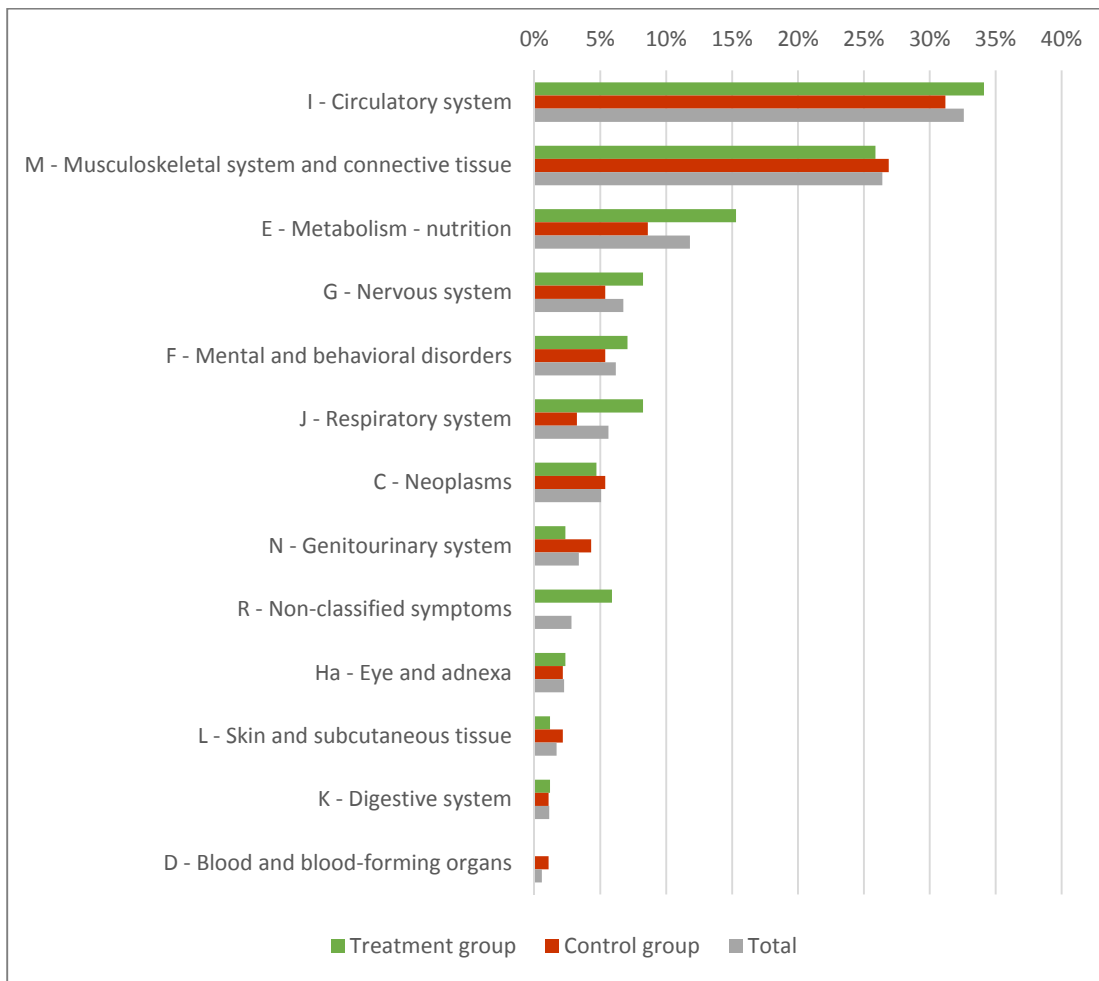
**Table 12: Number of different health issues and diseases**

Number of health issues		Total	Treatment group	Control group	Sig.
<b>Mean</b>		1.06	1.16	0.97	n.s.
<b>Median</b>		1	1	1	
<b>Min – max</b>		0 – 5	0 – 5	0 – 3	
<b>Range</b>		5	5	3	
<b>no disease recorded</b>	n	46	22	24	
	%	25.84%	25.88%	25.81%	
<b>1 disease</b>	n	90	36	54	
	%	50.56%	42.35%	58.06%	
<b>2 or more diseases</b>	n	42	27	15	
	%	23.6%	31.77%	16.13%	
<b>Total</b>		178	85	93	

Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis

The most prevalent disease types afflicting CiM participants related to the circulatory system (more than 30% in both the treatment group and the control group), the musculoskeletal system and connective tissue (more than 25% in both groups) and the metabolism (more than 15% in the treatment group and more than 7% in the control group) (see Figure 22).

**Figure 22: Types of diseases prevalent among CiM participants**



Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis (n=178)

### 8.1.8 Self-reported health status of CiM participants

Most CiM participants rated their health status at the beginning of the trial period in moderate terms, assessing their health as “fair” (49.11%) or “good” (24.85%). Less than 20% reported their health status as “poor” (16.57%) or “very poor” (1.18%) and less than 10% saw themselves as being in “very good” (6.51%) or even “excellent” (1.78%) health. There was no significant difference in the self-reported health status of the treatment group and the control group (see Table 13).

**Table 13: Self-reported health status of CiM participants**

		<b>Total</b>	<b>Treatment Group</b>	<b>Control group</b>	<b>Sig.</b>
<b>Excellent</b>	n	3	2	1	n.s.
	%	1.78%	2.50%	1.12%	
<b>Very good</b>	n	11	5	6	
	%	6.51%	6.25%	6.74%	
<b>Good</b>	n	42	21	21	
	%	24.85%	26.25%	23.60%	
<b>Fair</b>	n	83	40	43	
	%	49.11%	50.00%	48.31%	
<b>Poor</b>	n	28	12	16	
	%	16.57%	15.00%	17.98%	
<b>Very poor</b>	n	2	0	2	
	%	1.18%	0.00%	2.25%	
<b>Total</b>		169	80	89	

Source: WU, CiM Effectiveness survey 2017 (baseline), excluding 9 missing values (TG: 5 missing values, CG: 4 missing values)

### 8.1.9 Living situation of CiM participants

To get an idea about the living situation of CiM participants, we collected data about their relationship status, the size of their household, and the availability of an informal carer to provide support in their daily life, if needed. All participants were still living in their own (or non-institutional) homes.

Around one quarter (25.29%) of CiM participants were married or in a relationship, the others were single. In fact, a large part of participants, 47.65%, were widowed, and the others were either never married (14.71%) or divorced (12.35%). There was no significant difference between treatment group and control group (see Table 14).

**Table 14: Marriage and relationship status of CiM-participants**

<b>Marital status</b>		<b>Total</b>	<b>Treatment group</b>	<b>Control group</b>	<b>Sig.</b>
<b>Married or in relationship</b>	n	43	25	18	n.s.
	%	25.29%	30.86%	20.22%	
<b>Single, unmarried</b>	n	25	10	15	
	%	14.71%	12.35%	16.85%	
<b>Single, widowed</b>	n	81	33	48	
	%	47.65%	40.74%	53.93%	
<b>Single, divorced</b>	n	21	13	8	
	%	12.35%	16.05%	8.99%	
<b>Total</b>		170	81	89	

Source: WU, CiM Effectiveness survey 2017 (baseline), excluding 8 missing values (TG: 4 missing values, CG: 4 missing values)

In addition to being single, the majority of CiM participants, 64.67%, lived on their own, followed by 22.75% who lived in a two-person household and 12.58% who lived with two or more other people (see Table 15).

**Table 15: Household size of CiM participants**

		<b>Total</b>	<b>Treatment group</b>	<b>Control group</b>	<b>Sig.</b>
<b>Single-person household</b>	n	108	53	55	n.s
	%	64.67%	64.63%	64.71%	
<b>2-person household</b>	n	38	21	17	
	%	22.75%	25.61%	20.0%	
<b>3+ people household</b>	n	21	8	13	
	%	12.58%	9.76%	15.29%	
<b>Total</b>		167	82	85	

Source: WU, CiM Effectiveness survey 2017 (wave 2), excluding 11 missing values (TG: 3 missing values, CG: 8 missing values)

In total, 70.86% of CiM participants were able to draw on the support of an informal carer. However, there was a significant difference between the availability of an informal carer for members of the treatment group, where 84.34% had this kind of support, and the control group with only 58.70% in the same situation (see Table 16).

**Table 16: Availability of an informal carer to support CiM participants**

		<b>Total</b>	<b>Treatment group</b>	<b>Control group</b>	<b>Sig.</b>
<b>Available</b>	n	124	70	54	<0.001
	%	70.86%	84.34%	58.70%	
<b>Not available</b>	n	51	13	38	
	%	29.14%	15.66%	41.30%	
<b>Total</b>		175	83	92	

Source: Data provided by Hilfswerk Salzburg and ALDIA, own analysis

### **8.1.10 Use of ICT by CiM participants**

Initially, there was no significant difference between the use of mobile phones, computers, tablet computers, and the internet among the treatment group and the control group. While 85.96% of CiM participants did use mobile phones (the majority using non-smart phones), most people did not use a computer or laptop (74.12%), a tablet computer (88.76%) or the internet (69.59%). The others used these devices sometimes or regularly, with the indication that among this group, familiarity with tablet computers, such as the CARIMO tablet, was especially low (see Table 17).

Table 17: Use of technology among CiM participants

			Total	Treatment group	Control group	Sig.
Mobile phone	No	n	24	9	15	n.s.
		%	14.04%	11.25%	16.48%	
	Yes, an older mobile phone	n	108	48	60	
		%	63.16%	60.00%	65.93%	
	Yes, a smart phone	n	38	22	16	
		%	22.22%	27.50%	17.58%	
	Yes, both	n	1	1	0	
%		0.58%	1.25%	0.0%		
Total		171	80	91		
Computer or laptop	No	n	126	58	68	n.s.
		%	74.12%	73.42%	74.73%	
	Yes, sometimes	n	21	11	10	
		%	12.35%	13.92%	10.99%	
	Yes, regularly	n	23	10	13	
		%	13.53%	12.66%	14.29%	
Total		170	79	91		
Tablet computer	No	n	150	69	81	n.s.
		%	88.76%	87.34%	90.00%	
	Yes, sometimes	n	12	5	7	
		%	7.10%	6.33%	7.78%	
	Yes, regularly	n	7	5	2	
		%	4.14%	6.33%	2.22%	
Total		169	79	90		
Internet	No	n	119	53	66	n.s.
		%	69.59%	66.25%	72.53%	
	Yes, sometimes	n	21	12	9	
		%	12.28%	15.00%	9.89%	
	Yes, regularly	n	31	15	16	
		%	18.13%	18.75%	17.58%	
Total		171	80	91		

Source: WU, CiM Effectiveness survey 2017 (baseline), excluding missing values (mobile phones: Total: 7, TG: 5, CG: 2; Computer or laptop: Total: 8, TG: 6, CG: 2, Tablet computer: Total: 9, TG: 6, CG: 3, Internet: Total: 7, TG: 5, CG: 2)

### 8.1.11 Summary of sample characteristics

Recruitment of trial participants (treatment and control group) turned out to be challenging due to the low numbers of LTC clients eligible to participate. Given these difficulties, the sampling process – combining a random selection of potential users and a matching procedure to assure same characteristics of participants in both groups - worked out remarkably well. For most of the observable characteristics of the participants in the sample, there were no significant differences in characteristics at baseline. Differences could only be observed for the regional distribution due to the smaller number of participants in Italy and the mobility of older people. The recruitment of informal carers appeared to be easier for the treatment than for the control group. Nevertheless, the numbers of informal carer recruited did not meet the proposed numbers to be involved in the project.

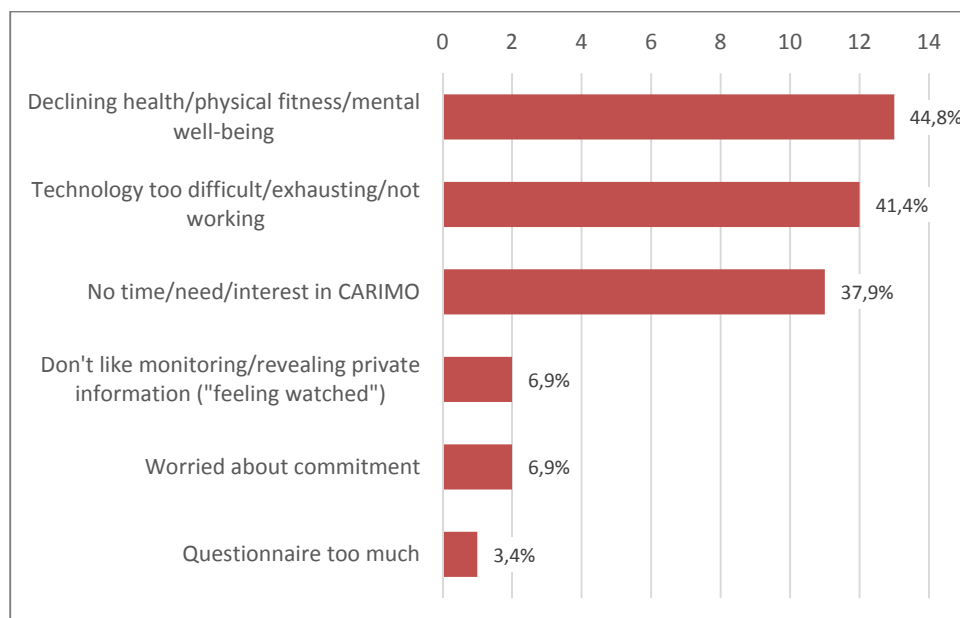
## 8.2 Drop outs from the CARIMO test group

From the initial 114 home care service users, who signed up for the CARIMO test group, only 104 effectively started the trial. In total, 29 participants dropped out after recruitment and during the course of the trial. The majority of dropouts left the trial during the first half of the CARIMO trial period: 41.4% had dropped out by the end of July 2017, and 79.3% had dropped out by the end of September 2017.

The care workers dealing with the collection of CARIMO devices from people who chose to end their participation in the project were asked to report the reasons for dropping out (either quoting the participants or providing their personal assessment of the situation). The statements were collected together with the final date of the participation, coded and sorted in categories according to themes. Some care workers cited multiple reasons for why a participant did not want to/could not continue in the test group.

The results from this analysis suggest that most people, almost half, dropped out due to a decline in their health status (including decreasing physical fitness or mental well-being), and, in similar proportions, because of issues with the technology of CARIMO – some perceived it as too difficult, too exhausting, or were put off by the technology not working. A bit more than a third dropped out of the trial period because they found they had no time, need, or interest in CARIMO. Finally, some participants dropped out due to privacy concerns, because they were worried about the commitment (e.g., feeling compelled to do the exercises) or found the evaluation questionnaires too much (see Figure 23).

**Figure 23: Reasons for drop-out of test group**



Source: ALDIA, Hilfswerk Salzburg, own illustration



## 9 Ethical considerations

### 9.1 Informed consent

Before the trial started, all project participants (LTC service users, informal carers and volunteers) were informed in detail about the project and could decide freely whether to participate or to decline. If they intended to participate, they received an information sheet and had to sign a consent form.

### 9.2 Confidentiality, anonymity

With regard to the analysis of information from the field trial, it was not possible to completely anonymize the data. Some user-related data (e.g. pulse, GPS data) were recorded via mobile devices. Other person-related data necessary for the evaluation of the field trial were collected via different media (tablet, wearable, paper questionnaires) and over different points in time. For a common analysis of those different sets of data, the cases had to remain identifiable. When data collection was concluded and the datasets were compiled, the data was pseudonymized (names and other identifying characteristics were deleted and replaced with a code).

### 9.3 Data storage and protection

Paper questionnaires were printed with individual codes to facilitate linking them with the other data. This data was entered into SPSS and stored in digital form on WU servers. The paper questionnaires were stored at the WU. For data sharing between the research institutions (SRFG, WU, PLUS), a data sharing protocol was devised. It included a double-password encoding of user identification and user code, and a simple password protection of data files only containing the user code. Data was shared using a protected file sharing service provided by the WU.

### 9.4 Ethical review committee

The CiM project and its evaluation design were reviewed and approved by an independent ethics committee at the University of Salzburg (EK-GZ 30/2016).

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