Agenda

- ISO/TS 11073-92001 Health informatics – Medical waveform format -- Part 1: Encoding rules
  -> Renumber ISO/DIS 22077-1

- ISO/NP TS 22077-2 Health informatics – Medical waveform format Part 2 Electrocardiography

- ISO/NP TS 22077-3 Health informatics – Medical waveform format Part 3 Long term electrocardiography
22077-1 Supports Waveform

ECG
- 12-lead Electrocardiography (included extended leads) 22077-2
- Electrocardiography for a long time (Ambulatory ECG) 22077-3
- Stress electrocardiography (Stress ECG)
- Late potential Electrocardiography
- Vector cardiology (VCG)
- Deriving inducement electrocardiography
- Intracardiac electrocardiogram and His bundle electrography
- Surface mapping ECG (Mapping ECG)

EEG/EP/EMG
- Electroencephalograph (EEG)
- Sleep electroencephalogram (Sleep EEG)
- Electroencephalographs for declaration of brain death
- Evoked Potential/Electromyograph (EP/EMG)

Monitoring
- Electrocardiography (ECG)
- ST Segment Electrocardiogram
- Continuous Blood pressure
- Pulse wave
- Respiration
- Impedance respiration
- Thermistor respiration
- Anesthetic and respiration gas
- SpO2, IBP, NIBP
- CO, CO2
- Temperature

Other
- Spirometry
- Heart sound
- EOG
- Fetal heart sound
- Fetal electrocardiogram + others

Medical waveform view.
Background

- Medical waveform data such as an ECG or an EEG are widely utilized in physiological examinations, physiological research, electronic medical records (EMR), healthcare information and other areas in the clinical field.

- Medical waveform data can be used for many medical and research purposes if digital signal processing technology is applied to standardize the data in a digital format.

Concept MFER

- Simple and Easy Implementation

- Harmonization with Other Standards

- Separation of Waveform Data between Application and Provider
Simple and Easy MFER

Harmonization with HL7

Report information uses standards, such as HL7 CDA.
Harmonization with DICOM

A present image of corresponding to MFER.

It’s under work here now

One more proposal.
(Arranges DICOM 2008 Waveform for MFER)

Transfer Syntax (0002,0010)
- MFER Waveform (NEW)

Modality (0008,0060)
- ECG, GW(NEW)
- MFER sample coding (NEW)

Waveform IE module
- 12L-ECG IOD Module, Generic Waveform IOD(NEW)
- 12L-ECG SOP, Generic Waveform SOP(NEW)

Current situation

- Japanese Ministry of Health, Labor and Welfare adopted MFER as recommended standard

- Japanese Society of Electrocardiography adopted MFER as standard of electrocardiogram

- MFER committee receives many inquiry about adoption of MFER from around the world.
Inquiry from?

- Norway
  Univ. of Agder
  Long Term ECG for Mobile
- USA
  DATAMED
  12 Lead ECG
- Germany
  Polaris,One
  (Nihon Kohden)
  12 Lead ECG (inc.Nerb)
- South Korea
  12 Lead ECG
- China
  12 Lead ECG
- Israel
  12 Lead ECG
- Vietnam
  12 Lead ECG
- UK
  12 Lead ECG
- Taiwan
  12 Lead ECG

Use Case serial comparison

- Fukuda denshi
  (Ambulance car)
- Nihon Kohden
  (Hospital)
ISO/NP TS 22077-2
Medical waveform format Part 2
Electrocardiography

Many estimated ECG

- It was estimated that more than 12 million was recorded in 2010 year in the clinic and the hospital in Japan.

- In 1993, it was estimated that more than 100 million standard ECGs are recorded yearly in the European Community.

(ISO 11073-91064:2009)
Scope of Electrocardiography

- Electrocardiography such as 12-lead, 15-lead, 18-lead, Cabrera lead, Nehb lead, Frank lead, XYZ lead.

ISO/TS NP 22077-2

Overview of the rules

- ECG Waveform Encoding

- Non-ECG waveform data
  - Measuring conditions (ex. Filter characteristic)
  - Measurement value (ex. HR, QT Interval)

ISO/TS NP 22077-2
Waveform Encoding

- Standard 12-lead ECG is shown by MWF_WFM waveform class.
- Waveform class is specified as follows:
  - ECG_STD12 Standard 12-lead ECG
    Standard 12-lead ECG including general ECG in short term recording.
- Extracted waveform
  - ECG_BEAT QRS beat
    In general, one heart beat waveform extracted from standard
  - ECG_DRV Derived lead
    Derived ECG from Frank vector leads, EASI lead, etc

Other Informatics

- Filter Information
  Tag : MWF_FLT
  Value: “HPF=0.05” (High freq. pass filter, cutoff =0.05Hz)
  “BEF=50^HumFilter” (50Hz Hum filter)
- Measurement Value
  Tag : MWF_VAL
  Value code : MWF_ECG_HEART_RATE
  Time point : sampling number from waveform start point
  String : “60^bpm”
  ( Heart rate = 60bpm )
ISO TS NP 22077-3
Medical waveform format Part 3 Long term electrocardiography

Scope of Long term ECG
Electrocardiography such as bipolar 2, 3-lead, 12-lead that are measured by medical equipment such as ambulatory ECG examination and patient physiological monitors.
Why use MFER for Holter ECG

<table>
<thead>
<tr>
<th>Media</th>
<th>Analog</th>
<th>Digital</th>
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</thead>
<tbody>
<tr>
<td>Dimension</td>
<td>200 ~ 300 g</td>
<td>35 ~ 100 g</td>
</tr>
<tr>
<td>Weight</td>
<td>270 ~ 320 cm³</td>
<td>30 ~ 100 cm³</td>
</tr>
<tr>
<td>Disposable</td>
<td>Tape, mechanical parts</td>
<td>No</td>
</tr>
<tr>
<td>Frequency</td>
<td>0.2 ~ 35 Hz</td>
<td>0.05 ~ 40 Hz</td>
</tr>
<tr>
<td>Future</td>
<td>NO more</td>
<td>More</td>
</tr>
<tr>
<td>extension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compatibility</td>
<td>Direct recording with sync. (32 Hz)</td>
<td>No compatibility</td>
</tr>
<tr>
<td>Quality</td>
<td>Poor quality (wow and flutter) (Irregular speed, Polluted head)</td>
<td>Good quality</td>
</tr>
<tr>
<td>Equability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Archiving</td>
<td>Cassette tape</td>
<td>Easy archiving</td>
</tr>
</tbody>
</table>
When MFER was used

- Users can use the combination of the favorite recorder and the scanner.
- Pacemaker spike and patient event can be dealt with except for ECG.

ISO/TS NP 22077-3

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## More information

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td>0</td>
<td>Pacing</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Ventricular pacing</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Atrial pacing</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Cheng Battery</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Electrode confirmation</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Radio field strength</td>
<td>0</td>
</tr>
<tr>
<td>8-9</td>
<td>Patient event 1,2</td>
<td>0</td>
</tr>
<tr>
<td>10-12</td>
<td>Body position</td>
<td>0</td>
</tr>
<tr>
<td>1, 4, 13, 14, 15</td>
<td>Reserved</td>
<td>0</td>
</tr>
</tbody>
</table>

For telemetry monitoring:
- 000: none
- 001: Standing/Seating
- 010: Supine
- 011: Right lateral decubitus
- 100: Left lateral decubitus
- 101: Prone
- 110: Reserved
- 111: Reserved

ISO/TS NP 22077-3
Information

Stress Test Electrocardiography

Scope of Stress Test ECG

- A scope is about the electrocardiography in stress testing by exercise or using medicine.
The feature of Stress Test ECG

- In a stress test, a time series compares change of each ECG the time of before applying load, having applied load, and having recovered.
- By applying load to the heart, an ischemic disease and the arrhythmia which appears at the time of exercise can be found.

Report of STRESS TEST

- Average wave for ECG changes
Report of STRESS TEST

- Full-disclosure wave
- Load information, etc.

Interoperability

- After the treatment of cardiac disease, in order to evaluate the recovery condition of cardiac function, it is required to refer former ECG data.
- The present system has too strong the originality of each vendor, and it has obstructed interoperability.
- The standard of waveform and load information in stress test is required.
MFER for stress test

- Extracted beat waveform
- Full disclosure waveform
- Intermittent record waveform
- Event record waveform
- Execution information on load
- Other biological information (Blood pressure, SpO2, etc…)

In order to diagnose ischemia, a serial comparison of ST segment of extraction ECG waveform is referred.
Full disclosure waveform

- The full disclosure waveform under stress test is recorded.
- This description method is the same as the long term ECG (TS22077-3).

Intermittent record waveform

- For example, 12 lead ECG is recorded every other minute during an examination.
- This description method is the same as the electrocardiography (TS22077-2).
Execution information on load

- The speed and grade of a treadmill, the watt and rotations of a bicycle ergometer, etc. are described as waveform data.

Conclusion

- MFER can describe all medical waveforms.
- MFER is very simple and guarantees interoperability.
- MFER can be used for multi purpose such as EMR, research, database and so on.
- Suitable for other waveform description (introduces Stress Test)

- ISO/TS NP 22077-2 Electrocardiography
- ISO/TS NP 22077-3 Long term electrocardiography

ISO/TS NP 22077-2 -3 Need Expant!
Please entry Participation.
http://www.mfer.org/en/

Basic policy of MFER

- MFER does not disturb good features of each product by according with MFER specification.

- MFER should easily translate stored past data on databases to new data in MFER, current data including future new waveforms will be still described in MFER.

- MFER does not exclude other rules.
Medical waveform rules

- HL7 (Health Level Seven)
  - Text String
- DICOM (Digital Imaging and Communications in Medicine)
  - Catheterization waveform
- SCP-ECG
  - Standard 12-Lead ECG
- ISHNE (International Society for Holter and Noninvasive Electrocardiology)
  - Holter ECG
- EDF, EDF+ (European Data Format)
  - EEG, Medical waveform
- X73 (IEEE1073, IS11073)
  - Monitoring waveform (ex.ICU, CCU)
- ASTM E1467-94
  - (Standard Specification for Transferring Digital Neurophysiological Data Between Independent Computer System)
  - EEG