An introduction to telehealth and remote monitoring and SNOMED CT

High level overview – history – mode and formats of applications – technology – options for interoperability

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Telehealth/Telecare definition

Below definition is based on the unofficial draft TelesSCoPE code pending approval and adoption of European Union member countries later in 2013.

Telehealth provides the means by which technologies and related services concerned with health/social care and well-being are virtually accessed by people, or through appropriate and competent professionals, totally independent from the distance of carer and patient/user. People who use telehealth services will normally be at (care-) home, in work, on the move or otherwise involved in their normal day to day family, social or economic activities.

Telecare definition is similar to above involving additional services for either speech intervention (by means of virtual video conferences), compliance surveillance of medical treatment (such as electronic pill boxes), electronic prescription services, or remote dispensing of medicines.

*Co-Director of the Age Research Centre at Coventry University (UK), and coordinator of the European TeleSCoPE project

Invited by M Fisk*
The following presentation will cover:

• brief history relevant to development of current telehealth services

• current application of telehealth services

• potential for extension of telehealth/telecare services using terminology

• future communication and interoperability of telehealth services

• how of the above can be achieved by implementation of currently available standards

• the need to build new devices to meet all requirements

• how to achieve communication interoperability using SNOMED CT between different care services and their data systems
Serving in the Council of Telemedicine and eHealth since 2003:

- Government liaison officer
- Representative of the library virtual user group of the Royal Society of Medicine (RSM)
- marking proffered research papers

Submitted 2011
How it all fits together

SNOMED CT (Systematized Nomenclature for Medicine – Clinical Terms) was first devised by the College of American Pathologists (CAP – until 2007) to provide an encoded medical terminology which encompasses all aspects of all medical, social care, vital signs and symptoms, clinical findings (including all disorders and their stages) and procedures as well as areas of veterinarian care. SNOMED CT was first released in 2002 after merging SNOMED RT (Reference Terms which was invented, developed and devised by Dr Roger Coté in Canada starting from SNOP and SNOMED) and READ CTV3. As an encoded terminology, SNOMED CT provides content for an interoperable messaging service based on different information models.

SNOMED CT is incorporated into the IHTSDO (International Health Terminology Standards Development Organization) a Danish company. The UK is a stakeholder and member of the IHTSDO. All NHS organisations in the UK are represented by the UK Terminology Centre. The other member countries of the IHTSDO are: the UK, Canada, Denmark, Sweden, The Netherlands, Lithuania, Slovakia, Slovenia, Cyprus, Singapore, Australia, Spain, and the USA. The non-English speaking member countries are still in a minority, partly because of translation issues with SNOMED CT and partly because of not having nationwide systems able to communicate with each other via messages using encoded terminology; the latter is the case in Germany.
How it all fits together

IEEE-11073 is a technical standard for connectivity profiles of medical devices. It describes the particular characteristics of the device measuring the vital signs or other data being recorded so that a clinician can see which device measured a particular parameter, how, and when. This is now incorporated as a British Standard too, as BS11073.

HL7 (Health Level 7) in particular version 3 is a carrier for SNOMED CT in co-implementation of systems according to IEEE-11073 – it is far more efficient at exchanging information between systems than XML, which is especially important for low power or other battery-life-sensitive equipment.

The last piece of the jigsaw is Continua, which is increasingly mandating the use of IEEE11073/SNOMED CT via HL7v3 as the universal interface between medical devices and systems. Continua Health also assess and certifies systems against their own device design guidance.
eHealth & Telemed 2012
3 million and rising: Integrating care, mainstreaming technology

This year’s conference focuses on an issue raised recently by the Department of Health that at least three million people in the UK with one or both of long-term conditions and social care needs could benefit from the use of telehealth and telecare services. And excellent there - as life expectancy grows so does the incidence of long-term conditions and the development of greater social care needs.

This conference will explore how telecare and telehealth can help address this issue. It is designed to bring together the whole telecare and telehealth community from frontline workers to national decision makers.

Key Objectives
1. Give concrete examples of care pathway transformation to show it is achievable.
2. Demonstrate potential for further transformation, including care service and organisational transformation.
4. Engage patients and their carers.
5. Demonstrate improved financial outcomes for the whole healthcare system.
6. Reinforce the RCN’s educational role for new healthcare technologies.

Social Event – Monday 26 November 2012
This year’s social event will take place at the Royal Society of Medicine on Monday 26 November 2012. The event will be held at the RCN to coincide with the rest of the conference.

Making it happen

1.50 pm Telehealth implementation in Europe: A summary
Mr Marco d’Angelantonio, Managing Director, HIM SA, Brussels

2.10 pm Telehealth implementation in Denmark
Mr Claus Pedersen, Head, Department for Clinical Innovations, Odense University Hospital

2.40 pm Telecare technologies and the transformation of healthcare
Professor Nelly Oudshoorn, Professor of Technology Dynamics and Health Care, University of Twente, Netherlands

Implementing telehealth at scale
Mike Worden, Head of Clinical Support Team, Tunstall Healthcare and Andrew Corbett-Nolan, Chief Executive, Good Governance Institute

2.20 pm The role of eHealth and telemedicine in a rapidly changing world
Lord Nigel Crisp, Cross Bench Peer, House of Lords

Using smart technology for smarter living
Mr Guy Giles, Programme Director, Looking Local

2.40 pm Telehealth, telecare, the hardware: The past, present and future
Mr Paul Marriott, Project Manager Telehealth South of Tyne and Wear
NHS South of Tyne and Wear

3.00 pm The app revolution
Mr Roger Donald, Head of Digital Delivery, NHS Direct Southampton
Aims of successful telehealth/telecare services

• Focus on the care, not the technology

• Use telehealth to support and extend patient care services (e.g. decision support, point of care systems)

• Telehealth to enable instant access to all types of health and social care on a virtual basis, globally, regardless of the communication technology

• Clinical audit process should easily adapt regardless of delivery

• Clear policies, procedures and standards must be complied with

• Appropriate training for both clinical and remote care staff

• QA monitoring is key
Q: Where is the documentation about the Patient’s mannerisms and possible records of abnormal behaviour as elements of a classic psychiatric assessment / interview?

...you can clearly interact with the patient to pick up mannerisms and hidden clues, which aids me to come to my diagnosis...
History and background for the development of telehealth services
The classic telehealth communication device
The classic telehealth communication device: Technical upgrades

POTS - ISDN

**ISDN Integrated Services Digital Network**

In this example a total of 10 analogue have been reduced to 2 ISDN2 (4 lines), resulting in a significant saving on line rental costs.

However, the biggest benefit is the company is now receiving DDI (Direct Dialling Inwards) and CLI (Calling Line Identity).

If you would like to discuss the benefits of ISDN, call (0845 0723777).
ISDN still available today

Q: Does ISDN interoperate?
Early mobile cardiovascular resuscitation services
History:

1950s
USSR

Moscow:
Development of mobile Cardio-vascular resuscitation/responder units
History:
1960s
USSR

Telehealth application – Vital signs

Third degree block Diagnosis

monitor and document P-waves
1960s Telehealth applications/remote monitoring:

History: USSR and surveillance of Cosmonauts

Today: Russian Federation and some CIS countries

Practical application of telehealth:

Current systems in remote territories of Russian Federation

Focus: Where is data collected and what is the mode of recording? Which data type?
Telehealth/remote monitoring today
Video 1:

- Telemedicine Centre –
- Mobile Consultation and
Diagnostic Centre
Russian Railways -
In late 1960s oil and gas were found under the seabed of the mid and northern North Sea.

From 1975 the first supply of oil from these fields were brought onshore into the UK.

Aberdeen in Scotland became the centre for launching oil rigs first in the northern North Sea and later wherever oil rigs were needed.

As the oils rigs became larger both in size and number of staff, the provision of health-/occupational care was required
The classic issue:
dealing with emergency – medical/security

high costs??

Telehealth application
Goose Bay Air Base

1078m

810m

200m off Nuuk

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Telehealth/remote monitoring today
1. What is the purpose of telehealth application?
   The profile of different telehealth applications
   Which plug-in devices?
   Which data is produced?
   Data storage?

2. Practical application of telehealth:

   Current systems in remote Scottish Highland territories
Issue of telehealth records:

• reports by e-mail means unstructured data representation and will require
• double or multiple re-entry of telehealth data

**Aim:**
One health data entry for all clinical and other care services (also telehealth)
Issue of telehealth records:
- double or multiple entry of telehealth data
- paper records

instead

Aim:
One health data entry for all clinical and other care services (also telehealth)
Q: How do these data update the patient record within the EHR?

Read = Read only?

Clear = delete

? How is the measurement data recorded?
other ways to provide telehealth services
Remember all medical assistance provided by C.I.R.M.
is completely free of charge

<table>
<thead>
<tr>
<th></th>
<th>612068 C.I.R.M. I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telex</td>
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<td>E-mail</td>
<td><a href="mailto:telesoccorso@cirm.it">telesoccorso@cirm.it</a></td>
</tr>
</tbody>
</table>

Italian Radio Coastal Stations asking for C.I.R.M.

WHEN REQUESTING RADIO MEDICAL ASSISTANCE COMMUNICATE THE FOLLOWING INFORMATION:

Regarding the ship:
name, international call sign.
Position, port of departure, destination, expected time of arrival.
Medicine chest available on board.

Regarding the patient:
Date of birth, nationality, rank
temperature, blood pressure, pulse and respiratory rates.
Onset the symptoms, accurate description of symptoms, location of pain, associated symptoms.
Other medical problems of the patient, with special reference to drug or other allergies, chronic illness and their eventual treatment.
In case of accident, where and how it took place.
Therapy already administered to the patient.

Q:
Does this service provide an option to interoperate with EHR/EPR data?
Future ways to provide telehealth through radio communications
...is a digital radio modulation standard using all traditional radio frequencies, including those of the AM band: Shortwave, Mediumwave, Longwave (Low Frequency [LF] and veryLF [vLF] 30-20 kHz; the latter could communicate to submarines, during diving status)

The format of MP4 standard (audio) would allow interoperative communication in form of a sideband allowing textual as well as text-to-speech (TTS) and speech-to-text (STT) content (Bandwidth limited to 9kHz; in North America 10kHz).
Current operating stations using DRM standard on 252 and 261 kHz (1.0 and 2.5 MegaW radiating power)
Telehealth provision through phone and tablet based medical applications for both care and well-being
Current Point of Care Systems

Example of a standalone blood pressure system which is the first system allowing input of observational devices but can only e-mail values and cannot be SNOMED CT enabled
Example of well-being electronic device: Blood pressure port and cuff data entry – data history/profiles– mode of data transmission -
Blood pressure port and cuff
- Presentation of data – unstructured data for transmission -

Q: How to populate a structured health database based on these records?
Refining telehealth provision:
• adding necessary remote examination in addition to telehealth consultation
• creating and communicating telehealth records and additional remote examinations to record and update EHR/EPR

Own publications:

Examples of my work in telehealth using SNOMED CT
Second Scenario: Telehealth *with* SNOMED CT – e.g. Teleconferencing

- Big screens to capture facial mannerisms, tics, automatisms
- Documentation with support of voice recognition and imaging and video recordings (to demonstrate the activity or inactivity of mimic muscles)
- Use of standardised terminology (which can be understood between regions and nationwide)
- Use of coded terminology (such as SNOMED CT)
- Identify both the psychiatric procedure as well as the clinical findings
- Send both the procedure description as well as the finding to update the EHR

Abbreviated SNOMED CT syntax

```
183928007 | residence remote from medical care | : { 363589002 | associated procedure | = (165172002 | diagnostic psychiatric interview |, 363589002 | associated procedure | = 601011000000118 | assessment via video conference encounter type | ) ) }
```
Extension of Telehealth Services with SNOMED CT

Long term remote patient care:

Adjuvant biochemical eHealth-enabled Point of Care analysis of patient blood as surveillance of Lithium Therapy (plug-in to Telehealth Hub)

1. Documentation and Capture clinical finding due to Psychiatric interview:
   76105009|cyclothymia|

Abbreviated SNOMED CT syntax

275917000 | lithium monitoring |: {363589002 | associated procedure | = 386457009 | surveillance: remote electronic |
   |, 363702006|has focus | =15220000 | laboratory test |, 
   | 260686004 | method |
   | = 54392006 | lithium measurement |, 363714003|interprets | |
   | = 77056006 | atomic absorption, flameless type |: 
   | 116686009 | has specimen| = ( 123038009|specimen |: 
   | 370133003 | specimen substance | = 256906008 | blood material |
   |, 246093002|component| = 85899009|lithium|), 
   | 272391002 | measurement | = ( 258813002 | mmmol/L | = 0.6 |
   | )}
## SNOMED CT – Enabled Point of Care Systems:

### Abbreviated SNOMED CT syntax

<table>
<thead>
<tr>
<th>eHealth Device reading</th>
<th>SNOMED CT output (post coordinated syntax)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thromboplastin test</td>
<td>15220000</td>
</tr>
<tr>
<td>PT = 12 sec</td>
<td>INR = 3.1</td>
</tr>
<tr>
<td>Blood pressure reading</td>
<td>46973005</td>
</tr>
<tr>
<td>Systolic pressure = 120 mmHg</td>
<td>Diastolic pressure = 80 mmHg</td>
</tr>
</tbody>
</table>
Required Standards

- HL7v2 messages
- HL7v3 messages (HL7 RIM)
- CDA (r2)
- CEN / openEHR format Entries/ ISO EN13606
- Proprietary data, converted to XML
- PDF

Information Model Artefacts: HL7 Domain Message Information Model (DMIM) to HL7 Hierarchical Message Definition (HMD)

Such as Vena Platform for Telecare services

Other future platforms: issue – interoperability according to standards
Requirements for International Use

Assumption: device output according to Continua Healthcare Alliance Certification White Paper v 1.0 and Design Guidelines 2010 using openEHR
Current SNOMED CT hierarchy concerning telehealth

138875005 :S=R-00000
SNOMED CT Concept

71388002 :S=P-00000
Procedure

128927009 :S=P-00999
Procedure by method

386053000 :S=P-009B4
Evaluation procedure

185316007 :S=P-00847
Indirect encounter

11429006 :S=P-00130
Consultation

386472008 | telephone consultation |

71388002 | procedure |

128927009 | procedure by method |

308335008 | patient encounter procedure |

14736009 | patient evaluation and management |

185317003 | telephone encounter |

185317003 | telephone encounter |

Telehealth (Telemedicine)
Procedures with respect to electronic devices
Current SNOMED CT hierarchy concerning telehealth

138875005 :S=R-00000
SNOMED CT Concept

473199000 | telehealth monitoring for chronic disease |

71388002 :S=P0-00000
Procedure

71388002 | procedure |

243120004 :S=P0-000DC
Regimes and therapies

243120004 | regimes and therapies |

128927009 :S=P0-009999
Procedure by method

128927009 | procedure by method |

239516002 | monitoring procedure |

386053000 :S=P0-009B4
Evaluation procedure

386053000 | evaluation procedure |

239516002 | monitoring procedure |

182777000 :S=P0-007D9
Monitoring of patient

182777000 | monitoring of patient |

170549007 :S=P0-00616
Chronic disease monitoring

170549007 | chronic disease monitoring |

138875005 | Telehealth Monitoring for Chronic Disease |

71388002 | Procedure |

243120004 | Regimes and Therapies |

128927009 | Procedure by Method |

239516002 | Evaluation Procedure |

386053000 | Monitoring Procedure |

182777000 | Monitoring of Patient |

170549007 | Chronic Disease Monitoring |

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Future possible SNOMED CT modelled hierarchy concerning telehealth and associated devices
(before current agreements with GMDN Authority were settled)
Conclusion:

Q: What is different between the exchange of face to face examination reports/records data from telehealth data and their binding in EPR/EHR?

A: telehealth data can be sent through quite different carriers which might not be as predictable and reliable as EPR/EHR connectivity from hospital, health centre or social care examinations via local area networks with or without wireless networks. Telehealth networks connectivity might include the above, but also has other connectivity depending on the purpose of the particular telehealth application. Therefore the bandwidth requirements for submitting telehealth data would vary widely with the need to sometime higher compression on carriers with limited bandwidth but still be able to sent different contents such as interpreted video, images, audio sequences and textural reports/observations generated by either voice recognition or conversion powered by software applications. All of the above will have specified and additional requirements on the design and implementation of telehealth systems including SNOMED CT systems in comparison to EPR/EHR and social care systems. However the binding of telehealth data into EPR/EHR will the same as those captured from all face to face care.
Acknowledgements/References:

Video 1: Telemedicine. Corporate Communications Department, JSC Russian Railways 2009
kindly donated by Valery L Stolyar PhD, modern information technology specialist of Medicine Department Telemedicine Centre and Executive Secretary of Russian Telemedicine Association (abbreviated version)

Video clips 2 and 3: Telehealth in Action. Scottish Centre for Telehealth
kindly donated by Dr Richard Wootton former director of Scottish Centre for Telehealth now: Research Director NST (Nasjonalt senter for samhandling og telemedisin), Tromsø and Dr James Ferguson Scottish Centre for Telehealth, Aberdeen, UK (abbreviated versions)

GA Brox, and JL Huston: Implementation of SNOMED CT in telemedicine and eHealth to standardize telemedicine record documentation for interactive communication with the electronic health record.
Med-e-Tel Global Telemedicine and eHealth Updates Knowledge Resources Eds.: M Jordanova, F Lievens 2010 pp. 30-35

GA Brox, and JL Huston: a Demonstration of the Impact of the use of SNOMED CT enabled systems in Telehealth to update EHR.
Med-e-Tel Global Telemedicine and eHealth Updates Knowledge Resources Eds.: M Jordanova, F Lievens 2011 pp. 270-273

MPEG-4 ISO/IEC 14496-3:2001

Subpart 2: Speech coding - HVXC (Harmonic Vector eXcitation Coding)
Subpart 3: Speech coding - CELP (Code Excited Linear Prediction)
Subpart 4: General Audio Coding (GA) (Time/Frequency Coding) - AAC, TwinVO, BSAC
Subpart 5: Structured Audio (SA)
Subpart 6: Text to Speech Interface (TTSI)
Subpart 7: Parametric Audio Coding - HILN (Harmonic and Individual Line plus Noise)

THANK YOU!

Questions?