The Extension of the DICOM Standard to Incorporate ‘Omics’ Data

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We stand at the dawn of a new understanding of disease...


**Initial sequencing and analysis of the human genome**

*International Human Genome Sequencing Consortium*

The human genome holds an extraordinary trove of information about human development, physiology, medicine and evolution. Here we report the results of an international collaboration to produce and make freely available a draft sequence of the human genome. We also present an initial analysis of the data, describing some of the insights that can be gleaned from the sequence.
The Double Helix Model

Watson and Crick – Nature 25th April 1953

Scanning Tunnelling Micrograph
The Biological Continuum:
supporting the revolution of molecular medicine

Today’s ePatient record
The Biological Continuum:
supporting the revolution of molecular medicine

Tomorrow's ePatient record
Advanced Web-based Information Systems

- Systems
- Viscera
- Tissue
- Cells
- Proteins
- Genes
Explosion of Omics Data: Biology as a high throughput science

Daily lab outputs:
- Flow cytometry
- Gel electrophoresis
- microarrays

And more:
- PCR
- Spectrometry
- Microscopy
- ...
Explosion of Omics Data:
Biology as a high throughput science

Data often not stored or impossible to retrieve

Daily lab outputs:
- Flow cytometry
- Gel electrophoresis
- Microscopy
- ...
Achievements from DICOM

- Inter Connectivity
- Inter Operability
- Archiving

All what ‘Omics’ data needs
Standardization efforts on biological data

- Gel Electrophoresis
  - Western Blot
  - 1D Gel
  - 2D Gel
- Flow Cytometry / FACS
- Microarray Experiments
- Mass Spectrometry
- Microscope Images

Status:
- Complete
- In progress
- Preliminary
CytometryML

--Robert C. Leif, Suzanne B. Leif, et al., XML_Med, a Division of Newport Instruments
Some Examples
Magnetic Resonance Imaging (The Biological Continuum – Tissue)

- MRI, PET
- deconvolution
- light microscopy
- Cryo electron microscopy
- NMR, x-rays
- AFM

Resolution and size scale:
- 1 nm
- 1 µm
- 1 mm
- 1 m

- molecules
- protein machines
- organelles
- cells
- tissues, organs, organisms
Imaging Bone and Articular Cartilage Damage

PD Sequence for Bone

SPGR Sequence for Articular Cartilage
Microscopy Imaging
(The Biological Continuum – Cells)

Resolution and size scale

- MRI, PET
- Cryo electron microscopy
- NMR, x-rays
- AFM

1 nm 1 μm 1 mm 1 m

- molecules protein machines
- organelles cells tissues, organs, organisms

Deconvolution light microscopy
Histological study using microscopy

DICOM Data

Standards Converter

Systems

Viscera

Tissue

Cells

Proteins

Genes

Unified
Visualisation

Data

e.g., Confocal Microscopy
Microarrays Imaging
(The Biological Continuum – Cells)

resolution and size scale

molecules protein machines
organelles cells tissues, organs, organisms

AFM
NMR, x-rays
Cryo electron microscopy

deconvolution light microscopy
MRI, PET

1 nm 1 µm 1 mm 1 m
Genetic marker screening using microarrays

DICOM Data

Standards Converter

Systems

Viscera

Tissue

Cells

Proteins

Genes

Unified Visualisation

Data

e.g., microarrays
Advanced Web-based Information Systems

Integrated framework
- standardized infrastructure
- continuous browsing
- enabled data fusion
What we are considering for the next step
Advanced Web-based Information Systems

- Systems
- Viscera
- Tissue
- Cells
- Cells
- Proteins
- Genes

Diagram showing a network of interfaces connecting Visualisation 1, Model 1, Visualisation 2, Model 2, Visualisation 3, Model 3, Database 1, and Database 2. The diagram also includes User Input and Display components.
Conclusions

- Because of the rapid development in molecular biology we now have to consider data across the Biological Continuum (BC).
- This is best done by the use of Web-based Advanced Medical Information System.
- It is important that data and models at all levels of the BC conform to a common information standard.
- DICOM meets these requirements, although it will require some modifications at the ‘Omics’ levels.
Thanks