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# CARU's Voice-controlled Emergency Call Feature:

## Trial- & Validation Requirements for the Acceptance Test in Switzerland (CARUcares DEL. 2.3 – part 1)

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# CARU's Voice-controlled Emergency Call Feature: Trial- & Validation Requirements for the Acceptance Test in Switzerland

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# Abstract

**Background**: The emergency call feature of CARU, a voice-assistant and smart sensor developed by CARU AG (Switzerland, Europe), is available on the market. The feature is innovative as it allows older people to call for help using their voice. This emergency call system has first entered the B2B (business to business) market, e.g. care homes, assisted living providers. Since April 2020, CARU has also served individual customers. There is, however, still little systematic research on the degree of acceptance of CARU's emergency call feature and factors influencing this acceptance, particularly in assisted living environments.

The CARUcares project aims to test CARU's emergency call feature in real-live settings with residents of bonacasa AG, a company based in Switzerland offering smart living services to community-dwelling people of all ages. In this test, we are interested to learn more about the operative readiness of CARU's emergency call feature and its acceptance in bonacasa residents aged 60 and older.

**Objectives**: The aim of this paper is to lay out the trial and validation criteria for the test of the operative readiness and the acceptance of the emergency call feature in Switzerland (ACTEST). More specifically, it explains the study design for the field trial and the proposed criteria for evaluating the acceptance of CARU's emergency call feature. This document also contains the proposed timeline for the field trial. The latter had to be adjusted for the implications of the COVID-19 pandemic that has affected Europe since early spring 2020.

**Methods**: The target group for the ACTEST are residents of bonacasa, aged 60+ who already have experience with an emergency call system or are interested in using such a system. According to the proposal, the sample should consist of at least 20 trial participants and 5 members of staff (concierges) of bonacasa. Recruitment will be conducted by bonacasa, a training and roll-out concept will be provided by CARU AG. Vienna University of Economics and Business (WU) is responsible for the trial design and data analyses. Quantitative data will be collected using functionality tests (test-scenarios) and online surveys. Two waves of online data collection will be conducted by bonacasa concierges using computer-aided standardized face-to-face interviews. Measures and influencing factors for acceptance will be derived from the UTAUT2 model. In addition, data from a qualitative interview with bonacasa's 24/7 emergency call center will be collected by HSLU. The ACTEST will start in September 2020 (postponed by 4 months due to COVID-19) and will last for two months (as planned).

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# Content

# Definitions, Acronyms and Abbreviations

| | |
|---|---|
| AAL | Ambient Assisted Living / Active and Assisted Living |
| ACTEST | Acceptance Test |
| BONA | bonacasa |
| CARU | CARU AG |
| CC-WS | Co-creation stakeholder workshop |
| CRM | Customer Relationship Management |
| HSLU | Hochschule Luzern – Lucerne University of Applied Sciences and Arts |
| JOHA | Johanniter |
| EU GDPR | EU General Data Protection Regulation |
| UTAUT2 | Unified theory of acceptance and use of technology |
| WU / WUWI | WU Vienna University of Economics and Business |

# 1 Introduction

The CARU voice-controlled emergency call, a feature of the smart sensor CARU, developed by CARU AG (Switzerland, Europe), is available on the market. In case of an emergency at home, the feature allows people to call for help using their voice instead of pushing, for example, a button of an emergency wristband. Depending on the preinstalled setting, CARU connects the person with care staff, an emergency call center or a relative to check the situation and provide support.

So far, the CARU emergency call system has been implemented mainly in institutional care settings. In addition, some 50 private households have used it so far (August 2020). Thus, there is still little systematic research on the degree of acceptance of CARU's emergency call feature and factors influencing this acceptance in community-dwelling older adults.

The CARUcares project aims to test CARU's voice-controlled emergency call feature in real-life settings with customers of the bonacasa AG, a company based in Switzerland offering smart living services to community-dwelling people of all ages. In this field trial, we are interested in learning more about the acceptance of CARU's emergency call feature in bonacasa residents aged 60 and older.

The aim of this paper is to summarize the trial and validation requirements for the acceptance test of the emergency call via the CARU sensor (ACTEST). More specifically, we explain the proposed study design and the criteria for evaluating the acceptance of CARU's emergency call feature. This document also contains the proposed timeline of the ACTEST, which had to be adjusted due to the COVID-19 pandemic that has affected European countries since spring 2020.

# 2 Aims of the ACTEST

The ACTEST aims to generate data on

(i) if and to what extent CARU's voice-controlled emergency call feature meets the criteria for acceptance (defined as 'intention to use') in real-life settings and

(ii) the factors facilitating and hindering such acceptance.

To this end, we will collect data on the views and perceptions of older people (residents in bonacasa apartments), service providers (bonacasa's concierges providing support to residents in smart living facilities), and the 24/7 bonacasa emergency call center.

# 3 Trial requirements

## 3.1 Implications of the nature of emergency call devices for trials

Emergencies are rare events: Emergency calls in community-dwelling older people areexpected to be rare events. As an emergency situation is not part of daily life, testing the acceptance of newly-developed emergency call devices within a two-months trial cannot rely on the occurrence of real emergency situations only. It has rather to find ways to facilitate trial participants to become familiar with the features of such a device in order to be able for them to form an opinion on the functioning and usefulness of a voice-controlled emergency call system.

Previous experiences with emergency call systems: Voice-controlled emergency call systems offer a new way to raise an alert. People with experiences with traditional emergency call features may rate the new system differently from people with no experiences so far. This has implications for the data collection. Data on previous experiences with emergency call systems have to be collected.

Poor performance may risk lives: Emergency features can be life-saving when working as intended. However, if these features do not working properly, help needed may arrive too late or not at all, with potentially serious consequences. This has two implications. First, we need to make sure that (a) CARU's voice-controlled system works as intended and (b) participants are aware of the system's potential limitations. Second, we need to allow trial participants to use (if available) their emergency system in addition to CARU's voice-controlled system.

## 3.2 No ACTEST participation without written informed consent of each participant

We have prepared information sheets and informed consent forms abiding by the EU GDPR (General Data Protection Regulation). A draft of this form has been approved by the data protection officer of the WU Vienna University of Economics and Business in September 2019 before the CARUcare project study design was submitted to the ethics board of the University of Applied Sciences Wiener Neustadt. The ethics board approved the CARUcares project study design. The draft of the informal consent will be adapted to the regulations in Switzerland by bonacasa AG and then used for the recruitment process.

## 3.3 Preparations accounting for the restrictions due to the COVID-19 pandemic

Preparations relate to recruitment, roll-out and any contact between the trial person and the project team or concierges of bonacasa.

The project team will abide by the Covid-19 regulation in force in Switzerland. In addition, all members of the test team agreed to

- Keep the recommended distance, whenever this is possible
- Wear a mouth-nose-protection, such as a facemask, whenever the recommended distance cannot be guaranteed or if this is desired by one of the trial persons, project team members or concierges
- Use disinfectants

## 3.4 Target groups and number of participants planned for the ACTEST

According to the proposal and refinements in the planning phase of the ACTEST, we plan to involve:

Target group 1: 20+ residents living in bonacasa's smart living apartments aged 75+ (women and men) who are…

- …interested in emergency call systems (not having one) – priority 1
- …already having an emergency call system – priority 2
- …none of the above – priority 3

Target group 2: 3-5 concierges (bonacasa employees) supporting test participants in target group 1

## 3.5 Recruitment of participants

Due to the COVID-19 crisis the acceptance test will be delayed. Accordingly, the recruitment of participants will start later than planned. At the beginning of April 2020, it was not clear, when to start with the recruitment. We will pursue the following strategy:

- We will follow the advice of the Swiss government concerning rules about social distancing and protecting older people aged 65+ (official risk group). The participants targeted for this ACTEST belong to the most vulnerable group in this pandemic.
- As soon as the official guidelines allow a start of the ACTEST, the involved project partners (BONA, CARU, HSLU, WUWI) will discuss the optimal starting date, including individual institutional regulations regarding COVID-19, summer break and project milestones.
- If we can conduct the ACTEST in autumn (September to November 2020), other project milestones will not be affected by this postponement of the ACTEST by five months. However, as the pandemic is causing severe restrictions to contain the spread of the virus in autumn or winter, type and timeline of project milestones are likely to be affected.

The following **steps of recruitment** were planned:

- About one month before the start of the acceptance test, we contact the concierges (bonacasa staff) of the buildings selected by bonacasa. A factsheet informs the concierges about the ACTEST and recruitment strategy which is in line with the general recruitment strategy for the whole project CARUcares (Sturm et al. 2020).
- BONA will prepare a list of possible test persons according to the target group definition (see above) for each building participating in the test. BONA will discuss possible candidates with the concierges.
- The concierges will then get in contact with these potential test persons for recruitment and will report back to bonacasa who is ready to participate in the ACTEST. The aim is to recruit 20 participants who test the CARU emergency call feature. As the test will be conducted with a group at higher risk of being infected with COVID-19, we have to consider that some participants may want to withdraw their consent before or during the trial period. Consequently, additional 3 to 5 participants will be recruited.
- The decision on which assisted living facilities to involve in the test will be made as a next step. The list will be shared with WU.
- Informed consents will be adapted, if necessary, by bonacasa.
- Data on participants who agreed to take part will be collected and shared with WU:
    - Age
    - Sex
    - Number of years living in this flat
    - Number of people in the household

- Relationship to members of the household
- Size of flat in sqm,
- Information to which assisted living facility the flat belongs
- Ground plan of the participants' flats

## 3.6 Roll-out concept for the ACTEST

The following sections detail the roll-out steps until final placement of CARU in the apartments.

### 3.6.1 Preparations

- Any restrictions due to COVID-19 will be considered for the ACTEST preparations.
- The concierge collects necessary data of each test person for the bonacasa emergency call center, if not yet saved in the bonacasa customer relationship management software (CRM) (i.e. contact details, place of living, contacts in case of emergency).
- Concierges will be equipped with a tablet computer for data collection.
- CARU provides CARU-IDs resp. the CARU telephone numbers. This information needs to be linked with CRM data. CARU will share these data (ID and CRM data required for the test) with WU.
- CRM data are directly transmitted to the bonacasa emergency call center via API.
- The bonacasa 24/7 emergency call center is also informed about who in the test group uses another security device that connected to the same emergency call center. These data will be shared with WU.
- The 24/7 emergency call center will receive a list of the data to be collected during the trial phase.
- CARU support will receive test person data for interaction in case of technical issues.
- Decisions on the provision of the first level support: Providing solutions to technical issues are in the responsibility of the CARU support. Concierges and users will be provided with a telephone number to contact CARU support. The handling of user alarms (incl. test alarms) is the responsibility of the bonacasa 24/7 emergency call center.
- CARU prepares devices and tests the connection to the bonacasa 24/7 emergency call center. All device configurations are completed by CARU two weeks before installation.

### 3.6.2 Installation

- As the ACTEST in Switzerland is expected to be postponed to summer/autumn 2020, due to COVID-19, installation has to consider possible restrictions in force to contain the COVID-19 pandemic.
- On installation day, CARU support or the concierge will plug-in CARU in participants' apartments .
- The optimal placement depends on the test person's needs (i.e. place of high security needs, frequently used rooms, central place in apartment).
- CARU support will check the functionality (i.e. mobile phone reception) and placement in the apartment (i.e. in distance of noisy loudspeakers as TV or radio). The placement of the device will be marked in the ground plan.
- The CARU support or the concierge interacts with the residents if they feel fine with the installed CARU on the day of installation. Additionally, the resident is trained on the use of the device, as the following concept shows.

## 3.7 Training concept for the ACTEST

The training contains three phases and different target groups. The training is mainly conducted via face-to-face meetings supported by written documents. The first two phases take place before or shortly after the start of the acceptance test.

The training of concierges and bonacasa staff takes place first:

- The concierge is trained as a so-called 'super user' by CARU support. After the introduction (30min) the concierge can seek clarification on the following issues and questions:
    - How to install a CARU sensor
    - How to instruct the older person on how to use the CARU emergency call
    - How to contact the CARU support
    - What is the plan for the acceptance test?
    - What are the responsibilities of the concierge during the test phase?
- This training is supported by a factsheet.

Second, the following steps are part of the **training of the residents** conducted by the concierge (with the help of CARU support, if needed):

- The concierge (again) informs test persons about the acceptance test (information can be found by concierges on the factsheet)
- The concierge provides an instruction on how to use CARU and motivates test persons to try it themselves. (The best outcome is, if test persons are not too shy to shout 'help' in front of other people. Otherwise the concierge will demonstrate this as an example) The full alarm flow is tested until it is connected to the emergency call center.
- The concierge takes notes on how the participant responded to the instructions (observations and questions). Data will be shared with WU.
- The concierge informs test persons not to shut off any other existing security devices. This is a test phase. Technical issues cannot be definitely excluded during a test phase.
- The residents sign the informed consents. The latter will be scanned and saved on the project's cloud share.
- The concierge distributes a flyer on how to use CARU and whom to contact in case of questions.
- The concierge motivates the residents to test CARU at least two times spontaneously during the entire test phase according to the test schedule.

Third, in the second week of the test, the **success of the training is evaluated**:

- The concierge gets in contact with the test persons. Trial participants' questions will be answered and the concierge performs a cross-check whether the residents understand how to use CARU. All data will be collected using an online survey software on a smartphone or tablet computer. WU will provide the online survey. The online survey will be part of the ACTEST. It will record whether trial participants (i) can recall how to activate an emergency call using CARU and (ii) were able to raise an alert from different rooms of their flat.
    - The concierge and the test user carry out a test alarm together.
    - The CARU support checks the functionality remotely (i.e. mobile phone reception during the first week). Results will be recorded.
- Finally, a feedback discussion between concierge and CARU support takes place. Results will be noted down in a systematic way and shared with WU.

- Whenever a trial participant decides that s/he no lo longer wants to have CARU in their homes, i.e. does not want to participate in the test anymore, the exit strategy (c.f. chapter 3.8) defines how the test will be stopped for this participant. All relevant project partners will be informed. In any other case, the exit strategy is executed at the very end of ACTEST.

## 3.8 Exit strategy of the ACTEST

We plan the following steps as an exit strategy:

- Regular exit: bonacasa staff will inform test users about the end of the testing phase and about further steps of the project, i.e. what happens with collected data and if test users could participate in the field trials. Furthermore, bonacasa takes notes of final comments by the customers on the entire ACTEST phase. At the very end, BONA offers a present for each participant for having contributed to the test.
- Early exit: trial participants can withdraw their participation at any time. The CARU device will then be collected by the concierge.
- Final steps:
    - CARU will be deinstalling the CARUs and set devices back to factory mode, i.e. the phone link to emergency call center is deleted.
    - The collected data will be shared with WU.
    - A “thank-you” card and local sweets will be handed out to all trial participants by bonacasa.

# 4 Proposed evaluation methods for the ACTEST

## 4.1 Overview of ACTEST methods planned

The next sections list the methods for collecting data on the acceptance of CARU’s voice-controlled emergency call feature.

### 4.1.1 Data collection at the participants’ apartments

- Test the CARU voice-controlled emergency call using 3-4 **standardized scenarios** in each of the participants’ apartments.

- Two waves of **online questionnaires** for all trial participants (bonacasa customers) administered by test supporters (i.e. concierges)

### 4.1.2 Data collection at the bonacasa emergency call center

- Data **automatically** collected by the call-center
- Data **recorded manually**, e.g. time of and reason for an emergency call using CARU
- **Semi-structured interviews** with the bonacasa emergency call center

### 4.1.3 Data collection at CARU AG

- Uptime (time of connectivity) of CARU sensors
- Downtime (time without connectivity) of CARU sensors
- Inactive time (power outage, plugged out or turned off) of CARU sensors

## 4.2 ACTEST I: test-scenarios and mini-UTAUT2

### 4.2.1 Aims of the test-scenarios, methods and time of admission

Two to three weeks after installation, bonacasa residents will be asked to call for help using the CARU voice-controlled emergency call system. They will be put in different emergency situations in their apartment. Concierges will carry out the test and support the data collection. The aims of this test are to check (a) trial participants' ability to use the feature and (b) if alarms can be raised from different rooms of the apartment. To this end, 3-4 test scenarios will be provided via an online-survey on a tablet by WU. In addition, the online survey will include questions for the test supporters to gain insights into their perceptions.

### 4.2.2 Test scenarios: emergency situations in three to four settings

Bonacasa's concierges and the test participants will jointly run through the test-scenarios. The concierges receive the scenarios via an online-survey and instruct test participants to activate the CARU emergency call. For all scenarios, the CARU sensor will be placed in the test participants' living rooms.

Three scenarios are mandatory:

1. “Living room”: CARU sensor and test participants are located in the living room
2. “Bedroom (doors open)”: CARU sensor remains in the living room; test participant calls for help from the bedroom (imaging a situation of not being able to get out of bed on their own)
3. “Bath room (closed doors)”: CARU sensor remains in the living room; test-participant calls help from the bath room (imagining having slipped on the wet floor and needing help)

If the apartment of the trial participant is equipped with a balcony or garden, trial participants will be requested to activate CARU emergency calls from their balcony or garden (door open).

Concierges use the online-survey to make notes on:

- Whether trial participants successfully recalled how to use the emergency feature on their own.
- Number of calls for a successful activation of the alarm.
- Trial participants’ perception of voice quality of CARU sensor and emergency call centre staff.

After completing the test-scenarios, the concierges pass the tablet on to the test participant to answer a selection of UTAUT2 - questions (12 questions in total) adapted for emergency features.

## 4.3 Period of use without intervention of the project team

Between installation and ACTEST I as well as after ACTEST I and the end of the trial, all trial participants will be free to trigger at least one trial emergency alarm.

## 4.4 ACTEST II: full UTAUT2-questionnaires for trial participants

### 4.4.1 Aims of the survey, methods and time of admission

The aim of this second survey is to test, if participants will adopt and adhere to the CARU technology and to identify factors associated with acceptance (37 questions in total). For this purpose, the UTAUT2 model is used (see below). In addition, questions on the participants’ socioeconomic background, mobility restrictions and fall prevalence will be implemented into

the online survey to gain insights into individual's needs for the CARU sensor and to control for sociodemographic influences.

To this end, WU developed an online questionnaire using LimeSurvey (https://www.limesurvey.org/en/). Feedback on the questions and response options was collected from bonacasa AG and CARU AG. 6-8 weeks after the installation of CARU, the link to the online survey will be sent to the concierges, who will conduct the interview the participants using a tablet (computer-aided standardized face-to-face interviews). Show cards aim to reduce the cognitive burden of respondents by visualization of the response options.

### 4.4.2 Contents of the questionnaire

Acceptance criteria were derived from the proposal, the heuristic evaluation of CARU at the beginning of the project (Trukeschitz, Kieninger, and Ebner 2019) and the brainstorming of end-user organizations and technical partners in the General Assembly in March 202 (The latter was held online due to the outbreak of Covid-19 in Europe). The acceptance criteria were compared with conceptual models for such tests. Finally, unified theory of acceptance and use of technology (UTAUT2) was chosen.

In UTAUT2, acceptance rates are measured by the individual's intention to continue using the CARU emergency call as well as their overall satisfaction with the CARU emergency call (Venkatesh, Thong, and Xu 2012).

In order to investigate the factors associated with an individual's acceptance of CARU, six out of seven key UTAUT2 factors were integrated into the questionnaire:

- *Performance expectancy*, measured by the user's perceived benefit from using the technology.
- *Effort expectancy*, the user's perceived effort in learning how to use the technology.
- *Facilitating conditions*, the individual's perception of whether he or she is able to get help by others, if they meet obstacles when using the technology.
- *Social influence* meters the influence of others (e.g. friends, family, concierges, etc.) on the adoption process, e.g. if using the technology is encouraged or admired by others.
- *Hedonic motivation* refers to the fun and pleasure the participant perceives while using the technology.

- Lastly, *habit* captures the user's perception whether using the technology can be integrated in the user's daily routine.

Due to the specific requirements of seniors interested in an emergency call system and the special features of CARU, the basic UTAUT2 model has been adapted. Three further factors were added:

- *Safety expectations,* the degree to which seniors feel save in their homes because of the emergency call feature of CARU.
- *Privacy risk expectations*, the degree of data security expectations.
- *Technological affinity,* the degree of experience with new technologies.

As the number of COVID-19 infections have increased in autumn 2020 in Switzerland, bonacasa requested to keep the questionnaire administered by their concierges short. Ideally, the response time should not exceed 15 minutes, which has been estimated by health experts as critical exposure time for the infection. We thus adjusted the questionnaire by taking out

- *UTAUT2: Price-value* models the tradeoff between the individual's financial investment in the technology and the perceived benefit from using it.
- *Question on highest education level*

All factors (original and adapted) are measured by at least three questions. The wording of all questions was adjusted to reflect the CARU emergency call feature. For each question, participants specify their level of agreement to the statement on a symmetric 7-point agree-disagree Likert scale.

# 5 Additional information for ACTEST II: semi-structured interview with 24/7 emergency call centers

WU will provide a draft version of an interview guide. HSLU (Hochschule Luzern – Lucerne University of Applied Sciences and Arts) will conduct a semi-structured interview with employees of the bonacasa's 24/7 emergency call center. The interview will be transcribed and analyzed by HSLU. a report will share the main findings.

According to a decision by the project lead, we will not conduct interviews with concierges as planned in the proposal as they will be only facilitating the process but are not directly involved in the residents – emergency call center relationship.

# 6 Timeline per ACTEST task group and changes to the timeline

The start of the ACTEST was postponed by 5 months due to the COVID-19 pandemic affecting all countries. The ACTEST is planned to start in September 2020. For details see Figure 1 and 2.

Figure 1:ACTEST: timeline WU Vienna: trial planning and evaluation

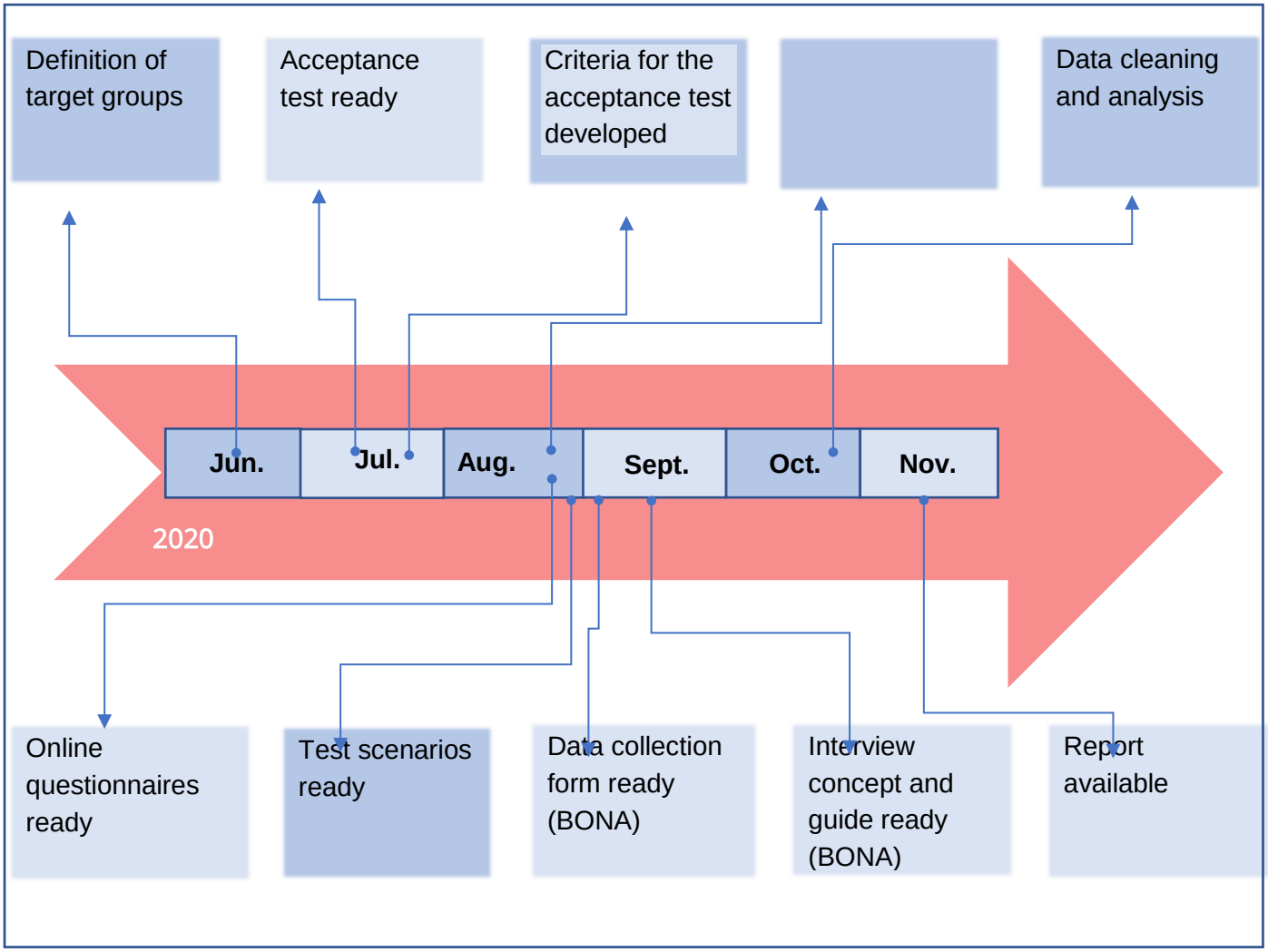
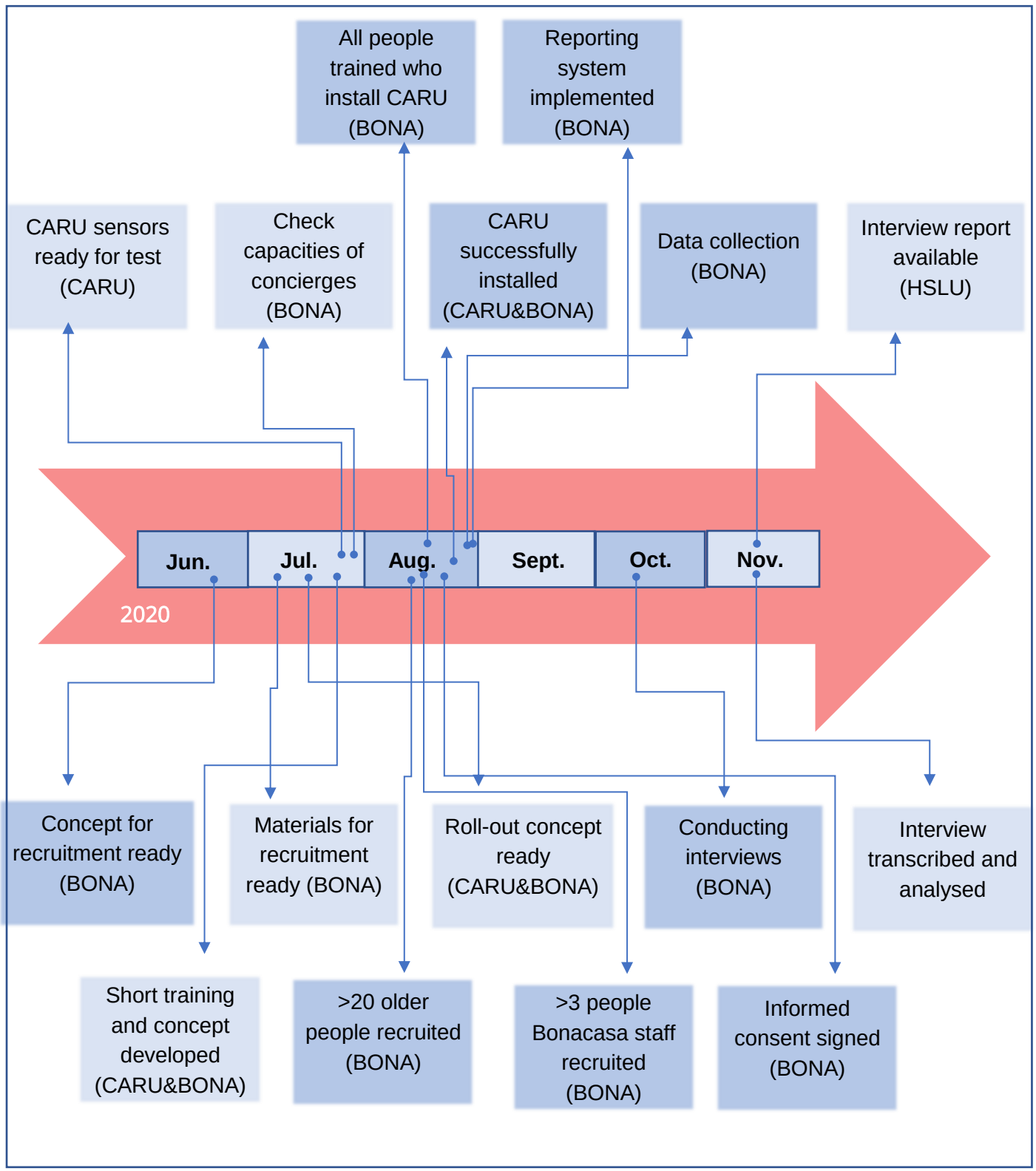


Figure 2: ACTEST: timeline CARU, BONA and HSLU: trial execution and data collection



# 7 Deviations from the proposal: decision and reasons

- Participants: Fewer than suggested number of bonacasa staff involved: as per decision of bonacasa, 3 instead of 5 concierges
- Methods: Changes of number and types of interviews: decision of the project lead to do an interview with the bonacasa emergency call center instead of interviews with bonacasa staff (28 Jan 2020)
- Timeline: the ACTEST was postponed by 4 months due to the outbreak of the Covid-19-pandemic in Europe

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