

# **ELDERLY AND HOMECARE TASKS: A LITERATUE REVIEW ON PROBLEMS**

Ashiful Alam, Mohammad Zarifi Eslami and Klaas Sikkel  
*University of Twente, the Netherlands*

## **ABSTRACT**

Personalization of IT-based homecare services is one of the essential requirements for their successful introduction. A service tailoring process assist a person responsible for deciding on the care activities (the 'care-giver') to create a personalized composite service for an elderly (the 'care-receiver') based on the care-givers professional knowledge and with minimal assumptions on their technical knowledge and skills. The outcome of the service tailoring process is called a service plan, which represents a composite service tailored to the specific needs of a care-receiver. Designing such a service plan from scratch is a difficult and time consuming task. The use of patterns can simplify the process of creating a service plan. A service plan pattern, as a starting point for the tailoring process, is a treatment pattern which is an activity structure for handling a generic homecare task. To define the treatment patterns the understanding of problems related to such homecare tasks is necessary. This paper, by means of a literature survey, studies characteristics of common problems faced by elderly and current existing solutions for these problems. We believe that identifying such problems helps IT experts to develop a better understanding of requirements and to define correct and complete treatment patterns.

## **KEYWORDS**

Homecare systems, elderly common problems, service tailoring.

## **1. INTRODUCTION**

The increasing percentage of elderly people puts health care systems in developed countries under great pressure (Ghorbel, Arab & Mokhtari 2008). Providing IT-based care services at home to elderly (the 'care-receivers') is one of the means for tackling this problem (Zarghami et al. 2011; Betge-Brezetz 2009). However, these services need to be tailored based on care-receivers personal needs (Zarifi Eslami et al. 2010). The outcome of such a service tailoring process is called a service plan, which represents a composite service tailored to the needs of a specific care-receiver as understood by his/her care-giver.

Designing such a service plan from scratch is a difficult and time consuming task. The use of patterns is believed to simplify the creation of a service plan. A service plan pattern is a treatment pattern for a specific generic homecare task (Zarifi Eslami et al. 2011). In this way, the tailoring system proposes a pattern to a care-giver, whenever she selects a homecare task from a menu with a list of common homecare tasks. Therefore, she does not have to create a service plan from scratch, and instead can configure and modify an already provided plan by the tailoring system.

To be able to provide appropriate treatment patterns to the care-givers in the service tailoring process, there is a need for identifying common homecare tasks and their corresponding treatment patterns. Zarifi and his colleagues (2011) have already identified the common homecare tasks through couple of interviews. To develop a better understanding of these common homecare tasks and their existing (IT-based) solutions, this paper contributes in studying these common tasks and identifying their characteristics. For this investigation a literature study has been carried out. We believe that, the result of this work can help IT provider to define appropriate treatment patterns for the homecare tasks.

The rest of the paper is structured as follows. In Section 2, we have discussed identified common homecare tasks (i.e., common problems faced by elderly) and in Section 3, we have discussed our findings and show how it can help IT providers to define treatment patterns and finally, in Section 4, we conclude our paper.

## **2. COMMON HOMECARE TASKS**

Among the homecare tasks, medicine taking is the most common problem. Poor medication adherence is one of the biggest problems being faced by many industrialized countries (Lee et al. 2009). This poor medication adherence causes death and also account for increase in medication cost. For example, in United States, non-adherence of medication causes over 100,000 deaths yearly (Boquete et al. 2009; Lee et al. 2009) and account for incurrence of cost \$177 billion (Lee et al. 2009). In addition to medicine taking, measuring blood pressure, weight and oxygen saturation level at home, having social activities and interaction, maintaining daily routine and physical training plan are some other examples of common problems faced by elderly. In this section, we discuss our findings regarding characteristics of the common homecare tasks. These common tasks identified through interviewing the care-givers (in a care institute in the Netherlands) in the work (Zarifi Eslami et al. 2011).

### **2.1 Medicine Taking**

Elderly face problems in medication consumption as well as in medication logistics. Based on Lee and his colleagues work (2009) we identify following problems faced by elderly in taking medicine.

- i.** Elderly forget to take their medicine on time. Forgetfulness or dementia is one of the common challenges faced by elderly. However, Lee and his colleagues' study identified different reasons behind such forgetfulness. Most common cited reasons include tiredness or distraction at the time of medication intake. Distraction may be caused by being busy with some other thing at the time of medication.
- ii.** Difficulty to handle complex regime (complicated prescriptions) is also common problem to elderly people. Elder people found facing difficulty to remember taking pill that is prescribed to be taken in middle of the day, every other day, weekly or in association with meals. Also elderly found difficulty to take medication when they are needed to be taken away from home such as middle of work or while taking meal in a restaurant.
- iii.** Coping up with the changes in lifestyle is another problem faced by elderly related to medicine taking task. Any change in life style causes elderly to miss medications. Different routines for weekends, shifting meal times, or travel/vacations are the reasons to affect the ability to maintain medication schedule.

### **2.2 Social Activity and Interaction**

An elderly requires participating regularly in social activities and requires interacting with their family members and/or friends. In the following, we list the characteristics of this problem.

- i.** Elderly with vision and/or hear impairment, lacks enough confidence to participate in social activities or perform a social interaction (Crews & Campbell 2004). Thus elderly with any of these two problems may found confused and impatient while interacting with other people.
- ii.** For performing social activities and interactions with friends and family, elderly require making prior appointment. But due to dementia elderly may forget to make appointment on time and thus, their social activity and interaction is limited.

### **2.3 Daily Routine Activities**

Although care-related tasks such as medicine taking and measuring blood pressure, oxygen saturation and pulse are part of daily routine activities, however, by daily routine work/activities, we mean general tasks of daily life such as walking, going to/out of bed, eating, bathing, toileting etc.

- i.** Crews and Campbell (2004) argued elderly with vision and hearing impairment having difficulty to perform their daily living activities. According to them elderly with such impairments found to have difficulty with walking, getting outside of their house, getting in or out of bed or chair and preparing meal.
- ii.** Elderly with more frail condition have more problems to perform their activity like bathing and toileting which requires involvement of a care-giver (England & Dyck 2011).
- iii.** Many elderly require performing a minimum level of daily physical activities. For example, the guidelines of the Centers for Disease Control (CDC) and the American College of Sports Medicine (ACSM)

1995's guidelines suggest that an adult should perform daily minimum 30 minutes of physical activity with medium intensity (Pate et al. 1995). Identification of problem related to this task is difficult. Proper monitoring of an individual elderly's daily activities can only reveal problems.

## 2.4 Training Plan

While talking about problem of elderly related to perform daily routine activities, we referred to Pitta and his colleagues' (2005) work, which is based on CDC and ACSM's guidelines from 1995. An updated recommendation of that guideline is done by ACSM and American Heart Association (AHA) (Nelson et al. 2007). This guideline provides required training plan for enabling an elderly to meet the guidelines of daily physical activities.

i. ACSM and AHA guidelines suggest different level of physical activity for various persons. A physical activity plan incorporates physical activities required for a specific person and routines for the person to adopt that plan. Thus it requires a tailorable training plan. Such a training plan for an elderly people can be complex. Nelson and his coworkers also argued that activity plans for many elderly people require to be integrated with preventive and therapeutic recommendation. They suggest such an activity plan should be tailored according to an elderly person's chronic conditions, activity limitations and risk of falls. For example, physical activity recommendation for a diabetes patient suggest performing at least 3 days of physical activity with no more than 2 consecutive days without activity, while for a patient with Coronary artery disease recommendation is at least 3 days of physical activities per week (Nelson et al. 2007). This means that activity plan for patient with diabetes must be different from an activity plan for a patient with coronary artery disease. Thus a training plan for such physical activity becomes more complex for an elderly. Adoption of such a complex regime of training plan is a problem for elderly people.

## 2.5 Blood Pressure Measuring

Although home blood pressure measuring is considered cheaper and available 24/7 and therefore, easier to predict high/low blood pressure values (Green et al. 2008; Pickering et al. 2008), its accuracy depends on following its recommendation and guideline of measuring. The problems related to this task are as follows:

i. Accuracy of blood pressure measurement depends on the reliability of the machine and the way it is used. For example, it is recommended that to ensure the accuracy of the machine, reading should be taken same time of the day, such as every morning, while taking the measurement subject should be resting in seated position (Pickering et al. 2008; Wong et al. 2005). Correct home blood pressure measuring technique is more critical; recommendation suggests three readings should be repeated after 5 minutes or more. Although home blood pressure monitoring tends to show accuracy (Pickering et al. 2008) and its usage found more common to elderly, it is a complicated procedure and elderly people may not be able to use those complex devices properly. Thus practice of such complicated procedure is a problem for elderly.

ii. Due to elderly people's inability to handle such complex devices properly, they need to be trained before using such a device (Pickering et al. 2008). Adoption of such training is an additional problem for elderly.

## 2.6 Oxygen Saturation and Pulse Measuring

Like blood pressure measuring, blood oxygen saturation and pulse monitoring system handling is complicated for elderly people. However, for measuring the pulse rate and oxygen saturation various kinds of devices exist, such as classical handheld pulse oximeter, wearable ring device (Anliker et al. 2004; Asada et al. 2003; Leonhardt 2006) which can enhance the measuring those values.

i. Lin and coworkers designed a ubiquitous monitoring system in living space of elderly, using biosensor and RFID technology (Lin et al. 2007). Along with providing continues tracking of elderly, this system is capable of measuring pulse rate, blood oxygen saturation and temperature. The problem with such a system is that it needs to turn on by elderly when care-giver is not around them. Since dementia is common to elderly (Bekkelund, Kujala & Rosenvinge 2001), bearing in mind to switch on such a device may be a potential problem for elderly.

ii. Elderly need to maintain a routine to attach the measurable device by them. Maintaining such a routine base work can be a problem for them. However, more modern devices such as wearable ring devices may reduce the complexity of such a routine.

iii. Many automatic monitoring systems exist for above mentioned two problems, which introduces problem related to battery as argued by Lin and his colleagues. Those systems do continuous measurement which may result in quick power consumption. As a result elderly may require changing the battery. So requirement of changing regularly the battery of these measuring devices is a problem for elderly.

iv. Like in blood pressure measuring, elderly have difficulty to handle different devices to measure oxygen saturation and pulse. Because measuring oxygen saturation and pulse at home requires handling many more complex devices.

### 3. DISCUSSION

Surprisingly we have discovered no in depth research has been done in identifying problems of elderly faced with performing homecare tasks. Few researches we found addressing problems from the perspective of providing a specific solution. For example, Lee and his colleagues' work (2009) only talk about elderly people's poor medication adherence. Some of those researches have broader view on problems, for example, Crews & Campbell's work (2004) doesn't have a different view for 'social activity' and 'daily activities'. But in our opinion a distinguishing view would help to develop a better understanding of these problems.

Table 1. Homecare problems, characteristics and tailorable parameters

<b>Problems C</b>	<b>haracteristics</b>	<b>Tailorable parameters</b>
Dementia	Requires different level of reminder.	Reminder schedule (Time), Reminder priority
Problems with complex regime	Requires different level of reminder, determination of patient specific threshold value for task (e.g. training plan).	Reminder schedule (Time), Reminder priority, Threshold value for a training/ physical activity.
Vision & hear impairments	Requires different level and type of reminder (e.g reminder by text or voice message).	Reminder schedule (Time), Reminder priority, Modality.
Problems with measuring devices	Requires different level of reminder, correct measuring technique and determination patient specific threshold value for alert (for measuring BP/ oxygen saturation task).	Reminder schedule (Time), Reminder priority, Threshold value for vital signs.

In section 2, we identified four major categories of problems of elderly with homecare tasks. These are dementia, problems with complex regime, vision & hear impairments and problems with measuring devices.

Table 1, summarizes our findings regarding these problems and it can help IT providers in designing It-based services. The first column of the Table 1 incorporates the problems we identified for elderly related to homecare tasks. The second column shows the characteristics that require incorporating in the service pattern to handle the corresponding problem. While in the third column we have included corresponding tailorable parameters. In our opinion each of those parameters are required for corresponding service pattern to be tailorable for an individual.

For all of the problems elderly requires reminder and reminders need to have different level and different priority depending on the patient's frail condition. Thus, a service plan to handle any of those problems needs to tailor parameters – *Reminder schedule (time)* and *Reminder priority*. A reminder schedule will be based on required service patterns for an elderly such as reminder time schedule for medicine taking, reminder time schedule for blood pressure measuring, etc. Also different reminders may have different level of priority. Further, if an elderly has hear and/or vision problem, then appropriate reminder is required. Thus reminder with appropriate interface (*modality*) needs to be considered. We identify the need for two other parameters

*threshold values for a training/physical activity and threshold values for vital signs.* By setting threshold values for a training/physical activity, an alert can generate and send to the care-giver if an elderly does too excessive physical activity. Likewise in blood pressure, oxygen saturation and pulse measurement tasks, patient specific threshold values need to be set and exceeding such a value will generate an alert as well. We also identified that there are problems that require direct care-giver intervention which should have especial consideration in service tailoring process. For example, many elderly with vision and hearing impairment or with frail condition may not be able to perform their daily routine activities like walking, getting into or out of bed, preparing meal etc. by themselves.

#### **4. CONCLUSION**

In this paper, we identified that due to forgetfulness, elderly face problem to remember taking medicine. This poor medication adherence is also caused by their change in life style or due to their inability to handle complex regime (complicated prescription). Vision and hear impairments are found to be the problems that make elderly people reluctant to perform their social activities and interactions. We also found these two impairments inhibiting elderly peoples' daily routine activities. It is also found that elderly with frail condition require care-givers' involvement to perform daily works. Many elderly with COPD fail to perform required physical activities, which are risky for such patients. Elderly with various diseases require performing different level of physical activities. To adapt those physical activities, elderly need to go through complicated training process. To measure blood pressure, oxygen saturation and pulse, elderly faces problems due to their inability to handle complex devices. To be able to use those complex devices, elderly may require training on the procedure of their measurement. Both handling complex devices and go-through the training process are challenging for elderly. Moreover, we found that due to dementia, elderly forget to remember switching on/off those device and take the measurement.

Our work is not free from limitations. One can argue that the list of homecare tasks is not complete as it is based on only one scholarship. We admit that limitation and we argue that a more extensive work to identify homecare tasks is required. Furthermore, some of the problems we have identified are not directly mentioned as problems by the scholarships. However, based on corresponding scholars' argument and our assumption, we inferred some of those. The reason behind such action was lack of scholarships. It was very surprising that there is a little number of works which study problems of elderly in homecare domain. We argue that researchers should look into this aspect and do extensive research to identify problems of elderly in the homecare domain.

Despite the argument regarding completeness of the homecare task or related problem list, we have shown how the identification of problems related to homecare tasks can be help in service tailoring process. If all the potential problems related to a homecare task is known to IT service providers, they will be able to define all the required service plan patterns. This will eventually help creating individual service plans for any care-receiver. Besides, we also have shown how identification of problems can lead to identification of required tailorable parameters.

#### **ACKNOWLEDGEMENT**

This work is part of the IOP GenCom U-Care project (<http://ucare.ewi.utwente.nl>) which is sponsored by the Dutch Ministry of Economic Affairs under contract IGC0816. We would like to thank Dr. Anupoma Haque for her support during this work.

#### **REFERENCES**

- Anliker, U, Ward, JA, Lukowicz, P, Troster, G, Dolveck, F, Baer, M, Keita, F, et al. 2004, 'AMON: a wearable multiparameter medical monitoring and alert system', *IEEE Transactions on Information Technology in Biomedicine*, vol. 8, no. 4, pp. 415-427.

- Asada, HH, Shaltis, P, Reisner, A, Rhee, S & Hutchinson, RC 2003, 'Mobile monitoring with wearable photoplethysmographic sensors', *IEEE Engineering in Medicine and Biology Magazine*, vol. 22, no. 3, pp. 28-40.
- Bekkelund, SI, Kujala, I & Rosenvinge, B 2001, 'Unrecognized Dementia in Elderly Patients Admitted to Hospital with Psychiatric Symptoms', *Journal of Geriatric Psychiatry and Neurology*, vol. 14, no. 1, pp. 7-10.
- Betge-Brezetz, S, Dupont, MP, Ghorbel, M, Kanga, GB & Piekarec, S 2009, 'Adaptive notification framework for smart nursing home', in *Annual International Conference of the IEEE*, pp. 7244-7247.
- Boquete, L, Rodriguez-Ascariz, JM, Artacho, I, Cantos-Frontela, J & Peixoto, N 2009, 'Dynamically Programmable Electronic Pill Dispenser System', *Journal of Medical Systems*, vol. 34, no. 3, pp. 357-366.
- Crews, JE, & Campbell, VA 2004, 'Vision Impairment and Hearing Loss Among Community-Dwelling Older Americans: Implications for Health and Functioning', *American Journal of Public Health*, vol. 94, no. 5, pp. 823-829.
- England, K, & Dyck, I 2011, 'Managing the body work of home care', *Sociology of Health & Illness*, vol. 33, no. 2, pp. 206-219.
- Garcia-Aymerich, J, Farrero, E, Félez, MA, Izquierdo, J, Marrades, RM, & Antó, JM 2003, 'Risk factors of readmission to hospital for a COPD exacerbation: a prospective study', *Thorax*, vol. 58, no. 2, pp. 100-105.
- Ghorbel, M, Arab, F & Mokhtari, M 2008, 'Assistive housing: Case study in a residence for elderly people', in *PervasiveHealth - 2nd International ICST Conference on Pervasive Computing Technologies for Healthcare, IEEE*, pp. 140-143
- Green, BB, Cook, AJ, Ralston, JD, Fishman, PA, Catz, SL, Carlson, J, Carrell, D, et al. 2008, 'Effectiveness of Home Blood Pressure Monitoring, Web Communication, and Pharmacist Care on Hypertension Control', *JAMA: The Journal of the American Medical Association*, vol. 299, no. 24, pp. 2857-2867.
- Lee, Y, Tullio, J, Narasimhan, N, Kaushik, P, Engelsma, J & Basapur, S 2009, 'Investigating the potential of in-home devices for improving medication adherence', in *PervasiveHealth - 3rd International Conference on Pervasive Computing Technologies for Healthcare*, pp. 1-8.
- Leonhardt, S 2006, 'Personal Healthcare Devices', *Amiware Hardware Technology Drivers of Ambient Intelligence*, Vol. 5, no. 6, pp. 349-370.
- Lin, YJ, Su, MJ, Chen, SJ, Wang, SC, Lin, CI & Chen, HS 2007, 'A Study of Ubiquitous Monitor with RFID in an Elderly Nursing Home', in *International Conference on Multimedia and Ubiquitous Engineering*, Seoul, pp. 336-340).
- Nelson, ME, Rejeski, WJ, Blair, SN, Duncan, PW, Judge, JO, King, AC, Macera, CA, et al 2007, 'Physical Activity and Public Health in Older Adults. Recommendation from the American College of Sports Medicine and the American Heart Association', *Medicine & Science in Sports & Exercise*, vol. 39, no. 8, pp. 1435-1445.
- Pate, RR, Pratt M, BLAIR SN, Haskell WL, Macera CA., Bouchard C et al. 1995, 'Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine', *JAMA*, vol. 273, pp. 402-407
- Pickering, TG, Miller, NH, Ogedegbe, G, Krakoff, LR, Artinian, NT & Goff, D 2008, 'Call to Action on Use and Reimbursement for Home Blood Pressure Monitoring: A Joint Scientific Statement From the American Heart Association, American Society of Hypertension, and Preventive Cardiovascular Nurses Association', *Hypertension*, vol. 52, no. 1, pp. 10-29.
- Pitta, F, Troosters, T, Spruit, MA, Probst, VS, Decramer, M & Gosselink, R 2005, 'Characteristics of Physical Activities in Daily Life in Chronic Obstructive Pulmonary Disease', *American Journal of respiratory and critical care medicine*, vol. 171, no. 9, pp. 972-977.
- Wong, WCW, Shiu, IKL, Hwong, TMT & Dickinson, JA 2005. Reliability of automated blood pressure devices used by hypertensive patients, *Journal of the Royal Society of Medicine*, vol. 98, no. 3, pp. 111-113.
- Zarghami, A, Zarifi Eslami, M & van Sinderen, M 2011, 'What Do Homecare Provider Stories Tell Us about Dynamicity?', in *REFSQ 17<sup>th</sup> Intl. Working Conference on Requirements Engineering : Foundation for Software Quality*, Germany
- Zarifi Eslami, M, Zarghami, A, Sapkota, B & van Sinderen, M 2010, 'Service Tailoring: Towards Personalized homecare Systems', in *ACT4SOC Workshop, Greece*, pp. 109-121
- Zarifi Eslami, M, Zarghami, A, Sapkota, B & van Sinderen, M 2011, 'Flexible Homecare Application Personalization and Integration Using Pattern-based Service Tailoring Supporting Independent Living of Elderly with IT', in *IEEE International Conference on Computer and Information Technology (CIT11)*, Cyprus