Telemedicine and Technology Solutions

March 2019

1. Introduction

The CASCADE project activity, deliverable and output that relate to telemedicine, and that are due in early 2019, are shown in Table 1. Achievement of A2.4, D2.4.3 and O3.1 is dependent on access to a fully staffed and operational Dementia Village (now named the Harmonia Village at Dover) for PP2 and a guesthouse with care facility at Medway, PP3. For reasons detailed in a separate report the construction of both facilities is behind schedule. Consequently, whilst the systems are ready to be deployed, A2.4, D2.4.3 and O3.1 will be implemented when opening of the facilities has taken place.

Table 1: Telemedicine activity's, deliverables and outputs due in early 2019

CASCADE Deliverable/ Output	CASCADE Action	CASCADE Target Date
D2.4.3	The telemedicine suite will be created using existing technology and made available to PPs to use in their own facilities. It will be reviewed and altered as necessary to suit national and cultural factors.	31/12/2018
A2.4	ICT will be used to keep PLWD safe throughout the 24 hr day and to assist staff in meeting patient needs. The technology used will ensure privacy while monitoring the patients in such a way that staffing levels can be minimised, in particular during the night. The most useful equipment, and configuration of technology and staff, will be identified and the impact on costs will be quantified. The intention will be to create a model of care that is safe, effective & that drives low operating costs.	28/02/2019
O3.1	The telemedicine package will contribute to better patient satisfaction & more skilled care being provided to patients living with dementia. Quicker access to services, support & expertise for patients, carers & staff thanks to the telemedicine. Elderly patients will no longer have difficult journeys to make to receive for an expert consultation. This is particularly disruptive for people with advanced dementia - they will be able to stay in their home setting.	28/02/2019

2. A2.4 and D2.4.3 and O3.1: Progress to date

The telemedicine suite of technology has two components 1. A resident monitoring system which supports and enables PLWD giving them autonomy and supporting staff decision making, 2. A video communications system. Decisions on system functionality, configuration and outputs were based on feedback received from focus groups, two surveys issued in English, Dutch and French via Surveymonkey (D2.1.1 and D2.4.1) and in-depth discussions between the relevant project team members. Based on this information a number of commercially available systems were reviewed.

2.1. Resident monitoring system

The majority of systems available for monitoring of people living with dementia (PLWD) are based on an alarm system that triggers a message/and or response from a relative/carer or

a call centre They are also generally set up to collect a number of vital signs metrics e.g. blood pressure. Consequently they are not adapted to use in an environment where care staff are in close proximity and as a system they have a tendency to "medicalise" issues, which can lead to an increase in demand on healthcare systems. The following system specification was developed and used to determine which providers to work with:

- Systems utilised must be as unobtrusive as possible
    - MCH are evaluating systems in addition to the sensors that will be used at the Harmonia Village
- Adapt an existing telecare system to clinical care environments
    - Staff interface
        - Suite of alarms where they must respond and/or are made aware of an event/situation
        - Daily/weekly/monthly/annual summary of a residents behaviour and data collected
        - Trend reporting
        - Easy availability of individual background/social information on a resident e.g. individual musical playlists
    - Care planning system
        - The data collected will be used to support personalised care planning. MCH already have their own system in place
- Adapt this technology to support decision making by staff
    - Real time
        - Reduce interventions by staff
        - Enrich staff/patient interactions
    - Predictive
        - Use of data from sensors and qualitative feedback to develop predictive capabilities
        - Develop approach to generating behavioural baselines
        - Early detection of changes to an individual's health and/or their ability to be independent
    - Providing staff with information relating to when they need to intervene and what intervention might be appropriate
- Information accessibility
    - Capability and connectivity to move the behavioural baseline around the healthcare system with the individual
        - Implementation of this approach will be a significant piece of work that is in addition to CASCADE commitments. The work will be initiated during the CASCADE project term and will involve discussions and agreements with local healthcare organisations that Harmonia Village will be used as the test bed for the approach
    - Storage and easy availability of an individual's background/social information, including things like musical playlists. Make this easily accessible in different healthcare environments
- Artificial Intelligence system (where available)
    - Identify correlations between data and observed changes in behaviour, health etc. and develop predictive algorithms
    - Manage and influence behaviour of residents e.g. using music
    - Manage the alarm system, help staff decide how to respond

A workshop was held with equipment providers and staff working on the CASCADE project team to determine what factors needed to be monitored by the sensors and whether this data was required in real time. Interestingly, the clinicians within the group decided that there was no real requirement for measuring vital signs, physiological parameters (see table 2)

Table 2: Sensors array

Not all sensors will be used in all locations and situations, for example, MCH will not be monitoring bed and chair occupancy.

Location	Parameter	Hard wired/Wi-fi	Information to where/who?	Data	
				Real time	Predictive
Wearable	Falls	Wi-Fi	Alarm to staff on handheld device	Yes	Yes
	Activity	Wi-Fi	AI software	Yes	Yes
	GPS location & movement tracking	Wi-Fi	AI software	Yes	Yes
	Staff emergency call	Wi-Fi	All other staff	Yes	No
Building Infrastructure	Door opening/closing	Wi-Fi	AI software and staff handheld device	Yes, in given time windows e.g. 20:00-8:00	N/A
	Motion	Wi-Fi	AI software and staff hand held device	Yes, in given time windows e.g. 20:00-8:00	N/A
	Floor pressure	Wi-Fi	AI software and staff hand held device	Yes, in given time windows e.g. 20:00-8:00	N/A
	Toilet use	Wi-Fi	AI software		
Bed & Chair	Occupancy	Wi-Fi	AI software and staff hand held device	Yes	N/A
	Humidity	Wi-Fi	AI software and staff hand held device	Yes	N/A

A further round of discussions focused on system capabilities (see table 3)

Table 3: System Capabilities

Parameter	Essential	Desirable
Identify and track individuals in a multi-person environment	Yes	
Unobtrusive	Yes	
Staff interface: Alarms, alerts, tracking information	Yes	
Data storage, trending and analysis	Yes	
Storage and retrieval of individuals social information e.g. music playlists		Yes
Integrated care planning system		Yes
Predictive capabilities		Yes
Artificial Intelligence		Yes

Initially the intention was to have the same system deployed at both the Harmonia Village and the guesthouse with care. However, following discussions with the project partners it was decided that using different systems at each site would be advantageous as this would

mean that the approach would not be system specific. This would demonstrate that various systems could be adapted for use, increasing the range of options for other organisations wishing to follow the CASCADE approach. Given the factors highlighted in the discussion above, PP2 have selected Miicare (https://miicare.co.uk/) and PP3 have selected Canary Care (https://www.canarycare.co.uk/) as their respective equipment providers. At present a total of 36 Miicare control boxes and sensor arrays have been purchased by PP2 and 20 Canary Care systems have been purchased by PP3. The staff interface is currently in the development phase. Once the staff interface work is complete the system will begin β-testing.

Discussions have been held with Google (www.google.com) and both they and YouTube (www.YouTube.co.uk) have agreed to provide free licenses for access to their music libraries for the residents at the Harmonia Village. In addition Google are in ongoing discussions with the project team and Miicare regarding access to their cloud and machine learning system, which, if successful, could significantly expand system capabilities.

2.2. Patient-pharma communications system

It is well recognised that the use of Information and Communication Technologies (ICT) in the daily life of PLWD and caregivers can help them understand the disease process and manage situations in a way that is beneficial for both parties (1). One area in which these can play a significant role is in improving communications between people with care needs and clinicians. Video communication telehealth platforms exist in two forms: synchronous and asynchronous. Synchronous telehealth involves the real-time, face-to-face communication via video calls e.g. Skype & Speakset. Synchronous remote consultation and video-conferencing to support people with care needs has been around for some time. Telemedicine projects using inexpensive technology over standard telephone lines have been successfully used in long-term care settings (2). An evaluation of the feasibility and reliability of commonly used clinical dementia assessments, for persons with mild to severe Alzheimer's disease (AD), when administered via direct-to-home telemedicine videoconferencing found that reliability was excellent in all measures. For the most part, participants and healthcare professionals found telemedicine to be a feasible option for assessing cognitive function and caregiver coping. Findings indicate that these measures can be used to assess persons with AD, as well as their caregivers, across the telemedicine platform, directly to their homes. To date, there are few studies that have assessed the suitability of these measures when used in this care setting (3). In another example a mobile device with video-conference capability was used to allow nursing home staff to present cases for PLWD in an acute setting to the on call physician. Review of patient's medical record, vital signs, medications, and physical examination were performed remotely prior to the disposition of each patient seen. During the study period the most common reasons for presentation were agitation, respiratory symptoms and falls. The study results suggested that Telemedicine can be useful in helping care providers in remotely evaluating patients with cognitive deficits, including those with AD during an acute change in condition and/or unusual incidents.

Further research is required to give a clearer understanding of the outcomes, costs, usability and patient acceptability of telehealth and new innovative approaches (4). Current reviews suggest the adoption of alternative study design, e.g. formative approaches, to understand more detail surrounding how telehealth can support patients and/or healthcare delivery (5, 6). Alternative approaches can consider the changes in processes and management from a healthcare delivery perspective and enable the identification of barriers to adoption of telemedicine (7, 8).

There are a number of video systems that allow direct synchronous communication between a patient/carer and a clinical professional. However, there are a several drawbacks to these systems. The difficulties of contacting a clinician by phone are well known and a video call system also suffers from this same difficulty. Consequently, they are generally reliant on a dedicated team to be available at all times to respond to the videos. An example of this is a current study by Airedale & Partners where " A secure video link gives staff and patients immediate access to a 'hub' of senior nurses for advice and support, and the health professionals can monitor people on screen and make early decisions about any treatment needed" (9). This is expensive and difficult to roll out more widely given the staffing requirements. These types of approaches are generally funded via grants or a user subscription. In addition there are already several services available to deliver crisis support:

- NHS – Single Point of Access
- 911 help line
- GP's
- Multi-disciplinary local care teams
    - Community geriatricians
    - Community nurses etc.
- Dementia support workers
- Charities

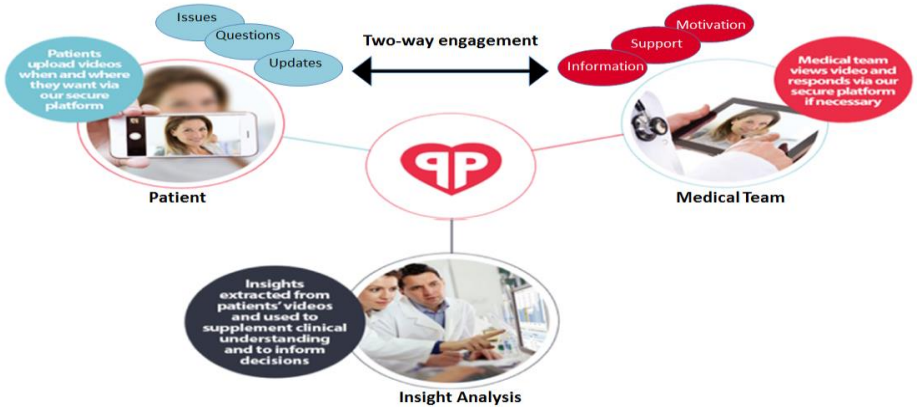
It is important that any system introduced compliments rather than replaces existing infrastructure, although this may prove possible in the longer term if the approach is successful. In order to create a transformative and financially sustainable approach which is deliverable from within an existing resource base PP2 and PP3 have moved their thinking towards development of an asynchronous video messaging system. Asynchronous telehealth involves video recordings that are not intended to be viewed in real time but as a form of messaging, akin to mobile text messaging. Asynchronous technologies have been widely used in wound care, dermatology, diabetes and ophthalmology (10,11,12,and 13). When comparing synchronous and asynchronous platforms in diabetes care, applications differed in the type of contribution in patient care like asynchronous telehealth was more successful at improving clinical values and self-care (12). In other disease areas, e.g. dermatology, asynchronous telehealth use can lead to shorter wait times for patients, patient and provider satisfaction, fewer unnecessary visits without reducing diagnostic accuracy (12).

The solution principles for the video system agreed upon by the team were:

- The idea of a "call centre" approach is outdated when all staff can have a smart phone/ipad
- The infrastructure will be based on users using an app available on mobile devices rather than a physically located centre
- The remote consultation and support service will be provided by the CASCADE network, administered by the Harmonia Village, leveraging the knowledge and skills available. This will utilise the healthcare and language skills available across the CASCADE partner network to deliver the service
- Questions and issues from PLWD, carers, community staff etc., will be "logged" with staff to be answered within a set period of time, thus ensuring that clinical activities are not routinely interrupted.
- An escalation protocol will be available if an immediate answer is required or in a crisis situation.
- A library of messages for an individual will be built up to give clinicians "context" when making clinical decisions and allow larger scale analysis to be conducted and trends identified at both and individual and macro level.

The Patient-pharma system has been chosen as the preferred video messaging system (http://www.patient-pharma.com/), it has end-to-end encryption and so information confidentiality is assured and it is in line with regulatory/legal requirements. A patient, carer, community clinician etc. can record a video or audio message which is queued on the system (see figure 1). Clinicians within the CASCADE network can then review and respond to videos in batches. Calls in English will be directed to Harmonia Village staff. The software platform will automatically re-direct calls/videos to a contact within the network with appropriate language skills, if these are required. The system is asynchronous i.e. no appointments, and ensures clinicians can make the best use of their time without interruptions. An escalation protocol will be developed to provide support in crisis situations. A record is kept of all interactions which can be used to enrich the data being collected and support the research aims of the project.

Figure 1: Process flow map for Patientpharma software



The system is commercially available and the app has been downloaded for evaluation to the phones of a number of team members. A pilot study is being organised with two nursing homes in the Dover area to test the approach, identify and resolve any issues prior to being implemented when the two facilities open.

2.3. Ethical approval of research

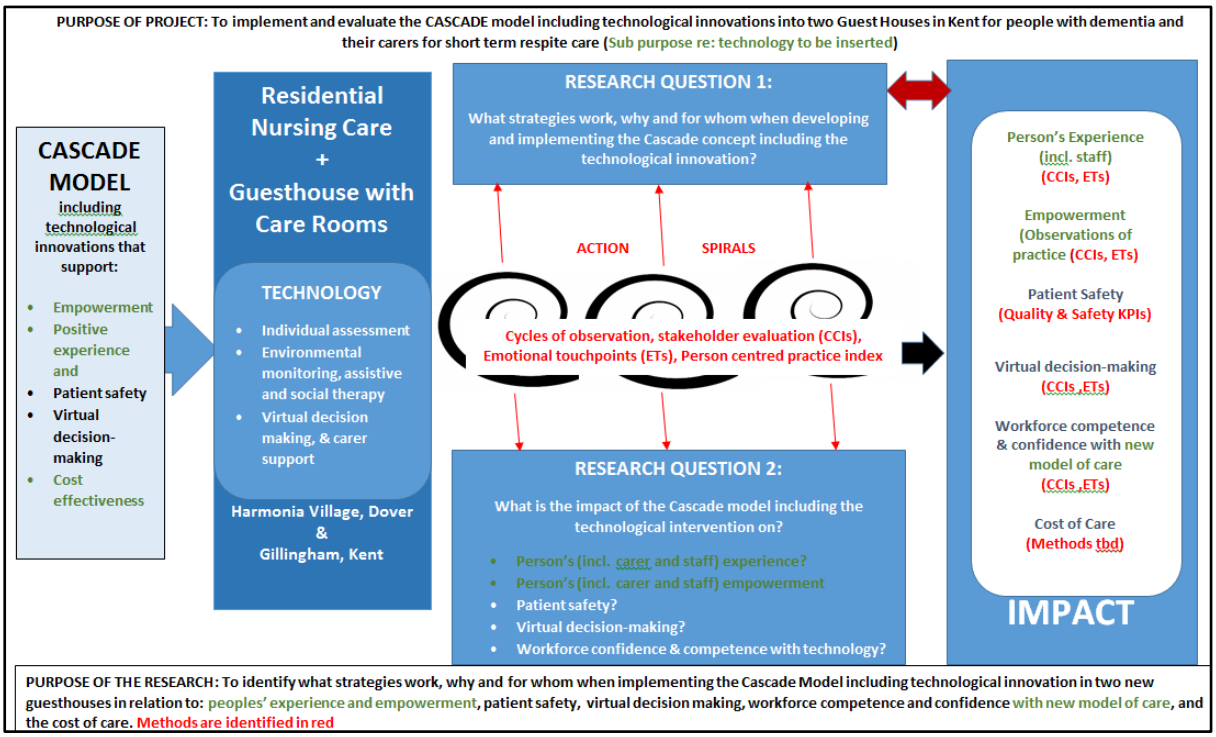
The potential requirement for ethical approval of the programme of research has been discussed with PP4. The key elements of the project from an ethical approval perspective are:

- The intervention with involve the use of technology to:
    1. Support the safety and independence of residents
    2. Improve sense of wellbeing
    3. Support clinical decision making
- The technology involves:
    1. Use of sensors to detect changes in gait and use of virtual reality to help with assessment of activities of daily living
    2. Tracking sensors
    3. Assistive technology - e.g. hand free taps
    4. Therapeutic technology to deliver music /messages
    5. Virtual assistance and video conferencing.

PP4 have completed a project self-assessment on the Integrated Research Assessment System (IRAS) the outcome of which, because of the vulnerable nature of PLWD, is that a full IRAS application is required in order to obtain Research Ethics Committee (REC) approval for the research.

PP4 have registered the project on the IRAS system, and conducted a CASCADE team session to summarise the research model (see figure 2). They will lead the submission and approval process, supported by PP2 and PP3.

Figure 2: CASCADE Research Model (for UK ethics approval)



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