Evaluating Automated Goals for Home Care Support

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Purpose: The aim of this study was to evaluate an approach to automating goals for supporting home care, with a view to understanding user experience when defining such goals and hence identifying improvements that could be made to the approach.

Design, Methodology and Approach: The study was designed to answer the key research question of whether users can understand, formulate and relate to automated goals for home care. In order to do this, a fictional text-based scenario was used about a couple with care needs. This helped to explore the feasibility, acceptability and usability of goals to manage care at home. Face-to-face qualitative interviews were undertaken with ten participants with a background in social care: four social care professionals, one health care professional, one formal carer, one informal carer, and three end users.

Findings: Overall, participants were positive being able to control the MATCH home care system through the use of goals. The results from the participant interviews will be used to help guide potential improvements to the home care system. The main issue that emerged from the study is that it would valuable to think in terms of outcomes as a higher level than goals. A second consideration is that it would desirable to adopt terminology that can be understood by all stakeholders.

Research Limitations and Implications: The study has demonstrated that automated goals for home care have a useful role to play and can be successfully used by carers. Although the range of participants in the study was limited, it has allowed confidence to be built in the approach and has identified useful pointers for future development.

Practical Implications: With the evaluation and validation of the goal-based approach, it has encouraged the developers to make automated goals more widely available in future deployment of the home care system.

Social Implications: The use of automated goals to support home care has been shown to be acceptable to carers. This will allow future home care systems to offer more personal and better customised services to those receiving telecare.

Originality and Value: The study provides a unique evaluation of the use of automated goals to support home care. Previous use of goals in the literature has been for highly technical applications, so their application to home care is novel and speculative. The study has demonstrated that the approach is viable, useful, and usable by carers.

Keywords: Evaluation, End User Involvement, Goal, Home Care, Qualitative Analysis, Policy, Telecare, Telehealth.

1 Introduction

1.1 Context

In the United Kingdom, the Department of Health estimates that 17.5 million people are living with a long-term condition (LTC) and that 45% of them will have one or more co-morbidities (Department

of Health, 2005). LTCs are costly to both the diagnosed person and society. Their care consumes a high proportion of health and social care resources, accounting for approximately 80% of all GP consultations and 60% of emergency hospital admissions (Kendrick, 2004). LTCs such as diabetes affect people of all ages, although prevalence increases with age. The UK has an ageing population and it is forecast that by 2030 the number of people with LTCs will have doubled in the over-65 age group (Department of Health, 2009). This raises social and economic problems of how to care for an increasing number of such people.

The four Governments in the UK recognise the possibilities created by telecare (remote social care) and telehealth (remote health care) to help deliver future health and social care services. Examples of Government programmes include 'Improving Quality of Life for People with Long Term Conditions' (Department of Health, 2013) and a National Telehealth and Telecare Delivery Plan for Scotland (Scottish Government, 2012). These programmes highlight that developing appropriate services and responses is as important as the technologies themselves. The UK DALLAS programme (Delivering Assisted Living Lifestyles at Scale) is expected to reach up to 169,000 people (McGee-Lennon et al., 2012).

Basic telecare products include flood detectors, smoke alarms, door entry systems and automated lighting. Basic telehealth products include vital signs monitoring and recording of specific conditions such as blood glucose. Home care systems have previously been relatively simple, single-user/single device systems such as pendant alarms. More advanced systems aim to provide a degree of automated support and reaction to changing circumstances and can now be characterised as typically multi-user, multimodal, distributed, integrated and adaptable in terms of application and services offered (Turner et al., 2009). Yet, despite the advantages that networking in the home can offer, these solutions have not become embedded within home environments. Home users are not highly trained experts. Therefore, commercially available home care systems that, for example, present reminders and alarms to this user group, are of little benefit if the user cannot attend to them effectively. Clark and McGee-Lennon (2011) found there is an over-estimation in the amount of technophobia experienced by older users towards home care technologies. This may help explain why these more advanced systems are generally not designed with home users in mind and require programming by experts to make service adaptations for each user (Turner et al., 2009).

1.2   Automated rules for home care support

The MATCH project (Mobilising Advanced Technologies for Care at Home, www.match-project.org.uk) aimed to develop and integrate facilities for telecare and telehealth as well as devices for monitoring the home to create a system that allows users with limited technical knowledge to control and manage a range of devices in their home.

Control of the MATCH home care system is through the use of rules, namely goals and policies. Goals, in this context, express the objectives and intentions of the person requiring care. For example, the user might wish to maintain social contact or to take medication as prescribed. Policies, in this context, are rules for how the home care system should behave in order to optimise achievement of the user's goals.

A library of goals and policies has been created to allow users to control their home. This library provides automatic and appropriate responses to events or situations in the home. For example, a sensor detecting a flood or a fall can trigger an alarm. Other sensors can turn on heating, switch lights off or record TV. Rules can also be set for a particular time or day, e.g. for a reminder to take medication. Goals and policies are defined by a user and/or their carers using a software 'wizard'.

A general issue for rule-based systems is that it can be hard for users to understand what the system will do in particular circumstances or why it reacts in certain way. For the MATCH system, an explanation facility has been created to ease this task (Turner, 2015). This allows the user to check how rules might be used in future and how they have been used in the past.

1.3 Related Work

1.3.1 Home care systems

A home care system (Turner and Maternaghan, 2012) uses a computer in the home to support delivery of social and health care. As well as telecare (e.g. monitoring for poor eating habits) and telehealth (e.g. monitoring for seizures), the system can support functions such as communication (e.g. staying in touch with friends), entertainment (e.g. automatically recording favourite programmes), home automation (e.g. keeping the house comfortable) and security (e.g. keeping the house safe at night).

The underlying facilities are sensors, actuators, services and external systems. Sensors are input devices that measure some physical aspect or activity such as movement in the house, room temperature or heart rate. Actuators are output devices that produce some physical effect such as shutting off water in an emergency, controlling a TV or sending an alert message. Services behave like sensors or actuators but use software, e.g. to manage reminders, learn user preferences or manage the home environment. External systems can provide services such as analysing medical information, allowing a care worker to check the user is well, and supporting communication.

Like the MATCH project discussed in this article, several research projects have adopted the approach of OSGi (Open Services Gateway initiative, www.osgi.org). This is an industry-standard framework for developing services, particularly in the home. Several projects have used OSGi in healthcare, e.g. e-HealthCare (http://ehealth.sourceforge.net), the Gator Tech smart house (Helal et al., 2005), Home HealthCare (http://www.ida.liu.se/~stuha92/anna-web/projects/HHC-overview.htm) and SAPHIRE (Hein et al., 2006). Other research projects have adopted their own approaches such as the Gloucester smart house (Orpwood, 2003), House_n (Intille, 2006), Place Lab (Intille et al., 2006), Safe at Home (Woolham et al., 2002), and SAPHE (http://ubimon.doc.ic.ac.uk/saphe). As would be expected, these academic projects have focused on key research questions such as how to integrate a wide variety of telecare and telehealth devices into one system, how to effectively control these, and how to support specific conditions in the home such as dementia. The Atlas approach used in the Gator Tech smart house is one of few examples where efforts have been made to commercialise the results of the project.

A range of commercial products support home-based care, with a few representative examples as follows. Docobo (www.docobo.co.uk) offer a home hub that monitors patients with long-term health conditions. Just Checking (www.justchecking.co.uk) record the movements of someone in the home and display this graphically for further analysis. OmniQare (www.omniqare.com) provide a touch-screen device and a framework for integrating third-party applications including home care. Tunstall Healthcare (www.tunstall.co.uk) support a wide variety of devices for telecare, telehealth and assisted living. Besides these platforms, there is strong growth in devices such as smartwatches and mobile phone applications for monitoring fitness and health.

Much of the work on home care technologies lacks a standard architecture. Health Level 7 (ANSI, 2003) defines a widely used standard for exchange of healthcare information. This is supported by commercial offerings as well as open-source projects like MIRTH (www.mirth.com). The Continua Health Alliance (http://www.continuaalliance.org) is working towards standards for interoperability of home health monitoring solutions. The European Telecommunications Standards Institute (http://portal.etsi.org/stfs/STF_HomePages/STF264/STF264.asp) has developed standards for interoperability of telecare equipment. For research projects at least, OSGi has emerged as a popular framework since the approach is industry-standard, vendor-neutral, device-independent and focused on service provision.

1.3.2 Rule-based systems

Rule-based approaches define how a system should react to changing circumstances. Rules are often in *when–then* form, i.e. *when* a particular event occurs *then* the system must react in the specified way. However, they lack the user-oriented capabilities appropriate for home care. The use of goals and policies makes rules visible and meaningful to users, and allows appropriately trained people to define rules following a dialogue with the relevant stakeholders, typically as part of a care assessment procedure.

Goals originated in artificial intelligence, where they are typically used by a planning system to build sequences of actions that achieve goals. Goals in a policy context are interpreted rather differently (Bandara et al., 2004). Because goals are high-level, they are appropriate for expressing user objectives and intentions, saying what should be achieved and not how to do this. As a result, goals cannot be executed directly. Instead, they can be realised by selecting appropriate policies to achieve them. For home care, goals might include maintaining social contact, following medical advice about exercise, staying comfortable and being secure. These are aims that users can relate to and are easier to formulate than policies. When a significant event occurs, the MATCH system automatically chooses the best policies to achieve the user's goals. If necessary, conflicts among goals and policies are automatically detected and resolved.

A policy is a form of rule that dictates how a system should react to external events. Policies are typically in *when–if–do* form. A home security policy might say: *when* movement is detected in the house, *if* the house is unoccupied, *do* alert a neighbour. A medication policy might say: *when* it is 9AM, *if* the user has not taken medication, *do* remind the user. This might be strengthened by a further policy: *when* it is 10AM, *if* the user has not taken medication, *do* alert a neighbour.

MATCH developed a distinctive approach to rule-based management of how a home system supports care needs. Goals are handled in a unique way, being achieved dynamically and optimally as events occur; most other approaches require static analysis and specialised knowledge Policies do not require specialist technical knowledge and are therefore suitable for ordinary users. Overall, this makes it easier to customise the home system according to user needs, and to adapt how the system behaves as care requirements evolve.

1.4   Overview of paper

The paper reports on an evaluation of the MATCH approach to supporting home care through goals (and their supporting policies). The aim was to understand user experience when creating goals of this nature so that improvements could be made to the system. In order to do this, a fictional text-based scenario was used about a couple with care needs to help explore the feasibility, acceptability and usability of goals (and policies) to manage care at home. The study focused on the key research question of whether users can understand, formulate and relate to automated goals for home care. A full evaluation of the supporting policies is beyond the scope of the current article and will be given in an upcoming paper.

The organisation of this paper is as follows. Section 2 describes the MATCH system and the approach used in the evaluation. Section 3 assesses the automated support of home care goals from the point of view of the user. Section 4 concludes the paper with a brief summary and recommendations for future work.

2   Approach

2.1   The MATCH home care system

The environment of the MATCH home care system is indicated in Figure 1. Within the home there can be several kinds of wireless and wired networks. The telecare system receives data from devices, feeding this to rule-based care services. This results in automated reactions that are sent back to devices. Care data is also exchanged with external care providers and information services.
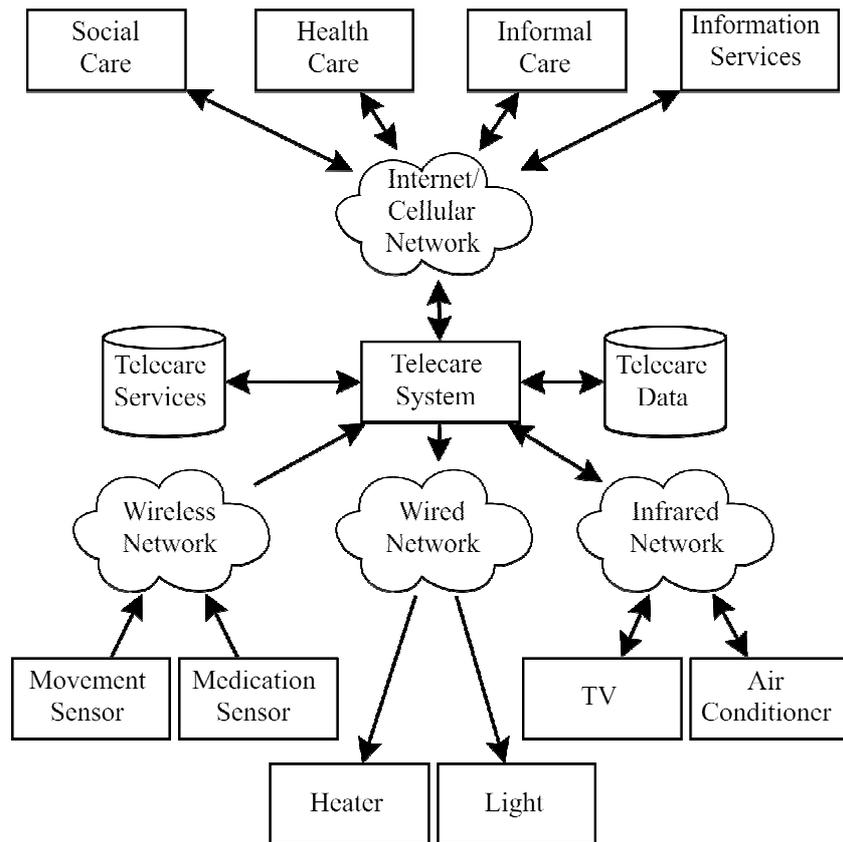
Figure 1. Example MATCH system environment

Rules take the form of goals or policies that are defined by a user-friendly wizard. Figure 2 shows a sample list of goals defined using the web-based wizard. Goals are edited by clicking on their names. Their relative importance can be changed by moving a slider.

Goal Measure	Status	Changed	Goal Importance		Remove?
Avoid allergens	Enabled	2015-05-22 20:10	1.5		Delete
Be active	Enabled	2015-04-04 20:11	7		Delete
Be comfortable	Enabled	2015-05-13 13:19	1		Delete
Be secure	Enabled	2015-04-04 20:12	4		Delete
Be social	Enabled	2015-05-22 19:49	0.5		Delete
Eat properly	Enabled	2015-05-22 20:35	3		Delete
Use less energy	Enabled	2015-11-06 11:17	5		Delete

Figure 2. Sample goals and weights

Goals and policies are edited in a similar way. As illustrated in Figure 3, their elements are presented to the user in near-natural language (currently in English, French and German). Clicking on an element allows it to be edited using drop-down lists. The figure shows a policy that notes when the user goes out in the afternoon. This information is used to encourage the user to go for a walk if they do not do so. If the user leaves by an exterior door during the period 2PM to 5PM, the system variable *pm_excursion* is set to true; after 5PM it is set back to false again.

Applicability (label, owner, ...):

    label   Note afternoon excursion

    owner   admin@cs.stir.ac.uk

    applies to @cs.stir.ac.uk

    status   enabled

Preference (must, prefer, ...):

    don't care

Rules (combinations, triggers, conditions, actions):

```
    when told of exit by door in exterior  •••
        if the hour is after 14:00:00  •••
    and
        if the hour is before 17:00:00  •••
    do set a variable called pm_excursion with value true   •••
    •••
failing that
    when generally
    if the hour is after 17:00:00  •••
    do set a variable called pm_excursion with value false   •••
    •••
```

Figure 3. Editing a sample policy

2.2 Evaluation methodology

Face-to-face qualitative interviews were undertaken with ten participants, identified from the MATCH user list (a database of names comprising carers, older people, social and health professionals that had previously indicated an interest in taking part in research run by the project) and by using a snowballing technique whereby participants were asked to identify additional participants. At least one week prior to interview, each participant received an email invitation with an attached Participant Information sheet. If participants decided to take part, a convenient time and place for the face-to-face interview was arranged. Each participant was asked to sign an Informed Consent form before the interview began. Interviews lasted between 45 and 90 minutes and were audio-recorded, transcribed and analysed using methods of Framework Analysis (Ritchie and Spencer, 1994). Ethical approval was obtained from the University of Stirling Psychology Department Ethics Committee.

Each participant was allocated an identifier code to ensure anonymity. The participants were four social care professionals (SC1, SC2, SC3, SC4), one formal carer (FC1), one informal carer (IC1), three end users (one healthy older user and two living with long term conditions) (EU1, EU2, EU3) and one health care professional (HC1).

During the face-to-face interviews, participants were first of all given written and verbal information, using examples to explain what is meant by goals and policies. Next, participants were asked to undertake a short exercise whereby they read the fictional scenario shown in Figure 4 about a couple living with care needs who wish to remain in their own home.

Fred and Shirley have been married for 50 years. Both are now in their 70s and are living with care needs. Shirley has severe arthritis and is no longer able to move around the house easily. Shirley believes that changes in the weather cause her arthritis to flare up, for example, if air humidity is not kept around 45% or the temperature in the house is not kept at 21°C. Shirley relies on Fred for tasks such as turning on the fire, flushing the toilet, closing curtains, putting on lights. However, there are times where Shirley does not like to ask for

Fred's help. For example, when Shirley gets out of bed in the middle of the night, she cannot switch on the hall and bathroom light and as a result has fallen twice in the darkness while trying to get to the bathroom.

Fred and Shirley have a daughter, Fiona, who lives an hour away by car. Fiona's home is small and she has three young children. Fiona visits once a week and does the main weekly shop for her parents. However, Fiona is worried because her parents no longer leave the house and she is often their only visitor. Fred and Shirley had always been very sociable. Fiona has been trying to encourage her parents to go to the local community centre where there are a number of activities on offer.

In addition, Fred recently had a mild stroke and has become very forgetful. Shirley has to continually remind him to take his medication each morning and evening. He also has been forgetting to lock the front door after letting the cat out before going to bed. Shirley has been feeling increasingly guilty. Despite all that Fred does for her, Shirley loses her temper when she has to repeatedly give him reminders.

Figure 4. Fred and Shirley scenario

After reading the scenario, participants were asked to formulate up to three home care goals for the couple, e.g. 'I wish to take my medicine properly' or 'I wish to be comfortable'. Participants were then asked to choose up to three policies for how the home care system should react in different circumstances, using a '*when–do*' or '*when–if–do*' form that best achieved the home care goals. Participants were also asked to think about their own home, to formulate a home care goal relevant to them, and to choose a policy that best achieved their home care goal.

Finally, participants were asked questions about the following kinds of issues: technological (usability, appropriateness, limitations), conceptual (are users able to relate to goals and policies?), psychological (user attitudes and acceptance), and sociotechnical (can a home care system using goals and policies be integrated into current care practices?).

Ten participants took part in the face-to-face interviews. Of these, nine participants completed the short exercise formulating goals and policies. One participant, a social care professional, was interviewed in full but declined to take part in the short exercise because:

> SC3: Formulating goals and policies would be disempowering them [users] rather than empowering them.

Participants were shown a library holding nine goal templates which included a 'blank' goal template for use if none of the predefined goals was considered relevant.

3 Home Care Goals Evaluation

First the researchers examined the home care goals and policies (rules) that the participants had formulated during the exercise to ascertain whether participants could think in terms of goals and policies. Overall, participants found it more difficult to define goals compared with policies, although participants typically opted for simpler 'when-do' policies compared to 'when-if-do' policies. Next, the researchers developed descriptive codes from the interview transcripts and these were validated by discussion. The following themes emerged from this study to inform the future design of the goals approach in the MATCH home care system.

3.1 Choosing goals from the library

Participants typically chose pre-defined goal templates from the library. The 'blank' goal template was considered to be an important option and was selected on two occasions. However, appropriate training would be important to ensure that those who are defining goals choose the most appropriate goal templates:

SC4: I do believe you have to have this blank in, but when it is there it does encourage people to end up [using it] … if they think that wording is not right they'll just keep going back to the blank.

This concern about the wording not being right was expressed by one participant who was unsure which goal template to choose when writing a goal. EU2 was formulating a goal around the importance of prompting Shirley (the hypothetical user) to move about if she had been sedentary for a period of time. EU2 was unsure whether this would fall under the goal template 'Be comfortable' because inactivity could lead to discomfort or the goal template 'Be active' because EU2 was defining a goal about activity. The expected outcome was that keeping Shirley active would likely have increased physical comfort. This example highlights a subtle difference: by choosing the template 'Be active' a goal is defined, and by choosing the template 'Be comfortable' an outcome is defined. This is an important point whose relevance is expanded in section 3.5.

3.2 Presenting the solution as the problem

There was a tendency by participants when formulating goals to jump ahead and think about the technological solutions that could be offered:

IC1: I'm getting the policy and the goals mixed up here.

SC1: I'm starting to give a description here of telecare so I'd better stop.

EU3: I think the problem is I'm trying to think in terms of what the technology can do rather than just thinking about the goals.

However, it is important that there is some level of understanding about what services can be offered by telecare and home automation as otherwise unrealistic goals may be set:

HC1: There are lots of considerations about how they [patients with care needs being discharged from hospital] are going to cope with day-to-day things like housework, so goals would be around getting the ironing done, getting housework done, …

Nonetheless, too much focus on the technology can result in goals being solution-driven rather than problem-oriented. For example, a goal by SC1 was written as 'Medication prompt for Fred', whereas thinking in a more problem-focused way suggests the goal: 'Fred to take medication on time'.

Focusing on what solutions are available may mean that some home care goals are not identified. For example, participants had experienced things such as automatic lights, taps and the toilet flushing in public toilets. However, these had not been considered by some participants as something that could be extended to the home. Advances in telecare and home automation are happening at a fast rate, so it is unlikely that end users and care professionals can remain up-to-date with all the technological possibilities. Therefore, a training guide could be made available to help users define goals in a more problem-oriented way.

3.3 User readiness and importance of tailoring technology to need

Better technical solutions can be delivered when there is a greater understanding of care needs. For example IC1 identified that, for the goal 'Be comfortable', one of the factors that would negatively affect this would be if the toilet was left unflushed because the user was unable to pull the toilet flush handle. However, IC1 expressed caution at a solution whereby the toilet would flush following the user standing up:

IC1: There is a thing to make it work [emptying the bowels] called double voiding where you have to stand, bend and sit back down again to force the bowel to push things through. So you'd probably have the toilet flushing three times if it flushed when she stood up. … It would need to be a movement sensor rather than relying on her shutting the door as not everyone will shut the door when they leave the bathroom.

This highlights the potential value in having some kind of assessment tool that has been developed in collaboration with a group of end users and care professionals whereby, once user goals are

identified, technical solutions can be considered for their appropriateness. Similarly, an assessment tool that measures the readiness of a person with care needs to accept technology into the home may also help to ensure technologies are used appropriately:

> *SC1: Putting this equipment in is not going to help him unless he is engaging in it and understanding that a piece of equipment is there to help him, because writing on a piece of paper stuck to the door might be all that the man needs at that point in time.*

Therefore, even if there are technological solutions available, technology should not always be considered as a first choice to meet someone's home care goals. Furthermore, the importance of tailoring technologies to individual circumstances is key and highlights the need for customisable solutions. Tools that can help identify an appropriate technical solution and a user's readiness to accept technology (and/or the amount of technology that would be acceptable) could be developed alongside the MATCH home care system. This could be for use by a non-technical person when translating user goals into policies to control the home in an appropriate way.

3.4 'Goals' and their place within a home care assessment

All participants were familiar with the term 'goal'. However, there was a general feeling that using 'goals' in this context did not fit within current social care terminology. To increase the chance of successful implementation it is important that the language fits within current assessment methods used by those who will be prescribing the home care system:

> *SC2: I suppose it's quite difficult because I find the language difficult because we use goals in social work quite differently. ... We talk about outcomes, what outcomes we are trying to achieve for people, and we set goals to achieve those outcomes.*

There was a general feeling that there was a higher level needed above goals, namely an outcome category:

> *SC4: [referring to the library of goal templates] That's the outcome, but in order to achieve that outcome you might have to break it down into a variety of different goals and maybe work on individual small goals that would then give you that outcome at the end.*

> *SC3: The other thing to think about around goals is that normally you have an end point with a goal ... Because a goal should be achievable and if you achieve that goal, it's then monitoring to see that it is still being maintained in some way.*

> *SC4: If you look at the goals, what we want to achieve, it is quite a generic term. For example, the goal there to be comfortable – the scope there is very big so I think that's why I have so many things in order to meet that goal.*

While most participants focussed on one area of comfort, SC4 defined comfort as being affected by a variety of issues: environmental (room temperature), social (socialisation, isolation), safety (safety at home), personal (body temperature, mobility, ability) and health (medication, mobility). To overcome this issue, SC1 had expanded the name given to the goal: 'Making the environment comfortable'. Extending the goal library to include, for example, 'Environmental comfort', 'Personal comfort', etc. could be one way to help deal with the large number of factors that could potentially be listed if there were only one template 'Be comfortable'. However, if instead a higher level above goals was created (outcomes) then if being comfortable were an outcome, the goals within that could be broken down into, for example, 'I want the environment to be comfortable' and 'I want pain maintained at a comfortable level'. These could be further broken down into the factors that affect each goal.

An outcome-focused approach may also be more meaningful to end users and help to minimise conflict during a home care assessment. SC3 felt that, as part of the wider discussion around how to improve the relationship, a likely issue would be Fred forgetting to take his medication. If Fred remembers to take his medication then Shirley would no longer have to nag him about this. The end result would be that the care professional would still have a goal to increase Fred's medication compliance. In a telecare service, for example, a rule to remind Fred could be written. However, for

the end user to see the relevance of this telecare solution being installed within the home it is important that they recognise that it is within the context of helping to achieve the outcome of improving their relationship.

3.5   *Outcomes as an alternative to goals?*

Once participants had chosen a goal template from the library they defined the factors related to achieving their goal.

> *SC4: It is about the person working with them to make sure that they are identifying achievable goals [that] could be broken down into tasks.*

> *SC4: We use 'outcome' a lot, and that seems to be the buzz word at the moment.*

Using the terminology emerging from the interviews, a possible alternative structure is proposed. By thinking in terms of 'outcomes' at a higher level than goals, goals would feed into achieving the overall outcome. Goals are dependent on a number of smaller tasks. Tasks could be written as brief, clear statements that can be translated into possible solutions (policies). A procedure is suggested in Figure 5 using an example situation identified by the interviews. Similar policies could be defined for medication at other times.

Outcome	I want my relationship with Fred to be better
Goals	I want to stop shouting at Fred to take his medication
	I want to stop feeling guilty about asking Fred to flush the toilet
Tasks	Maximise Fred's medication compliance
	Minimise the number of times Fred needs to flush the toilet
Policies	**when** the time is 10AM
	if the morning medicine has not been taken
	do remind Fred to take his medication
	when the bathroom door sensor detects leaving the bathroom
	do automatically flush the toilet

Figure 5. Possible hierarchy for managing the home care system

Current social care terminology has been influenced by Scottish Government policy in the Community Care Outcomes Framework. This framework shifts community assessments and care plans to focus on user and carer outcomes. At least 10 of the identified 16 outcome measures are used by each local authority as part of their current care assessment process (Petch et al., 2007). These user-defined outcomes may be useful to elaborate the current library of 'goals' (or 'outcomes').

The outcomes defined by service users would generally relate to telecare services. Home automation outcomes would also need to be defined as something that could be done in future work involving a user group. This would also ensure that what appears in the library is displayed in a way that is relevant to users. For example, this could be done by making a clear distinction between personal goals and goals for the home:

> *SC4: I think if there is some way that we can change the terminology so it's more about focusing on that person and their goals in life … I can't imagine a goal for them [Fred and Shirley] is going to be using less energy. That might be a by-product. If we can add that, by doing all these other things to make you meet all your goals, you are also using less energy, they may think that's great: I'm doing all these things to fulfil my goals and I'm using less energy.*

This highlights added value that the MATCH home care system can offer users whereby they are provided with feedback from the system. This may serve to reinforce acceptance of such a system

within the home if users can see clear benefits such as a reduction in energy costs. In addition, a desire for feedback in the form of praise was also expressed by EU1:

> *EU1: It would be nice to get a text at the end of the day to say 'good going' because I haven't been in the biscuit cupboard today.*

3.6 Who should define home care goals?

Formulating home care goals as part of a care assessment was viewed by all participants as something that should be done, as far as possible, by a care professional in conjunction with the home user and, if appropriate, their family. However, there was agreement that where users have a cognitive impairment such as dementia it may be more appropriate for somebody who knows the home user well to represent their goals:

> *EU3: A family member or someone who knows the person and can think about what is important [to them] and what sorts of goals they would choose themselves.*

> *EU2: [It should be] themselves and someone who knows a bit about their background, but someone who isn't in a huge position of power .... It is definitely a mutual thing, but I think the actual person should have the majority rule at the end of the day unless they have severe mental health issues or dementia.*

EU2 also highlighted concern that the care professional carrying out the assessment should not be viewed by the user to have too powerful a position. It was suggested that an appropriate person may be:

> *EU2: A community nurse because it's not directed at one area, it's your overall wellbeing.*

4 Conclusion

4.1 Summary

The inflexibility of current telecare systems prevents their configuration and customisation to meet the specific needs of home users. This may lead to local agencies trying to fit users to the available technologies rather than prescribing appropriate technologies to suit the real needs of these users. There may also be a potential for further inflexibility in these systems if one manufacturer builds a monopoly in the market place. The MATCH home care system offers a solution by allowing a range of manufacturers' technologies and services to be customised to the fit the real needs of end users and other stakeholders.

Multiple stakeholders have an interest in the goals for home care. Most obviously the end users themselves should be involved in defining goals, but their families and carers may also have views on these. In practice it is expected that social and health care professionals will have the formal responsibility for specifying and monitoring goals. Since defining goals using the MATCH system requires specialised training, these are the people who would be best placed to define goals. The procedure for identifying home care goals should be an integrated care assessment that deals with all aspects of an individual's care – goals being just one aspect of this.

From a technical perspective the goal-based approach has been shown to be successful, though the improvements emerging from this study should be made. The system supports a wide range of goals based on key factors in home care. When a relevant event occurs in the home, the system is able to give an optimal response within one second after considering all goals and policies. However, it is acknowledged that goals (and policies) can be defined using only the available technical information. It may not be possible to define some goals if there is no technical data to underpin them. Consider, for example a goal to maintain fluid levels or a goal to have regular social contact. These goals could only indirectly be technically supported.

Overall, participants were positive being able to control the MATCH home care system through the use of rules (goals and policies):

> *SC1: I think most people will be more than happy to have this technology in their home if they think it will help them stay in their own home.*

The results from the participant interviews will be used to help guide potential improvements to the MATCH home care system. One main issue emerged from the interviews. By thinking in terms of outcomes at a higher level than goals, then goals would then feed into achieving the overall outcome. These goals would be dependent on a number of smaller tasks which could be written as brief, clear statements. These additional task statements would be later be translated into the possible telecare solutions (the policies). A second main issue from the interviews was that different stakeholders have different interpretations of the terms goal and policy. Finding terminology that is understood by all stakeholders therefore needs consideration.

4.2 Limitations

It is important to consider the possible limitations of the current study. This was a preliminary investigation to discover whether participants could think theoretically in terms of goals and policies (rules). Therefore, participants were not required to actually programme (control) the system. This may have impacted upon participants' understanding of how the system would behave and feel in reality. However, participants who took part in this evaluation had expressed an active interest in technology so this may be more of a concern where participants are less technically motivated. It is also acknowledged by the authors that the small sample used in this study may represent different opinions from those in harder to reach groups.

4.3 Future work

Further user-led research to evaluate goals and policies within real home environments is necessary:

> SC4: Until you can get some users who can actually use it and be able to put it into practice, [only] then you'll get a better idea of what's going to work and what's not going to work and some of the wordings as well.

The interviews also identified a number of recommendations for the future development of the MATCH rule-based home care system:

- Set up a user group to consider all stakeholders' current understanding of the language used and to suggest where alternative terminology could make the system more comprehensible.
- The importance was highlighted of offering the user a choice of interfaces to access the policy wizard. In particular, an app on a smart phone or tablet was the preferred choice by all participants.
- To help users define rules for the system it may be of benefit to ask them to think in terms of 'outcomes' as a higher level than goals. This may help users to better express their needs.
- While the blank policy template is valuable, its use should be monitored to ensure that it is not being used where predefined templates already exist. In addition, it may highlight where additions are needed within the library.
- The home care system could also be marketed as a system to offer reassurance to family/carers or a system for the 'worried well'.
- The ability should be added for the system to offer feedback. For example, this might allow the user to access historic information such as whether they have taken medication.
- User training guides should be made available to help with defining goals in a problem-oriented way and with appropriately formulating policies in response to user goals. It is important that both the assessor and the end users have an understanding of what technologies are available and do not limit themselves due to an outdated view of what technology can offer.
- The development of marketing materials would normalise the use of home care systems being used to help people live independently at home.

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