Community alarms to telecare - The need for a systems strategy for integrated telehealth provision

Technology and Disability 14 (2002) 63–74
IOS Press

Community alarms to telecare – The need for a systems strategy for integrated telehealth provision

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Abstract. Telecare systems are increasingly being seen as a means of providing a cost-effective response to the increasing demands placed on healthcare provision. However, in order to meet all levels of stakeholder need, there is a requirement to adopt from the very beginning an integrated, system based strategy to the definition and development of the relevant technologies which brings together and takes account of such needs while supporting effective and efficient management of limited resources, both human and financial. In particular, the resulting system must facilitate an ability to respond rapidly and effectively to changes in client need occurring through time while giving the care providers and managers access to the specific information needed to support the most effective care provision and allocation of resources. The resulting system must also not only be capable of integrating future and developing technologies but also be able to encompass existing technologies such as community alarms. Based on ongoing research, the paper considers the implications of the introduction of such a systems approach to telehealth and telecare provision and the likely impact upon health care provision in relation to prospective stakeholders.

Keywords: Telecare, health informatics, intelligent monitoring, user attitudes, smart homes

1. Introduction

The United Nation's designated 1999 as the *International Year of Older Persons*, the aim of which was to promote the United Nation's Principles on Ageing [8], two of these aims were that older persons should:

- Be able to reside at home for as long as possible;
- Be able to live in environments that are safe and adaptable to personal preferences and changing capacities.

While these principles are set within the context of older people, they can be applied equally to all potential clients of telecare and offer a design goal against which to assess any proposed telehealth system.

Within the context of the paper, the terms telehealth and telecare are used rather than telemedicine to reflect the multi-disciplinary, and multi-professional, approach to care which extends across a number of different professions including medicine, health promotion, health administration, social services and information systems as well as encompassing unofficial carers. Many definitions of telehealth and telecare have been suggested [4,10], however, the definitions adopted here are that telehealth is [7]:

> *"The promotion and facilitation of health and well-being with individuals and communities, by use of telematic services."*

The term 'telecare' then refers to the branch of telehealth concerned specifically with the remote delivery

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ISSN 1055-4181/02/$8.00

of healthcare services into the home [5] and may be defined as.

> *"An holistic approach to the remote provision of healthcare, assistance and monitoring in a community setting, via the use of appropriate technologies, in order to assure client well being."*

The development of telecare has to date been relatively fragmented and centred around individual projects targeted at meeting specific needs in isolation [1,2,22]. The result is that system costs remain high, while system purchasers have limited flexibility or choice and have not in any real sense been able to develop means of matching technology provision to client need or of readily altering such provision as those needs evolve. The danger with such an approach is that both the purchaser of the technology and the intended client group lose confidence in the ability of the technology to meet their needs, further delaying its introduction!

It is therefore argued that what is required is a needs led and systems based approach to the development of technologies for telecare and telehealth which is structured around stakeholder need and which can evolve to accommodate changes in client need as well as to new technologies as they become available. Such a systems led approach would then support the best matching of technology to need in order to maximise resources, human, technical and financial, across a wide range of healthcare environments. As needs and technology evolve, the system would then be able to grow and develop to accommodate such evolution, ensuring the confidence of all levels of system stakeholders.

The provision of distributed intelligence through the telecare system also provides for a more integrated operation by effectively managing the available information in order to ensure access at any time by all system stakeholders to information relevant to their specific need [19,21]. System stakeholders would then be characterised by their individual requirement to access the various classes and types of data and information available on the system. This introduces the concept of stakeholders as 'data clients' requiring intelligent and secure 'data gateways' through which they would access such data and which would be configured to meet their need. Thus, the gateway associated with a client's home would only permit the onward transmission of certain data following agreement by the client while access to that data once it had been transmitted would also be controlled by an established need [18]. Table 1 identifies some of the principle stakeholders in the care process considered here.

The best established telecare type service currently in use in the UK and elsewhere is the network of community alarms which provide 24-hour support for clients while in their home. Such *'social alarm'* systems typically involve the use of a *'panic pendant'* or *'pull cord'* which enable the user to raise an alarm and to initiate a request for assistance via a hands-free telephone with an operator in a control centre. This operator then acts as an agent on behalf of the client in notifying care providers and, if necessary, emergency services. It is estimated that there are currently some 900 such centres operating throughout Europe, providing a service to 2 million households [11,17].

These and other systems which rely on the user to initiate the request for assistance rely on two major assumptions:

a) That the user is aware that there is a problem requiring external intervention.
b) That the user is capable of taking action to initiate the contact with the control centre.

These assumptions cannot be taken for granted. Thus an individual on a course of anti-hypertensive drugs may not be aware that their blood-pressure remains uncontrolled while an older person living alone who suffers a fall may be unable to reach and activate a push-button or pull-cord.

At the most sophisticated level, 'Smart Home' technologies offer the potential to provide support for a wide variety of individuals with particular needs such as brain stem injuries or severe physical disabilities. However, for a large number of individuals living alone such as the 'well elderly', this technology may well be far in excess of their current needs and in some cases may even be detrimental by depriving them of opportunities for physical exercise which would otherwise have existed.

In an earlier paper [21], the authors have presented an integrated systems architecture for telecare and telehealth. Referred to as CarerNet, its primary elements are identified in Fig. 1 and it is intended to provide a framework for the deployment of technology to meet client care needs. In doing so it makes use of both local and distributed intelligence to support care and service providers in meeting those needs. It is also suggested [3] that provided a holistic and integrated approach is adopted balancing the requirements of stakeholder groups such as social services, housing departments, health services and emergency services then telecare and telehealth systems could be a cost effective means of meeting the expressed wish of individuals to

Table 1
System stakeholders

Client groups	Healthcare professionals	Government
Healthcare Trusts & Co-operatives	Health Services	Pharmacists, Dentists, etc.
Social Services	Housing Departments	Housing Associations
Healthcare Administrators	Health Promotional Services	Emergency Services
Voluntary Organisations	Informal Carers	Family Members
	Technology Providers	

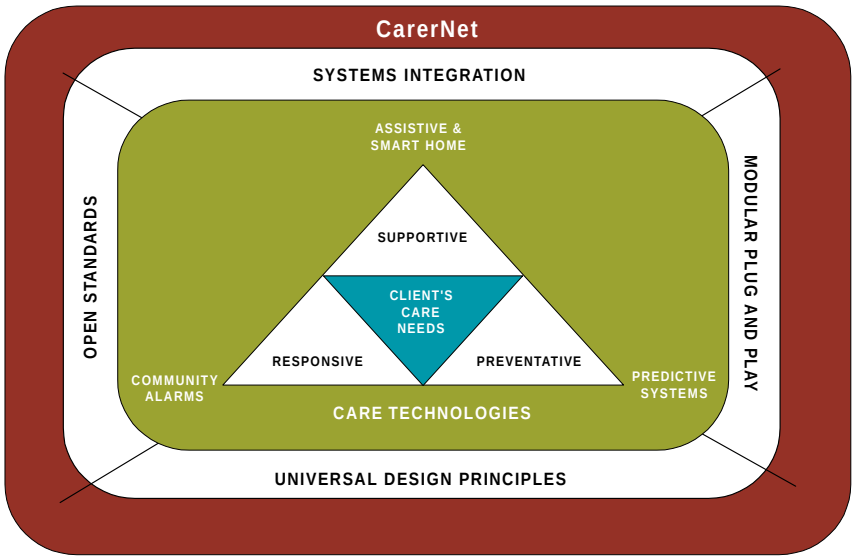

Fig. 1. CarerNet principles.

remain independent within their own home environment.

The achievement of a fully integrated telecare and telehealth system should therefore be considered as a long term goal in which developments in ambulatory monitoring, community alarms and smart technology have a significant role to play. It is argued that by adopting *ab initio* a systems approach to development, then this will result in viable and cost-effective systems earlier than would be possible if current, essentially independent, developmental strategies are maintained.

2. Motivators for change

The primary motivating factors in the moves towards the introduction of effective telecare systems may be summarised as follows:

- The increasing proportion of older people, and particularly the 'old elderly', in many societies.
- The increasing cost burden of high-technology hospital healthcare, with added pressure from suppliers of new and costly technology.
- The expressed desire of individuals to live independently within their own home environment for as long as possible, with a growing willingness to pay for care provision to enable them to do so.
- The restructuring of healthcare models with a move to home-based alternatives to acute hospital/institutional care.
- Increasing expectations for more and better care services which promote 'consumer choice' through provisions such as early discharge from hospital supported by home-based technology.
- Better utilisation of resources, for instance through a reduction in bed occupancy times.
- Increased involvement of both formal and informal stakeholders in the healthcare system.
- Support for a wide range of stakeholder clients from the 'well elderly' to individuals in palliative care.

To be successful in meeting these and other expectations, telecare must not only integrate new and developing technologies, but must also seamlessly integrate with current healthcare systems. This will require the involvement of those higher level stakeholders such as

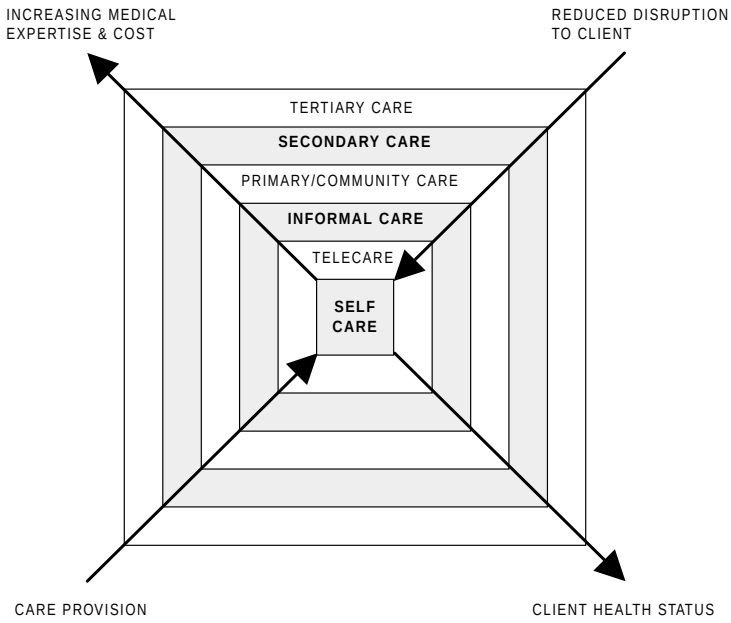

Fig. 2. A continuum of care.

Government, Healthcare Trusts and medical specialists responsible for the management and operation of the system and for the allocation of resources together with those who receive and respond to the information provided by client systems. In this context, Fig. 2 illustrates how telecare might be considered as a layer of care provision which as well as providing some direct care features such as alarms also acts to facilitate the communication between the client and the other layers within the overall hierarchy of care provision. In this context therefore telecare acts as a facilitator to provide relevant, and agreed, information between the client and outside care agencies as appropriate.

Above all however, the adoption of a telecare technology by an individual must not be seen as a *badge of need* but as something which will bring them positive benefits and enhance their quality of life.

3. Inhibitors to change

Incorporating an integrated telehealth solution within a social organisation such as healthcare inevitably constitutes a change to current clinical procedures and practices. Despite the fact that all those involved in addressing healthcare needs depend upon each other for the quality and timeliness of the key data and information, some stakeholders are likely to see such a change as a threat to their legitimate power [6], inhibiting 'telereadiness' and the system's equilibrium. In considering the use of the power concept in evaluating the impact of a telehealth environment on both patients and care providers, a number of power related inhibitors to change are noted:

- Ineffective management of change with a lack of clear operational goals and organisational targets coupled with ineffective communication between all levels of stakeholders. This leading to resistance by the 'grass roots' workforce who see powerful management as imposing technology to control and limit their autonomy.
- Erosion of a hierarchical management structure through technically enhanced collaboration between different facets of the organisation with indistinct boundaries between professionals. This blurring of the 'chain of command' then impacts on corporate responsibility by inhibiting change, for instance through fear of litigation.
- Shifting the reliance on communication with patients to dependence on data and information about patients while enabling better disease management and prevention and the detection of 'real time' emergencies. This also impacts on therapeutic interactions leading to resistance to change by both providers and patients.
- An economic and organisational structure that allocates responsibilities and resources in a way that inhibits co-operation and leads to competition for

financial resources between cost centres. This is particularly apparent where expenditure by one organisational cost centre generates savings not for itself but for other cost centres.

4. Telecare technologies

4.1. Community alarms

Since their initial introduction in the UK, developments in community alarms have been largely in terms of improvements in reliability and access. Over this period, there has been relatively little change in the function of the community alarm, the major innovations having been in the introduction of radio pendants and, more recently, speech activated systems together with a few added value functions such as smoke and gas alarms.

For community alarm systems to evolve they must become more responsive, reducing the dependence on user action. This should not however be achieved at the cost of the client losing control over their environment. Indeed, clients must always retain the option of turning the system on or off; in which case the control centre, along with all other relevant agencies, must be informed of this decision. It is also recognised that there may well be systems, for instance fire alarms, which must remain on at all times and hence cannot be under client control. Careful consideration must therefore be given to the balance of user controlled function and functions with a wider implication.

The introduction of advanced systems is also likely to impact on the way in which current human resources such as control centre operators and wardens function within the overall systems context. In particular, the introduction of technology should not be seen as a replacement for these individuals, but as a means of freeing up this human resource for more 'human based' activities by removing the need for them to perform essentially mechanistic functions.

Finally, such advanced systems must be seen to be cost effective, particularly given the likely increase in system costs resulting from an increased cost of technology together with additional maintenance, installation and operational costs. Studies by the authors [3] have suggested that advanced telehealth and telecare systems such as that illustrated in Fig. 3 showing the links between various stakeholder groups and based on the development of community alarms can result in significant savings over a 10 year period through reductions in the amount of time spent in hospital or delayed entry into care. A particular feature of such a system would be the ability to prioritise and automatically direct calls, for instance on the basis of criteria established and agreed between the client and a clinician.

4.2. Smart technologies

Smart technologies are a relatively new concept in the context of telecare and telehealth but are likely to play an increasingly important role in development [20]. The potentially large quantities of data which may result from a client with a high level of dependency on telecare has led to a model of distributed intelligence within the client's local environment [21]. Such intelligence manifests itself within sensors or therapeutic devices, together with a central information processor which is capable of making decision and reaching conclusions from rules programmed by healthcare professionals.

While evidence from interviews suggests that clients are ready to adopt healthcare technologies, this does not remove the need to work with clients in the development and introduction of what may, in some instances, be considered an intrusive device. Steps must therefore be taken to ensure clients are comfortable with the technology being provided.

As already indicated this means that the ultimate decision as to whether to use the technology must be left to the client. Thus they may opt not to turn-on, or to turn-off, a particular device, in which case this decision must in some way be recorded by the system. This can lead to very real conflicts at the system level as is illustrated by the following scenario.

> *"A client using a medical sensor chooses not to wear it on a particular day and leaves it on their bedside table. However, other possibilities are that the client has become ill or incapacitated and is unable to get out of bed or to summon assistance. The local system, on detecting that the sensor has not been activated by a particular time must then check to see if the client is active, perhaps as a result of data from motion sensors throughout the home. If activity is detected then the system should query the client as to their intentions with regard to the sensor. However, should no relevant activity is detected, the system should then seek to initiate a response from the client to confirm that they are alright and that they are aware of the situation. Failure to achieve such a response would then result in a call by the system to a warden, relative or neighbour to ask them to check on the client."*

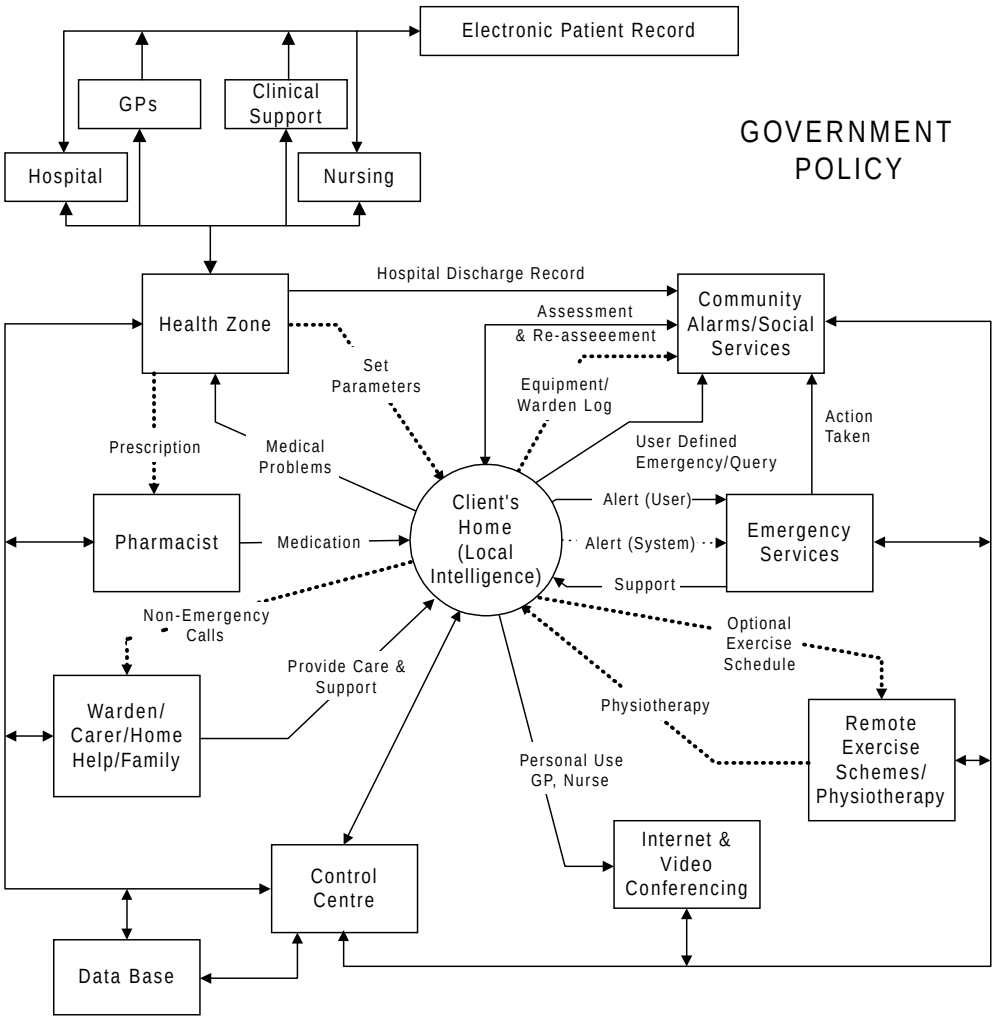

Fig. 3. System structure for advanced telecare.

The situation presented in this scenario requires that the local intelligence is capable of making sophisticated decisions from the interpretation of a range of data from a variety of sources. It is also important in relation to this, and the full range of other possible situations, that the client is fully involved in all discussions leading to the decision as to what information should be transmitted outside the home environment, and in what circumstances this transfer takes place.

5. Integrated telecare

Previous sections have suggested some of the areas of technology that are fundamental to the success and widespread adoption of integrated telecare systems having as their logical starting point client needs and requirements. Table 2 sets out some of the possible client groups to whom telecare might be directed and illustrates the diversity and range of provision required, suggesting an equally diverse range of telecare services. In general, the range of services that might be expected can be divided into the categories of *responsive*, *supportive* and *preventative* as in Fig. 4 and Table 3.

In practice, certain of these devices and systems require the presence of other systems in order to function. Thus the monitoring of *Activities of Daily Living* will require some form of activity monitoring system, which could also have a security role, and smart appliances. Solutions in zones A & B of Fig. 4 are therefore more device based while those in zone C are more system intelligence based, where parameters are derived from datasets provided by devices installed in the client's home.

Table 2
Telecare client groups

Client group
Individuals supplied with equipment as part of their hospital discharge plans to support early release.
Individuals who find themselves temporarily incapacitated.
Individuals who require some basic assurances and support in order to lead an independent lifestyle in their own homes – the 'well elderly'.
Individuals with mild forms of dementia who require some support to lead an independent lifestyle in their own homes.
Individuals undergoing needs assessment, perhaps following a change in personal circumstances.
Terminally ill individuals receiving palliative care at home.
Individuals considered to be at risk of accident or relapse.
Physically disadvantaged individuals.
Individuals suffering from chronic ailments such as diabetes, hypertension, bronchitis or asthma.
Individuals addicted to heroin or other drugs and who are taking part in a controlled course of treatment to enable them to control and manage their addiction.

5.1. Responsive systems

Current responsive systems are represented by first generation systems such as the community alarms already described and discussed. These systems provide a moderated response to a call for assistance, usually initiated by the client; although a number of *extended first generation systems* such as fall alarms which are compatible with first generation systems and which will autonomously initiate a call for assistance are becoming available [15,16].

Next generation systems featuring smart sensors and local intelligence will increase the capability of responsive systems. However, they will still essentially be calling for help from the extended carer network.

5.2. Supportive systems

Supportive systems are used where clients require aids to support themselves in an independent lifestyle in their home environment and may well be a means of breaking out of the *cycle of dependency* of Fig. 5 [12]. Supportive systems are likely to be particularly suitable for clients who suffer from some form of physical or mental incapacity and would include devices such as:

- Smart wheelchairs.
- Reminder systems for individuals suffering from dementia.
- Drug delivery and compliance monitoring units.
- Therapeutic systems such as a Transcutaneous Electrical Nerve Stimulator (TENS) unit for individuals with chronic pain.
- Biofeedback systems for stress control.

Conventional smart home technologies also have a supportive role, for instance for individuals with limited mobility or physical capability.

5.3. Preventative systems

Preventative care provision relates to situations where the local intelligence is responsible for inferring or deducing the current, and possibly future, status of the client from the available data as provided by monitoring and supervisory systems. For instance, by employing predictive indices based on the multi-variable analysis of local data it may become possible to predict the like occurrence for a particular individual of possible problems such as falls. By setting appropriate intervention thresholds in consultation with the client it is then possible to target care resources to those most in need, leaving others to care for themselves in the knowledge that assistance will be provided should the intervention thresholds be breached.

Such preventative systems may well form the basis of a more proactive and interventionist strategy for care in the community. This must however take place in the context of consultation and discussion with the system clients and be capable of accommodating client choice as discussed previously.

5.4. System integration

System integration addresses the means by which the various technologies comprising the integrated telecare system are brought together. At the level of the client's home, this is the combination of the home-based communications network and the local intelligence to provide the analysis and decision making capability.

Such a system has obvious parallels with Smart Home technology, and indeed it may well be possible to share protocols and media supported by a common applications language. However, until there is commercial adoption on a large scale of the proprietary standards that have been developed then such systems are likely to remain expensive.

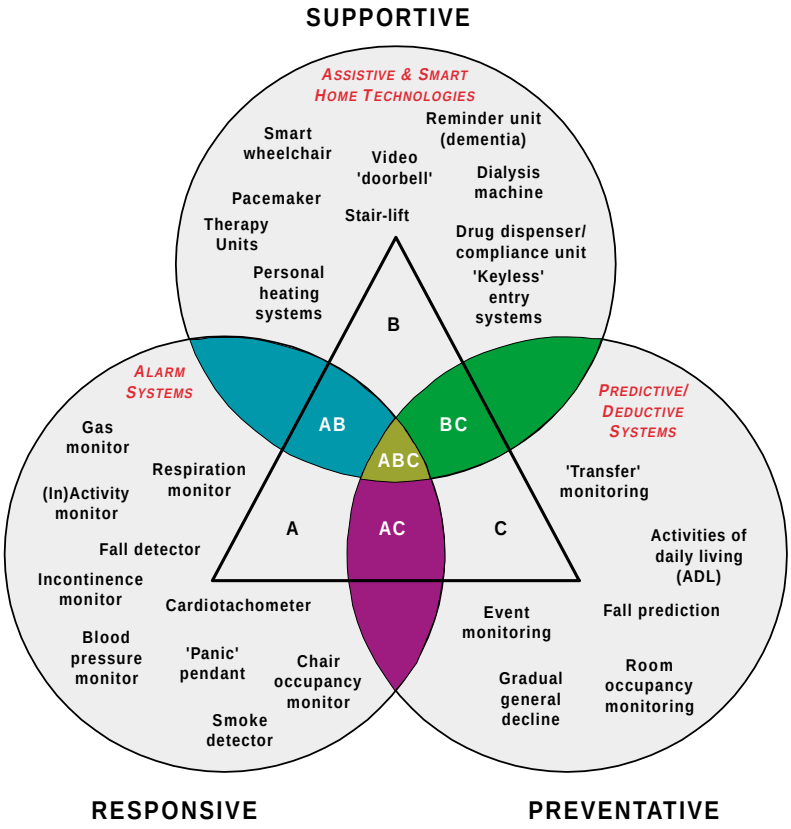

Fig. 4. Care options.

At another level, system integration means ensuring that there is the appropriate transmission and communication of data and information between system stakeholders. However, there remain significant issues to be addressed including:

- Data security and access and the definition of appropriate 'data clients' who can make use of specific items of information within a wider data base.
- Link between human and machine intelligence for decision support.
- Identification and resolution of conflicts – both technical and human.
- Information management and 'need to know'.
- The location of knowledge, both 'hard' and 'tacit' among stakeholders

One of the key elements in designing the system is to ensure that the maximum number of people can benefit from and use the system. All elements of the system, including the physical environment, should therefore be capable of evolving with an individual over their lifetime and of adapting, or of being adapted, to changing needs with minimum disruption and modification.

The concepts of Universal Design [13] are summarised by Table 4 and represent a set of goals against which any system may be evaluated and implies an adaptive system which is capable of expanding the range of services offered and supported as the client need develops. This in turn suggests a modular approach based on a 'plug and play' strategy which would also allow for the reallocation of resources as they are released, for instance following the removal of a component from the system. It would also support the configuring of systems to match individual needs by means of an 'off the shelf', building block approach following needs assessment.

However, any design process is also concerned with the identification and management of constraints and must inevitably involve compromise, for instance between achievable functional requirements, availability of technology, physical and other limitations and cost. It follows therefore that the strategy for systems integration must be accompanied by one for requirements capture and needs analysis in order to ensure that the necessary decisions are made early on in the overall process. The adoption of a formal systems approach

Table 3
Care provision for zones of Fig. 4

Zone	Situation	Provision
A	A middle aged individual discharged from hospital following cardiac surgery	Cardiotachometer Fall detector Panic pendant
B	An individual suffering from multiple-sclerosis	Smart wheelchair Some automated house functions
C	Individual being assessed for living alone following a change in personal circumstances	Activities of daily living
AB	Older individual living at home	Panic pendant Fall detector Video doorbell Drug compliance monitor
BC	Older person suffering from mild dementia	Reminder unit General long-term monitoring
AC	Older individual living alone requiring reassurance	Panic pendant Chair occupancy monitor Room occupancy monitor Security system Event analysis system Fall Detector
ABC	An individual post stroke	Activities of daily living Reminder unit Fall detector Chair occupancy monitor Room occupancy monitor Drug compliance monitor Virtual consultations Etc.

would support those involved in needs assessment in the mapping of individual need onto system functionality.

However, in pursuing the development of advanced, integrated telehealth and telecare systems the management of the increased complexity of such systems is of concern. A model of the behaviour of a control centre operating an advanced system of the form of Fig. 3 has been developed by the authors [23] and used in association with data from functioning control centres to assess the impact of such systems on their operation. Results from the model suggest that the ability of the advanced system to automatically prioritise and direct calls will serve to reduce the load on operators while freeing them to provide increased interaction with their clients.

5.5. Human aspects

Thus far, the emphasis has been on the provision of technology. However, the human aspects of the system must not be ignored, and indeed must be designed into any system. In particular, the balance between the need of each of the human stakeholders to access the information they require with the requirement to ensure the confidentiality of that information must be given special attention.

By treating such stakeholders as ‘data clients’ [14] the flow of information throughout the system and the use to which it is made can be considered. Once this has been achieved, then commonality between information flows and the means of handling these can be established.

It must also be understood that the primary objective of the adoption of the techniques and principles of telehealth and telecare is to use technology to provide better support for client need while at the same time maximising the utilisation of limited resources. This means that the system should be structured to enable individuals to become increasingly able to concentrate on the human aspects of their work in the knowledge that they have at all times ready and appropriate access to the information they require.

5.6. Information structures

The information structures associated with telecare are extremely complex, existing as they do on a number of levels. At the level of the client, the communication centres on individual needs and perceptions of need while at the highest levels the information being

Table 4
The principles of universal design (after [13])

Design principle		Description
1	Equitable use	Allows users to operate device or system with ease without stigmatising them.
2	Flexibility in use	Ensures that the product or system can be used by individuals with varying abilities, preferences and skills.
3	Simple and intuitive use	Employ a consistent user interface. Provide suitable prompting and feedback during and after task completion. Above all keep it simple.
4	Perceptible information	Multi-sensory approach to the presentation of information supporting user definition. Keep messages simple and clear.
5	Tolerant of error	Fail-safe approach with suitable and appropriate warnings and checks. Minimise adverse consequences of accidental or unintended actions.
6	Low physical effort	Easy to use and ergonomically effective design.
7	Size and space for approach and use	Access must be suitable for all users irrespective of personal circumstances.

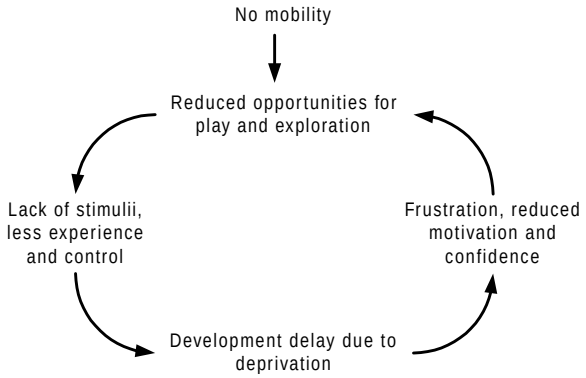

Fig. 5. The cycle of dependency (after [12]).

transmitted is concerned with the allocation and management of resources, human, physical and financial. In addition, the system stakeholders at each level have their own priorities in accessing the available data.

The telecare system must therefore be structured not only to support the flow of information at any given level, but also to ensure that there is a corresponding flow of information between the various layers in the system. This latter flow of information must be considered in relation to individual decision making processes to ensure that users have access to that information they consider to be necessary. It also leads to the possibility of the system itself acting to collate the data from various sources before presenting it to the user. However, for this to be possible the relationships between the various types and layers of information must be established.

6. User perspectives

Attitudes towards technology were found to be a key determinant of the effective use of computers in the work place [9]. It is suggested that positive attitudes may also have a key role in clients' acceptance and willingness to use home based healthcare technology. Knowledge of the distribution of positive and negative attitudes to technology and telecare was gained through analysis of a questionnaire which was specifically developed following a qualitative analysis of interviews with potential users. This data collection tool was distributed amongst selected groups of older people (over 60 years) residing in Scotland in two geographical areas.

The questionnaire contained 6 sections to enable the capturing of comprehensive and rich data which included: demographic details, opinions about technology in general, feelings about their current home, views on the future use of technology in providing support at home, communication and source of advice regarding home care technology. The 199 returned questionnaires (42%) were analysed using SPSS, a computer statistical analysis package.

Using descriptive statistics to chart responses suggests that older people have little enthusiasm towards learning about new technology. Indeed, the great majority of respondents felt that they were too old to learn about new technology and that using digital means of communication was best left to 'younger folk'. At the same time however, nearly all subjects (94%) agreed that current domestic technology assists in making their lives more pleasant. Inferential statistics revealed interesting distinctions between various groups in the *non-homogenous* group of subjects. It also assisted in building a profile of those individuals most likely to be receptive to future telecare use.

These latter individuals will tend to be younger (under 80) and be satisfied clients of current healthcare services. Regardless of their gender they are likely to perceive themselves as having good mobility as well as a good ability to express themselves over the telephone. They are more likely to be home owners, generally

living with a partner, and to value their autonomy in deciding whether to take risks at home. They are also likely to appreciate the benefits of using current domestic and home technologies and would feel reasonably exited about learning about new technologies. They are likely to express a wish to stay at home for as long as possible even when they need a lot of help or have to pay for care. They are nevertheless likely to expect the government to pay for healthcare technology and would resent having to pay for it themselves. They are also keen to use an interactive communications system for both social interaction and medical consultation.

The general conclusion from the above is that while the 'old old' are relatively reluctant to adopt new technologies, the 'younger old' express a positive attitude towards technology. If this attitude is maintained, and there is no reason to suggest that currently receptive individuals will change their opinions with age, then this suggests that individuals in this younger age group will increasingly welcome the intervention of technology in providing care and support. A limitation of the study is that it made no attempt to assess actual use but concentrated on establishing attitudes, which could be different to use. However, as already noted above, studies [9] suggest that attitude towards technology can be a significant factor in determining its use.

It is argued that such knowledge about prospective client groups will aid the understanding required to underpin the design, development, implementation, uptake and use of future telecare systems and services. It may also enable better future use of scarce resources through matching design, training and education appropriately to specific users' needs.

7. Conclusions

Telehealth and telecare have significant potential to contribute to healthcare provision by ensuring that the best match of resources to client need is achieved while freeing those responsible for the provision of care from its more mechanistic elements. However, in many of the model environments studied thus far, the emphasis has largely been on the nature of the technologies of telemedicine and telecare rather than on a system structure. By adopting a systems approach from the outset it is believed that it becomes possible to define an integrated care environment which is sufficiently flexible to allow the introduction of new technologies as they become available while creating the associated information and management structures that are required.

It is argued that while such an approach is useful in gaining understanding as to how technology might be deployed and of the levels of functionality that are required, it is only with the provision of such technology within an integrated systems framework incorporating a holoistic approach to funding and management that telecare and telehealth will be able to make a significant impact on care provision and management. Unfortunately, current funding models do not always support such an approach and indeed may mitigate against investment where savings occur in a different funding area to that incurring the expenditure. Thus, while the investment in new technology may come under social services or housing, the savings may very well acrue in areas such as health, requiring the funding structure to be modified accordingly.

It is recognised that human factors play an important role in the operation of any healthcare system with the direct contact between a client and a district nurse, health visitor or a housing warden often having a major therapeutic role. By ensuring that the district nurse, warden and other care professionals have access at all times to all the necessary information, it perhaps becomes possible to free their time to increase their level of interaction within their client groups.

Thus, while the development of technology remains perhaps the most important driver in the development of a telecare system, it is the deployment of that technology with a human centred system model that is going to enable it to be widely accepted and used effectively.

Acknowledgements

The authors would like to acknowledge the support provided by the Engineering and Physical Sciences Research Council, Pentyre plc, Human Resources plc, TeleLarm Care Ltd., Tayside Primary Healthcare Trust and the University of Abertay Dundee for their support and would also like to thank Technology In Healthcare Ltd. for their input.

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