

**Health Informatics**

**Medical waveform Format Encoding Rules  
ISO/TS 11073-92001**

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***Koichiro Matsumoto***

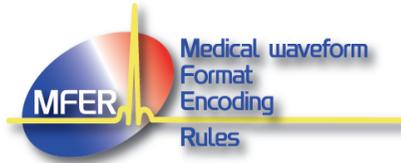
***MFER Committee***

***Nihon Kohden Corp.***

***Oct.11-13 2010***

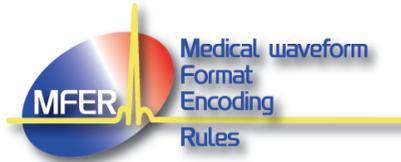
***ISO/TC215 & CEN/TC251***

***Health Informatics in Rotterdam***



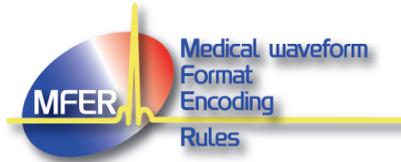
# Background

- **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.**
- **For medical waveforms it is essential to standardize the data format to expedite the mutual application of the standard so that the data can be processed electronically and used in a variety of ways.**



# What is the user demand for medical waveform?

- **reproducible data when examined**
  - the same data as when acquired
- **undistorted data**
  - unfiltered and uncompressed raw data
- **compatibility between different vendors**
- **reuse of past data**
- **not needed expensive and specific viewer**



# Type of medical waveform data

## ECG

- **Electrocardiogram (ECG)**
- **12 standard Electrocardiogram (included extended leads)**
- **Electrocardiogram for a long time (Ambulatory ECG)**
- **Stress electrocardiogram (Stress ECG)**
- **Vector cardiogram (VCG)**
- **Deriving inducement electrocardiogram**
- **Intracardiac electrocardiogram and His bundle electrogram**
- **Surface mapping ECG (Mapping ECG)**
- **Late potential Electrocardiogram**

## EEG/EP/EMG

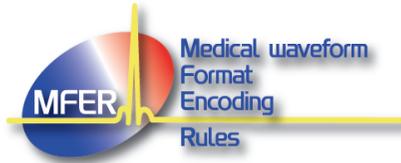
- **Electroencephalograph (EEG)**
- **Sleep electroencephalogram (Sleep EEG)**
- **Electroencephalographs for declaration of brain death**
- **Evoked Potential/Electromyograph (EP/EMG)**

## Monitoring

- **Electrocardiogram (ECG)**
- **ST Segment Electrocardiogram**
- **Continuous Blood pressure**
- **Pulse wave**
- **Respiration**
- **Impedance respiration**
- **Thermistor respiration**
- **Anesthetic and respiration gas**
- **SpO<sub>2</sub>,IBP,NIBP**
- **CO,CO<sub>2</sub>**
- **Temperature**

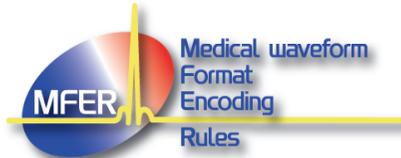
## Other

- **Spirometry**
- **Heart sound**
- **EOG**
- **Fetal heart sound**
- **Fetal electrocardiogram**



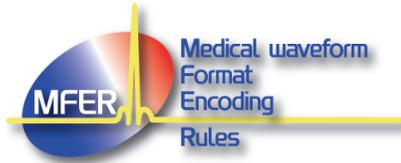
# Medical waveform rules

- **HL7** (Health Level Seven)
  - **Text String**
- **DICOM** (Digital Imaging and Communications in Medicine)
  - **Catheterization waveform**
- **SCP-ECG**  
(Standard Communication Protocol computer assisted electrocardiography)
  - **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**



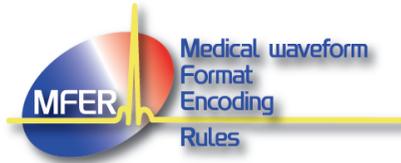
# About MFER (Concept)

- **Simple and Easy Implementation**
  - **MFER consists of simple rules.**
  - **Simplification facilitates understanding, easy installation, trouble shooting and low implementation cost.**
- **Harmonization with Other Standards**
  - **MFER is specialized in Medical Waveform Data.**
    - For encoding information other than medical waveforms, it is suitable to use the HL7, DICOM or IEEE 1073 format, whichever has its forte for the specific non-waveform information.
- **Separation of Waveform Data between Application and Provider**
  - The waveform data provider should make the waveform data as accurately as possible.
  - The application is not required to comply with all of the specifications.



## Basic policy of MFER

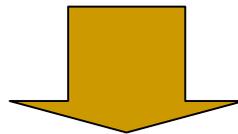
- **MFER does not disturb good features of each product by according with MFER specification.**
- **MFER should easily translate stored past data on databases to new data in MFER, current data including future new waveforms will be still described in MFER.**
- **MFER does not exclude other rules.**



# Appeal point of MFER

## Comparison with HL7

- **HL-7 will be able to describe data of any form. However, in some cases, it requires data cutdown and it cannot describe manufacturers' characteristic specifications.**

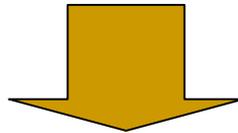


- **HL-7 excels at V2 message conversion and CDA document description. For this reason, it is actual and reasonable to use MFER (waveform data reference) in combination with V2 (ordering and patient information management) and CDA (examination report).**

# Appeal point of MFER

## Comparison with DICOM

- **Since DICOM requires detailed and strict standardization, it disturbs legislative process. See from a cost-effectiveness standpoint, DICOM waveform standards are inefficient. Therefore, as for 12 lead ECG, only limited functions (e.g. 13 channel waveform and 13 sec description) are standardized.**

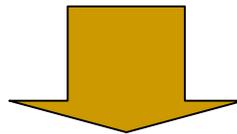


- **Hospitals are using DICOM server for radiological image management.  
If medical waveform data described by MFER can be saved on the same server, it is user friendly.  
Therefore, it is one of a subject of future investigation.**

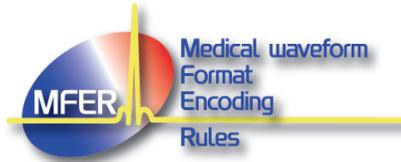
# Appeal point of MFER

## Comparison with SCP-ECG

- **Since SCP-ECG specializes in 12 lead ECG, some functions are excluded from the specifications. It causes a difficulty on confirmation of linearity. (e.g. only 1 minute ECG is acquired)**

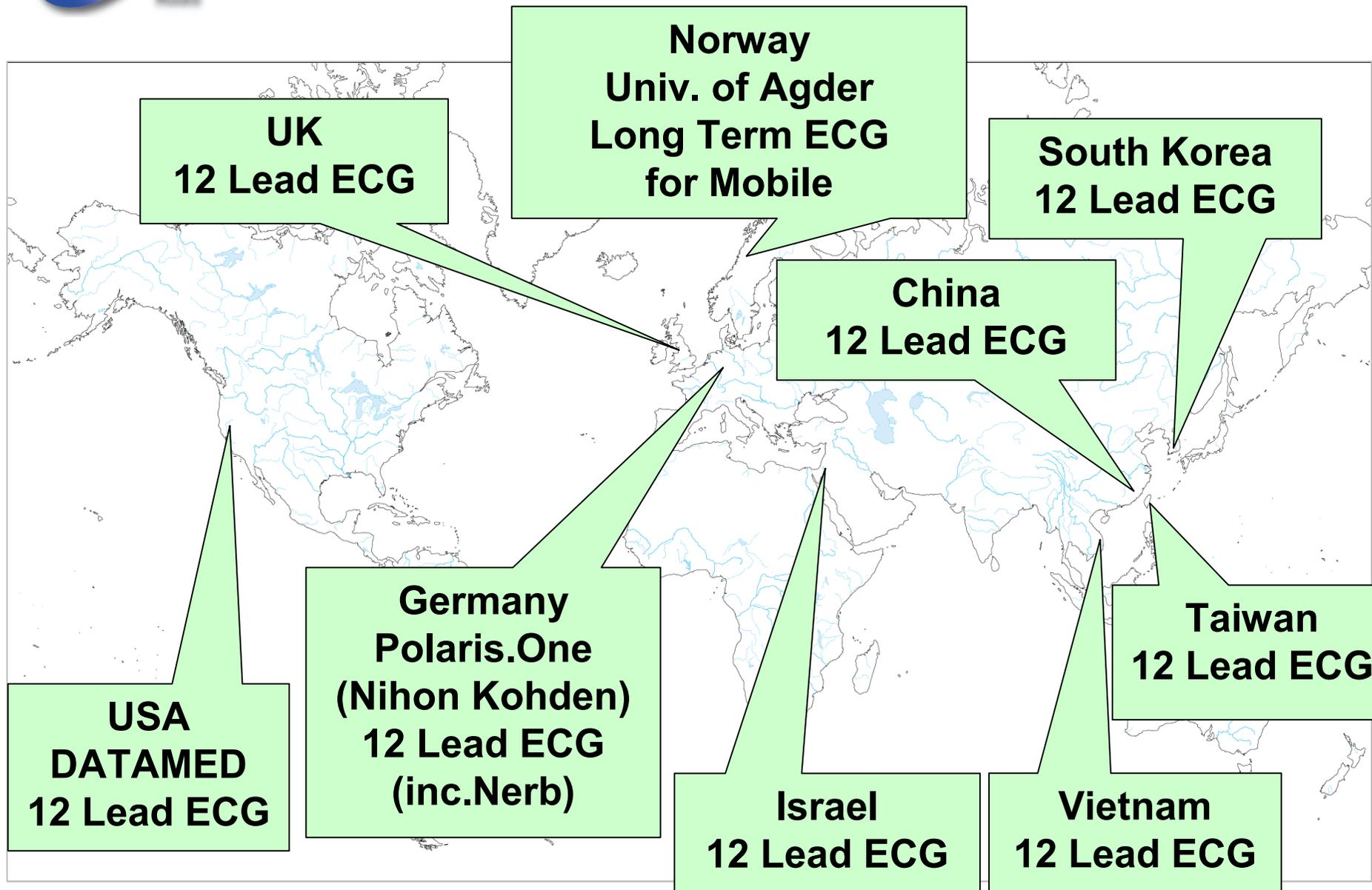


- **MFER committee provides a guidebook for converting SCP-ECG into MFER. It is necessary to pay attention to the missing data caused by nonlinearity and filter.**

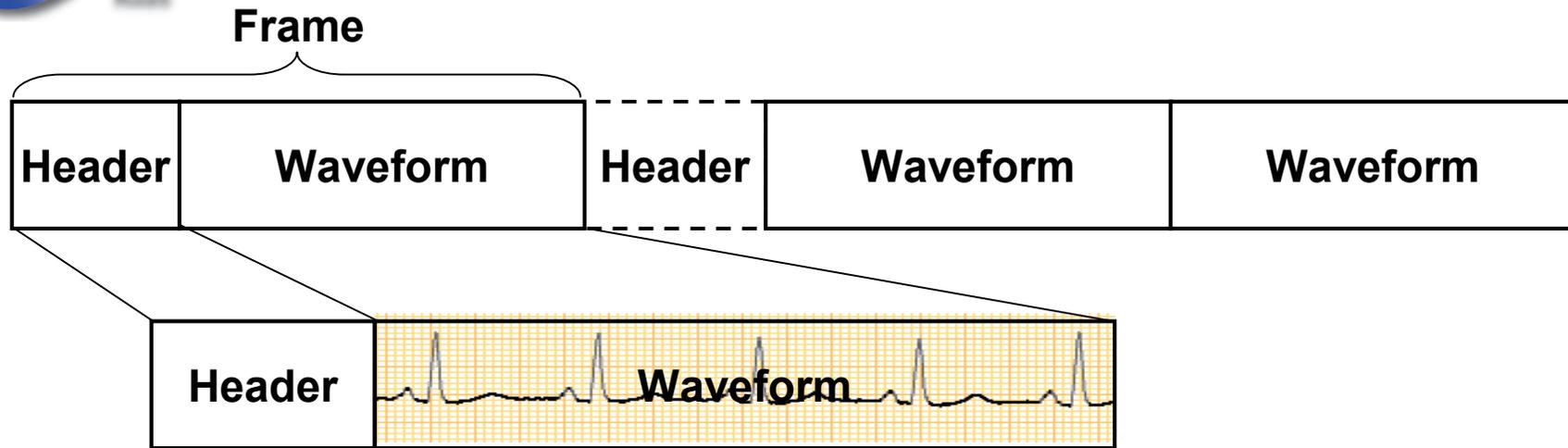


## Current situation

- **Japanese Ministry of Health, Labor and Welfare adopted MFER as recommended standard**
- **Japanese Society of Electrophysiology adopted MFER as standard of electrocardiogram**
- **MFER committee receives many inquiry about adoption of MFER from around the world.**



# MFER description



MFER defines as a gathering on a frame which consist of header and waveform. Header is described with sampling attributes, waveform frame attributes and other supplemental information.

# Demonstration

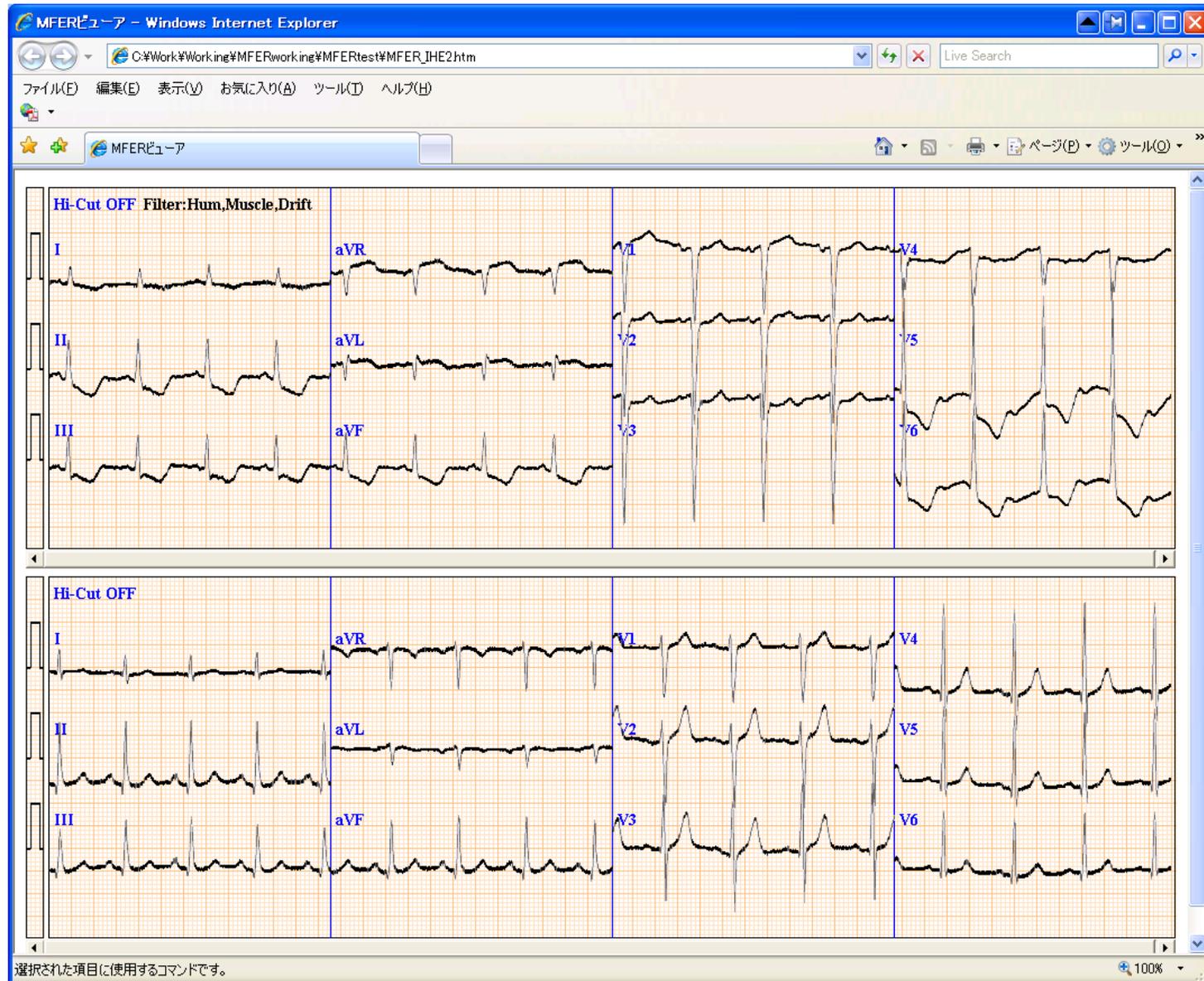
## 12 leads ECG

- IHE-J (National Extension) demo at JAMI as National project.
  - Use case
    - ST depression was occurred when ECG was measured in Ambulance car by Fukuda Denshi
    - ECG was backed to a normal condition when ECG was measured at a Hospital
    - Comparing between two ECGs



# Demonstration

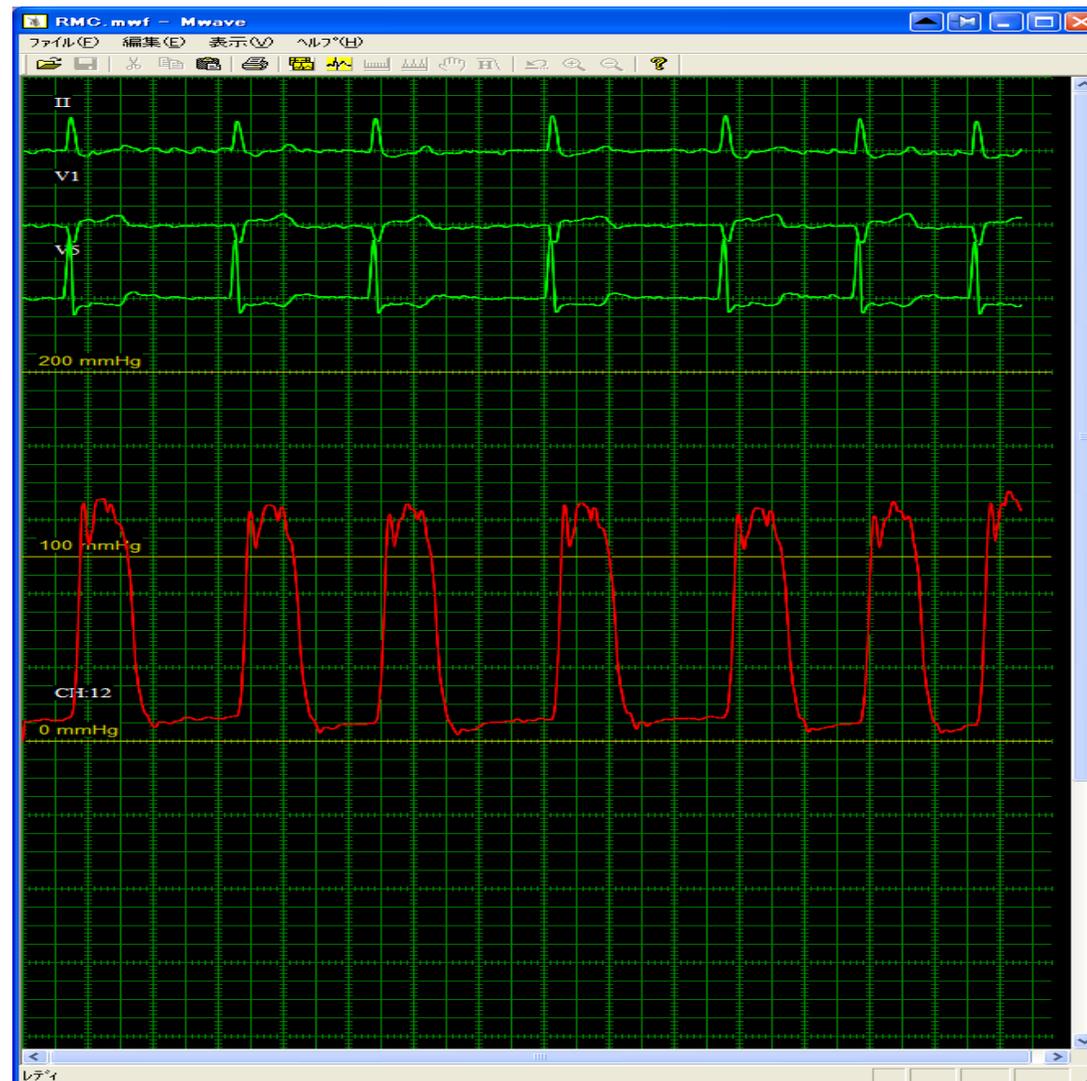
**Fukuda  
denshi**  
(Ambulance car)

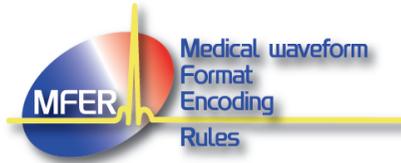


**Nihon  
Kohden**  
(Hospital)

# Catheterization ECG

- Catheterization data consists of 12 lead ECG, His bundle ECG, Blood pressure e.g. Aorta and Radial Artery and others.





## 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.
- We expect many excellent product, software and tool will be developed for MFER waveforms and many researchers will easily investigate the waveforms and we will contribute to human health.

**MFER was approved as TS11073-92001 in 2007.**

**Since 2010 is a renewal year, MFER committee intends to obtain IS. we ask for the understanding and cooperation of you.**