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Telehealth Standards Directions Supporting Better Patient Care

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Abstract

Conventional Telehealth activities aim at providing variants of existing health services at a distance, by adopting various telecommunications technology solutions for linking clinicians with patients or patient-related information held elsewhere. Here we consider an approach for defining a view of Telehealth which is broader in scope, based on the different component factors which constitute a Telehealth activity rather than on pre-existing clinical processes. This approach provides a more constructive (bottom-up) environment in which the development of new Telehealth-enabled patient centred models of care is feasible. A taxonomic framework and related concepts corresponding to this approach are described, within which the development of generic standards for Telehealth activities could be undertaken. Some examples of new Telehealth initiatives which would rely on such standards are provided.

1 – Objective:

This paper discusses a new approach to representing knowledge about Telehealth activities, prompted by recent Australian standards development efforts [1]. This approach relies on the definition of a generic taxonomic framework for consideration of Telehealth activities. This framework is based on the various component factors which constitute a Telehealth activity, rather than on specific clinical processes. Consequently this approach provides a foundation to extend the scope of Telehealth to permit various patient-oriented modes of interaction to be included. Examples of the approach applied to patient health monitoring and personal health records are described.

2 – Background:

Telehealth (or telemedicine) has long been advocated as a means for improving the quality and efficiency of health services delivery. The established view of Telehealth has been that it enables existing forms of interactions between health service providers and their patients to be delivered at a distance, through telecommunications-based activities such as teleconferencing and telecollaboration. Customised approaches to achieve this have been adopted within some clinical specialities (e.g. telepsychiatry, teledermatology) and in particular types of clinical service settings (e.g. teleconsultation, telecare) [3]. Generally these approaches closely follow the process and details of the underlying health service activity, and their operations are centred on the role of the health professional(s) undertaking that activity. Sometimes guidelines for clinical practice are produced which tend to reinforce the conformance of the Telehealth version of the activity with the normal version, usually from the perspective of the responsible clinician controlling the activity.

There are two major limitations arising from this situation. First, the clinician-oriented (or clinical process-oriented) approach to defining Telehealth activities does not provide sufficient flexibility to allow new models of care to be catered for easily. For example, a patient logging their vital signs measurements daily in order to receive health status assessment from a remote computer system would require consideration of different aspects of their Telehealth environment than if they were interacting over a turnkey clinician-patient teleconsultation service. Second, the development of guidelines per clinical speciality rather than generalised approaches restricts good practices from being widely adopted by other specialities and inhibits the emergence of broader standards. For example, guidelines for the acquisition of digital images as part of a Telehealth activity could vary widely according to the clinical area (e.g. wound healing vs opthalmology),

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yet wider adoption of such methods would be assisted by developing a standard which identified which factors pertaining to image capture needed to be specified for a given area (irrespective of the actual values chosen).

Noting these limitations, it is perhaps not surprising that there are few widespread formal standards in place which are directly applicable to Telehealth activities [4]. Recent survey work by the Standards Australia IT-14-12 Subcommittee on Telehealth [1] has resulted in a proposed framework for discourse on Telehealth activities, with a view to informing future standardization efforts. This approach provides a constructive (i.e. bottom-up) environment with multiple dimensions (or perspectives) within which appropriate concepts may be located. We will describe the framework and related concepts in the section below.

3 – Methods:

A natural way to divide up the space of Telehealth is to recognise that there are two considerably different "applicability" domains which have fundamentally different views of what constitutes the characteristics of interest in a Telehealth system:

- the "Tele" (or data) domain includes technical scientific and engineering characteristics (e.g. information or equipment related aspects, including software, telecommuncations, human factors);
- the "Health" (or usage) domain includes clinical or applications aligned characteristics (e.g. health care processes and systems).

If there is ambiguity about which domain is more appropriate, one should consider whether the item of interest is specific and unique to the health care environment, in which case the "Health" domain might be deemed more appropriate for it. For example, the choice of a videoconferencing configuration which will provide acceptable quality for human conversational interaction may be associated with the "Tele" domain, while the acceptability rating of image quality (including resolution and lighting/colour) to allow remote clinical decision making for trauma cases may be associated with the "Health" domain.

Within these two primary domains, we next identify major subsets associated with functional differences corresponding to the time sequenced nature of tasks in both of the domains. In the "Tele" domain, the functions deal with stages in the handling of data during a Telehealth process, while in the "Health" domain, they deal with stages of severity and complexity of intervention in the treatment of patients. Each of these functional stages is then broken down further into components and sets of standards or standardisible tasks can then be described for this level. The table on page 3 provides a map of the existing and potential standards space using this taxonomy.

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DOMAIN	FUNCTION	COMPONENT
Tele (Data)	Capture	Physical Characteristics e.g. colour, measurements Device Types e.g. audio, image, video, sensors
	Storage	Compression e.g. JPEG, MPEG Content e.g. regions of interest, physiological signals
	Transmission	Coding e.g. protocols, packets, errors
	Processing	Transforms e.g. scaling, noise
	Quality	Display e.g. screen properties Observer e.g. subjective opinion
Health (Usage)	Assessment	Clinical guidelines Screening/consultation Telepresence/robotics
	Diagnosis	Reporting guidelines Remote testing and imaging Decision making and expert consultation
	Treatment	Prescribing and medication Formulation of care plans
	Management	Execution and modification of care plans Coordination of multiple carers
	Monitoring	Recording from medical devices Messaging / terminology Analysis of data, images, signals Carer-patient e-mail/web usage

In addition to understanding the landscape of Telehealth according to this taxonomy, we also need to consider aspects of use and performance which make a Telehealth system "fit for purpose" in given operational circumstances. The following concepts address this need.

The association of a Telehealth activity with an underlying clinical task requires us to identify the various elements of health data handling at which different Telehealth interventions are possible:

- *Gathering* of patient health data by observations and devices (including images and test results)
- *Transfer* of patient health data (i.e. communication) between health personnel and/or computer systems
- *Aggregation* (or summarisation) of patient health data to exclude redundant details
- *Extraction* of higher level information from data to use in supporting clinical deliberation
- Clinical *Decision* making based on communication and follow-up between health parties
- Clinical *Evidence* discovery from patient data and supporting population and longitudinal studies.

For example, observations made by the consulting clinician during a telepsychiatry session may constitute a data *gathering activity*; investigating long term correlation of patient behaviour patterns with medication dosage levels via a multi-party expert conference may be seen as an *extraction* activity, and discussion of the care approach needed for the patient with other members of the care team may be seen as a *decision* activity.

Next we must consider how to characterise the various modes of *participant action or interaction* which occur between the various potential parties in a Teleheath situation:

- *Patient Self-care* (e.g. wellness programs; personal health records) where there is mainly patient-computer interaction and the computer system provides advice and direction (although a health professional may also be involved in the overall activity);

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- *Carer-Patient and Clinician-Patient* (e.g. home telecare; remote assessment) where there may be some Telehealth patient-computer (or patient-carer/clinician-computer) information gathering aspect, and some Telehealth interaction between one or more supporting carers or health care professionals and the patient.
- *Carer-Carer, Carer-Clinician and Clinician-Clinician* (e.g. care planning; case review) where Telehealth interactions are between health care personnel for direct health care purposes, such as managing delivery of health care services to the patient.

It is possible that an autonomous system (such as a medical device or a computer) could take the place of one of the carer or clinician parties in the above options, serving as an "agent" or surrogate for human presence. It is also possible that two devices might communicate directly with each other on behalf of a patient, carer or clinician (e.g. for active continuous monitoring of patients). However, at some point the process must be grounded in a human interaction of one of the above three mode categories.

Overlaid on the space defined by the above concepts are numerous technical factors: that is, the details of structure or operation of the enabling technology, in order to realise the particular Telehealth activity. Some of these factors are:

- Timing: whether the Telehealth interaction takes place in real-time (synchronous, such as teleconsultation) or separated (delayed) in time (asynchronous, such as telepathology)
- Medium: how the interaction is conveyed, such as by voice, video, tactile device, physiological signals
- Mechanism: which type of capture and presentation (display) devices are used for the interation, such as a videoconferencing unit, webcam, PDA, wearable sensors
- Channel: which telecommunications means is employed to deliver the interaction, such as broadband, network, wireless, store-and-forward
- Performance: how the operational criteria for the interaction are specified, such as reliability, affordability, quality-of-service, error rates and recovery
- Human: how the user related aspects of the system are specified, such as user interface, realism, useability, acceptability.

A vast body of technical knowledge exists for these areas, and specifics are best addressed by the appropriate technical specialists. This is an aspect in which Telehealth must fall back on the more general engineering or scientific foundations of the Health Informatics operational environment in which it exists.

4 – Results:

Using the above sets of concepts we can readily envision other forms of interaction between parties beyond the typical Telehealth activities of today, including:

- *large-scale multiparty interactions:* e.g. care team planning sessions, multidisciplinary team diagnosis, multisite (patient/physician/specialist/nurse/carer) consultations;
- *augmented reality interactions:* e.g. portable medical device inputs, haptic/tactile sensations, telepresence/realism enhancements, critical care situations;
- *automated or virtual interactions:* logging of patient data by ambulatory monitoring, smart environment devices, home telehealth stations, patient surveillance.

Some of these require a more patient-oriented view of the circumstances within which the Telehealth activity takes place. We will now consider two examples of these, to illustrate the usefulness of the above framework.

Much effort is currently being invested in *home-based health care*, with an expectation that telemonitoring of a patient's personal situation, including changes in health condition, response to medication and treatment, and adherence to care plan or lifestyle choices, will be achieved by Telehealth means [2]. This could consist

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of *gathering* patient physiological information using sensory devices (or a "smart home" environment), and feeding this to a summarisation computer program for *aggregation* and *extraction*, followed by conveyance of reporting and advice *decisions* back to the user. In the Health domain, this constitutes *monitoring*; in the Tele domain it covers most functional areas. The types of standardization that might be required will therefore be better linked with the Health domain: for example, one could envisage specifying what types of physiological data should be collected for a range of patient types or device types. The activity is inherently linked with the *patient self-care* mode of action, and so the design of the application would need to be based on appropriate user requirements models for this.

Another area of contemporary interest is the development of *personal health records* (PHRs) which would enable individuals to understand and manage their own whole-of-life health microcosm [5]. While potential elements for PHR standards are under discussion, there has been little progress in defining standards environments in which they might be captured, updated or exchanged with other forms of health data repositories. A Telehealth activity might be provided through a remote software application, so that individuals could systematically work through their personal health histories using the application to access other stored data securely, and to guide or prompt them intelligently in that process. In the Health domain this constitutes a *management* activity, while in the Tele domain it is a *storage* activity. This is another example of the *patient self-care* mode of operation, and involves chiefly data *gathering* actions. The anticipated opportunity for standardization would therefore be aligned with the way in which a patient could most efficiently and intelligibly proceed through the data space, allowing personal variation to the sequence of tasks rather than enforcing a rigid "form-filling" kind of approach.

These two examples underline the importance of empowering the patient by enabling access both to data and to the processed or interpreted results derived from that data. In both cases, a higher level of care could be achieved by making use of the richer personal data that would become available for that patient, to customise and adjust their health care regime. In practice it would be highly desirable (at least initially) that such systems should be set up with a means of human oversight or intervention. This opens a promising new door for Telehealth, in the same league as the health call centres which have proliferated, in the form of health expertise portals and health coaching.

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