

How to save waveform, endoscope image,  
fundus camera image and so on,  
except radiology image.

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本日はこのような発表の機会を与えていただきありがとうございます。  
오늘은 이러한 발표의 기회를 주셔서 감사합니다.

오늘은(おぬるるん)  
이러한(いろはん)  
발표의(ぱるぷびい)  
기회를(きふういるる)  
주셔서(ちょそそ)  
감사합니다(かんさはんにだ).

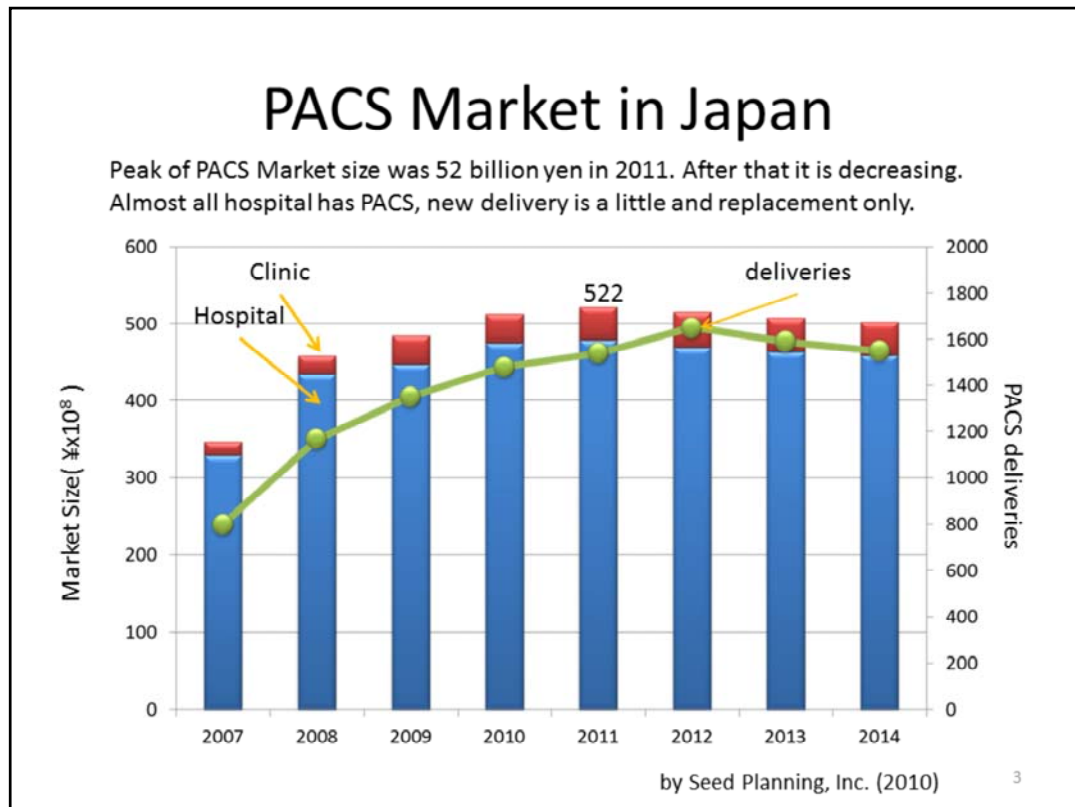
# Contents

- PACS market in Japan
- DICOM Gateway
- How to save medical waveform data
- About MFER(Medical waveform format encoding Rules)
  - MFER description
  - How to describe MFER in HL7 CDA
  - MFER in the world
- Conclusion

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これは本日の発表の内容です。

This is the content of today's presentation.



はじめに日本のPACS市場についてご説明します。

I will explain the PACS market in Japan at the beginning.

このグラフは日本のPACS市場調査について、調査会社が調べたものです。

This graph shows PACS market in Japan research company has created.

棒グラフは市場規模を示しています。

The bar graph shows the market size.

青色は20床以上の病院での市場規模を示し、赤色は20床未満のクリニックを示しています。

Blue bar indicates the market size in the hospital of 20 or more beds,  
red bar shows it in the clinic less than 20 beds.

市場規模は2011年の52billionをピークに僅かに下がるとされています。

The peak of market size is 52billion yen in 2011 and after that slightly decrease.

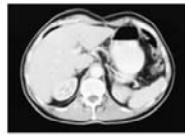
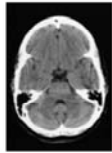
また、設置数も2012年をピークに下がる傾向を示しています。

In addition, the number of deliveries shows a tendency to fall after 2012.

現在、韓国と同じように日本の多くの病院ではPACSが普及しています。

Currently, PACS is popular in many hospitals in Japan as same as South Korea.

Images stored in the PACS are mainly  
Radiographic images .



How do we have saved waveform data (ECG, etc) and endoscopic image (non-radiographic images) ?



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多くの病院でPACSが利用されていますが、その中身の多くが放射線画像です。

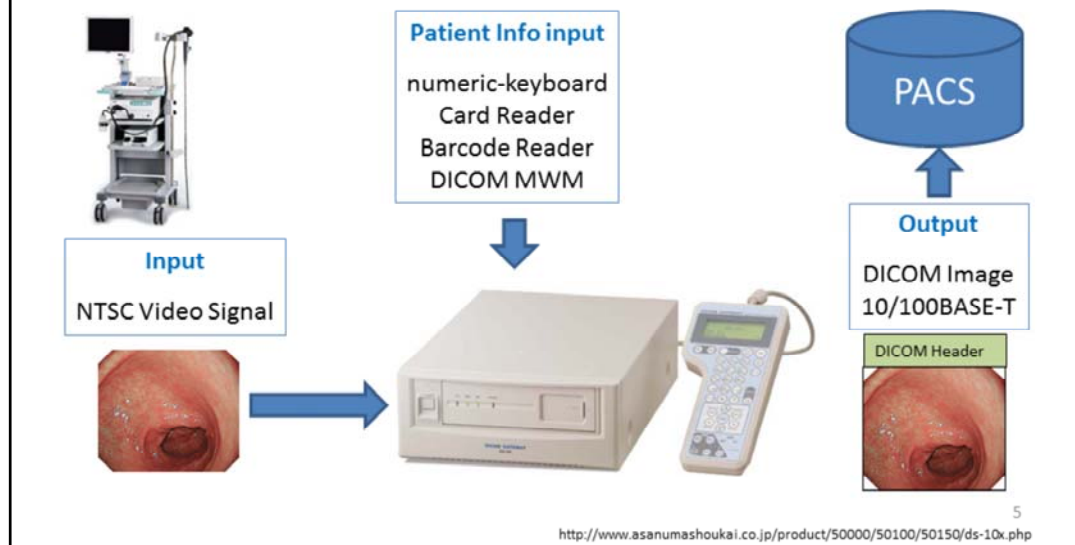
Many hospitals used PACS, but a lot of its contents is the radiographic image.

では、心電図のような波形データや内視鏡などの画像はどのように保存しているのでしょうか？

So, how do we have saved the non-radiographic image, such as endoscopes or waveform data?

# DICOM Gateway

It capture the video signal from endoscopes and convert it into a JPEG image.  
The captured JPEG image is added patient information and converts it into DICOM image.  
Finally the DICOM images are transferred to PACS through a network.



従来からある方法はDICOMゲートウェイを用いて、画像化してPACSに送る方法です。

DICOM gateway is conventional way to transfer data to DICOM image and sends to the PACS.

スライドを読む

患者情報は数値キーボード、カードリーダーやバーコードリーダーを用いて入力します。

Patient information is input by numeric keyboard, card reader and barcode reader.

したがって、私たちは最低限の情報しか入力することができません。

Therefore, we will enter only the minimum information.

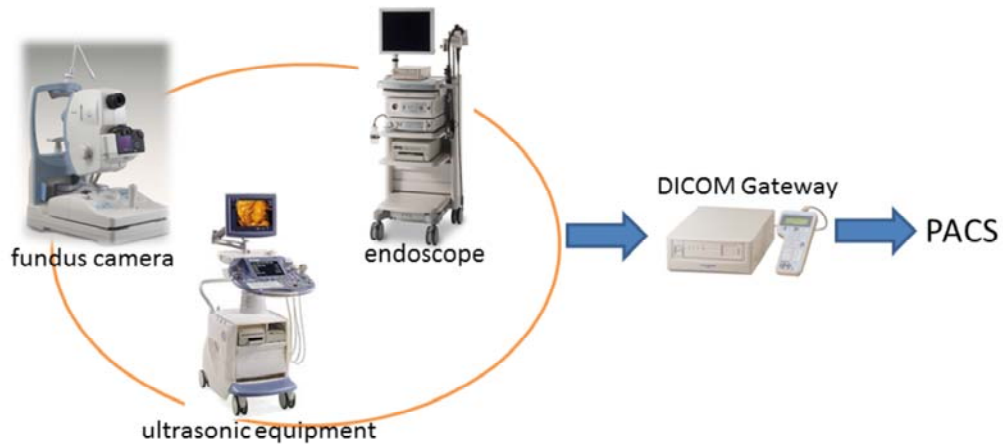
一部の機器はDICOM MWMに対応しています。

Some devices are available for DICOM MWM.

検査情報に関しては非常に少ないといえます。

We can say the study information is also very little.

Generally using DICOM Gateway to capture from a video signal of non-DICOM device (endoscope, ultrasonic equipment, fundus camera and so on) into DICOM images we save them to PACS.



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しかし、DICOMゲートウェイはnon-DICOM装置からデータを得るのに広く用いられています。

スライドを読む

## How about the waveform data such as the electrocardiograph?

Of course we convert it into DICOM as an image  
and can save it in PACS.

But the waveform data as an image has demerits.

- When you expand the waveform data and observe it in detail, it depends on the resolution of the screen capture image.
- Re-analysis of the waveform is impossible because the meta-data of waveform has been lost.
- Long time waveform data is not suitable for saving, because the captured image is managed by the screen units.
- Synchronization and synthesis of waveform is also impossible.

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スライドを読む

デメリット

3) Long time・・・

これは任意の時間の波形データを観察したいとき、非常に問題になります。

When you want to observe the waveform data at arbitrary time, this will be very problematic.

4) これはカテーテルの圧データと心電図を同期や合成した時に問題です。

This is a problem when it is synthesized and synchronize the electrocardiogram and pressure data of the catheter(きやせたー)。

## Saving way of Medical waveform data.

- 1) To save as image data.  
It has been conventionally performed.
- 2) To save as PDF data.  
Using the document scanner from printed ECG data.
- 3) To save as DICOM standard data  
DICOM Supplement 30 defines.
- 4) To save as MFER data.  
New method to save waveform with meta-data.

**MFER** is abbreviation of  
**M**edical waveform **F**ormat **E**ncoding **R**ules.

● 医用波形データの保存方法には大きく4つあります。

There are four major methods for storage of medical waveform data.

● ひとつは画像として保存する方法です。既に紹介しました。

One of them is a way to save as an image.

I mentioned before

● 次にPDFとして保存する方法です。

Next Saving as PDF.

これは画像と同じ問題を持っています。

This way has a problem as same as image.

● 期待される方法としてDICOM規格として保存する方法です。

Expected method is saving as DICOM standard.

これはDICOMサプリメント30で定義されています。

This is defined by the DICOM Supplement 30.

● そして期待されるもう一つの方法はMFERのデータとして保存する方法です。

Another expected method is saving as MFER.

MFER is abbreviation of Medical waveform Format Encoding Rules.





## Medical waveform in DICOM

### Feature

- It is standardized to support the image reading.
- It is recorded as image or waveform for display.

### Merit

- It can share the common resource of PACS.
- Waveform can be displayed along with the image data.

### Demerit

- It is limited to the modality with “image”.
- Enhancement limited in the DICOM

期待する方法の一つであるDICOM規格の医用波形について説明します。

I will explain a medical waveform of the DICOM Standard supplement 30.

This way is one of the expected way.

特徴は

I will show two features.

メリットは

今使われているPACSサーバに医用波形データを保存することができます。

You can save the medical waveform data to current PACS server.

デメリットは

波形データのみを扱う装置に限界があるということです。

Because there is a limit to the device for dealing with only waveform data.

DICOMの世界の中で考えられているということです。

It is that is considered in the world of DICOM.

## What is MFER?

- MFER is a data format that takes into account the compatibility of medical waveform data.
- In 2002 MFER committee was established and MFER ver0.9 was proposed.
- In 2007 it was published as an International Standard ISO / TS 11073-92001:2007.
- Features of MFER
  - It is a standard that specializes in the waveform
  - It is easy for waveforms to synchronize and synthesize.
  - Study and patient information is designed to conform to the DICOM and HL7 for upper protocol.

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So standardization of the waveform data format was considered in Japan.

That is MFER.

スライドを読む

MFERは良い設計思想を持っていると思います。なぜなら、それは波形データの記述に特化し、患者情報などはHL7やDICOMに任せる方法をとっています。

I think MFER has a good design concept.

Because, it specializes in the description of the waveform data, and patient information rely on DICOM and HL7.

## 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 / Electromyography (EP/EMG)

### Monitoring

- Electrocardiogram (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

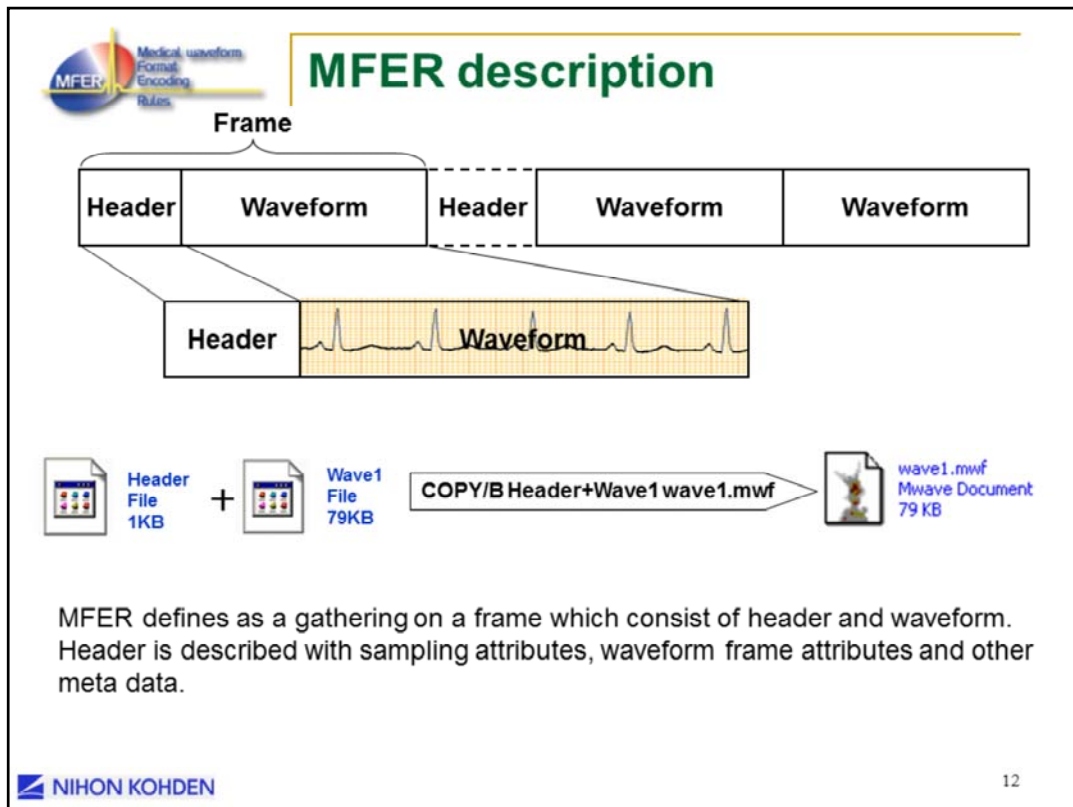
- Spirometry
- Heart sound
- EOG
- Fetal heart sound
- Fetal electrocardiogram

私たちは医療でたくさんの波形データを利用しています。

We are using the waveform data a lot in medical area.

MFERはこれらの波形データをカーバーします。

MFER covers these waveform data.



MFERの記述はとてもシンプルです。  
 MFER's description is very simple.  
 スライドを読む



## How to describe in HL7 CDA?

It is very useful to describe medical waveform information in MFER and other information in CDA of physiological report. Since dividing report into two data sets (CDA and MFER) is very convenient.

※Clinical Document Architecture

◆ CDA is useful for EHR, EMR, etc.

◆ MFER waveform is utilized for research, clinical trial, data analysis and so on.

Patient information

Study information

Interpretation results

Measurement data

Wave data

**Described in CDA**

**Described in MFER**

NIHON KOHDEN

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例としてHL7でどのようにMFERを利用するか紹介します。

I will show you a example how to use the MFER in HL7.

患者情報、検査情報などはHL7のCDAで記述されます。

Patient and study information are described in the CDA of HL7.

そして波形データはMFERで記述されます。

And waveform data is described in MFER.

MFERのファイルはCDAから外部参照できるように記述されます。

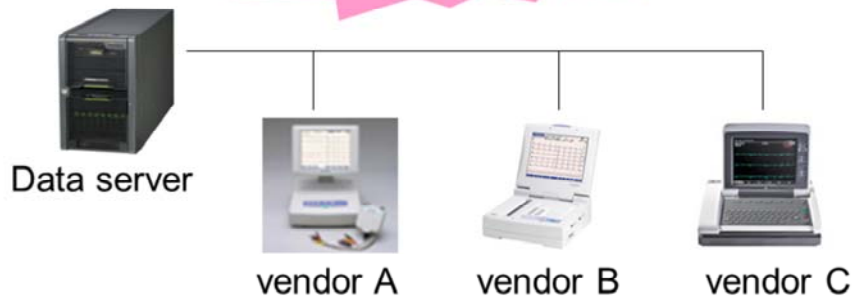
MFER file is written as a external references from CDA.

したがって、MFERとCDAは独立した存在です。

Therefore, CDA and MFER is independent existence.

## Useful for HL7 CDA + MFER

**Clinicians Strong Claim**



**It is possible to be compatible with each vendor**

MFERを利用して管理することのメリットは異なるベンダーのデータを再分析したり、合成してみたりすることができることです。

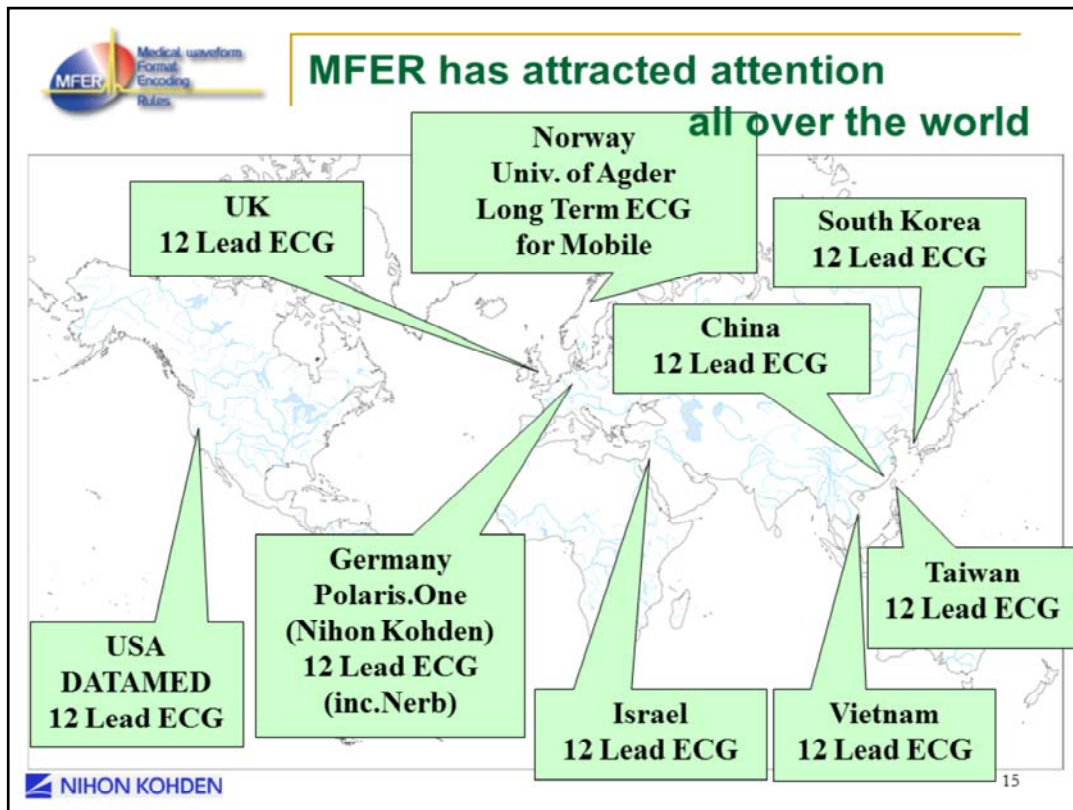
Benefits of MFER is that it can be re-analyzed and synthesized each vendors data.

つまりベンダー間の互換性が確保できることです。

In other words, It is possible to be compatible with each vendor.

医療現場でのこれまでのクレームが解消されます。

Claim so far in the medical field will be eliminated.



現在、MFERは世界各国で注目されています。

Currently, MFER has attracted attention around the world.

韓国はもとより台湾、中国などアジア諸国、ヨーロッパや北米でも注目されています。

Of course South Korea watches this standard, and other Asian country, Europe and North America also watch it.

## Conclusion

- In many cases, non-DICOM data using DICOM Gateway to capture the video signal convert the DICOM images and save into PACS.
- MFER is expected as an international standard.
  - MFER has a lot of merits.
  - It is important to share the multi-vender waveform data and among hospitals.
  - MFER improves the medical quality.

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結論です。  
スライドを読む。



# Acknowledgement

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Nihon Kohden Corporation Mr. Tanaka gave me a lot of information.

Thank you for listening.

끝까지 경청해 주셔서  
감사합니다

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クツカジ キョンチョンヘ(キョンチョゲと聞こえます)ジュシヨソカムサハムニダ