

ECG Description in MFER and HL7 Version 3

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Abstract

Medical waveforms such as ECG and EEG are described in MFER, which is a medical waveform format standard, and observation results are written in HL7/XML. The MFER and HL7/XML combination is excellent for understanding, research, EHR, and so on. We applied this combination to a pharmaceutical clinical trial application.

Keywords:

Medical waveform, MFER, HL7

Introduction

MFER is a format standard for medical waveforms such as electrocardiogram, electroencephalogram and respiration waveforms. On the other hand, HL7 is widely used as a message exchange standard for healthcare information. HL7 is also able to describe the medical waveforms by itself, but the HL7 description for medical waveforms is not always a good solution from the viewpoint of efficiency and descriptive capability. In this paper, we developed an HL7/XML and MFER combined description for ECG observation and QT interval evaluation for cardiac toxin of pharmaceutical clinical trial. In this combination, MFER describes the standard 12 lead ECG waveforms and HL7 describes the patient information and observation result. With this combination, the readability and understandability is greatly improved. Because we would like to use ECG equipment from any manufacturer, we adopted both standards. Therefore the ECG equipment only outputs MFER ECG waveforms to the QT application. Standardization is an indispensable condition for a multi-vendor environment.

MFER outline

MFER is a medical waveform description standard for “Interchange of waveform information”, “Waveform database”, “Electronic Health Record”, “Research, Investigation, Signal processing” and so on.

MFER has two main components, sampling information and frame information. The attributes of sampling information are sampling frequency (sampling interval), sampling resolution and optional attributes if necessary. The Frame information is composed with data block length, channel and sequence number ().

MFER has some other optional attributes for special usage, but all attributes have an initial value, so MFER only defines a minimum description. Observation time, patient information and other related measurement information are described in MFER, but this kind of information should be described with HL7 or RDBMS, etc. In this paper, measurement values of ECG and observation information were described in HL7/XML and ECG waveforms were described with two limb lead (I, II) and six chest lead (V1 – V6) in MFER. Because other limb lead (III, aVR, aVL, aVF) can be derived from I and II, MFER doesn't include these leads, just I and II.

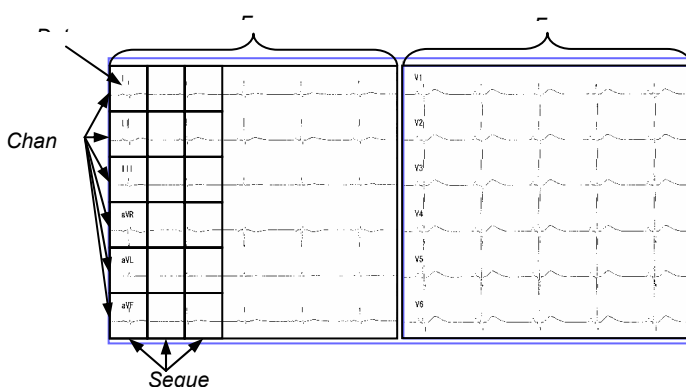
ECG acquisition (ECG equipment)

ECG waveforms are converted to digital data by an A/D converter through the ECG preamplifier (Fig. 2), The digitized ECG waveforms are processed by filtering or other processes by microprocessor. MFER requires that encoding should use the original waveform without filtering, (or unfiltered montage for EEG, etc.) if possible.

Unprocessed waveforms before filtering are stored in the MFER application process according to the purpose. If the ECG equipment uses a filter, the filter information is stored in the MFER processing information. Because sampling rate and resolution conditions are not unified, these conditions may be decided by each manufacturer. Also, sampling condition, frame information, waveform and lead names are stored in the MFER if necessary.

HL7/XML description

The information other than waveforms are described in XML format according to the RCRIM/JWG model. XML has the excellent feature of being both machine-readable and human-readable. In this procedure, XML in accord with HL7 version 3 describes observation conditions, measurement values and reference pointer of MFER ECG waveform. In this project, ECG equipments, which are made by four manufacturers, output the MFER ECG waveform, then QT measurement application program



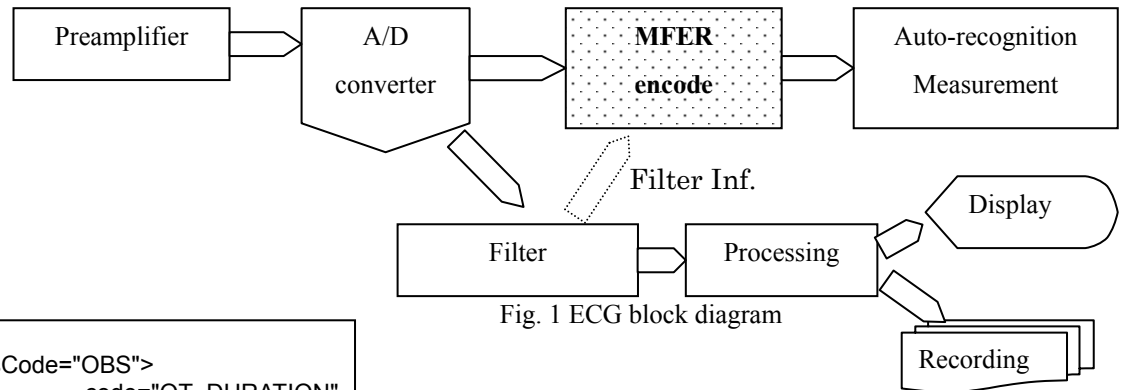


Fig. 1 ECG block diagram

```

<subjectOf>
  <annotation classCode="OBS">
    <code code="QT_DURATION"
codeSystem="MDC"/>
    <component>
      <!-- Mean -->
      <Annotation classCode="OBS">
        <code code="mean" value"
codeSystem="localCode"/>
        <value xsi:type="PQ" value="94"
unit="ms"/>
      </Annotation>
    </component>
    --
    --
    --
  </annotation>
  <someObservation classCode="OBS"
moodCode="EVN">
    --
    <value xsi:type="ED" mediaType="text/plain">
      <reference value="011200305210022.mwf"
/>
    </value>
  </someObservation>
</subjectOf>
  
```

Fig. 2 XML coding sample with MFER ECG pointer(*.mwf)

measured, evaluated, and confirmed by physician. After physician confirmed, QT measurement program output XML file includes these observation data with MFER/ECG reference pointer as HL7 “ED (encapsulated data)” data type.

QT measurement, the application program can display MFER ECG waveform can decide or confirm, including automatically recognized points, the onset of QRS and offset of T wave for each beat, so the physician, then it measures the QT interval. This application program stores statistical values, mean, variance, standard deviation and so on, in XML format. Because HL7 doesn't have a code system for statistic, we used local code temporarily. In this description manner, XML becomes simpler, easier for humans to read and easier for data processing. Because HL7/XML data with MFER reference pointer are easily processed with XSL, Internet Explorer can display both information on the same screen with an MFER viewer plug-in module.

Conclusions

In this paper, we harmonized XML and MFER to observe medical waveforms such as ECG. XML/HL7 can describe medical waveforms in text format, but it is quite complicated to describe and represent huge amounts of numeric text data. Therefore, we described observation and measurement information in XML and waveforms in binary format of MFER. Description of medical waveforms such as ECG need special knowledge, but the waveform format' is usually not necessary for a clinician. An ECG waveform is coded as a reference pointer of HL7 with some recognition points for QT measurement and other information like observation value are described in HL7/XML. This description architecture is helpful for understanding and research applications