Models and Information
(Chaps 1 & 2)
HINF1100
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Objectives

❖ **Understanding**
  ❖ Models (chapter 1)
  ❖ Information (chapter 2)

Chapter 1

Models

Towards Models

❖ **Healthcare is based on concepts about**
  ❖ Human body
  ❖ Disease   Ideas from
  ❖ Treatment   observation of the
  ❖ Nature--plants, chemicals, physics   physical world

❖ **Informatics is based on concepts about**
  ❖ Models
  ❖ Data   Abstract ideas
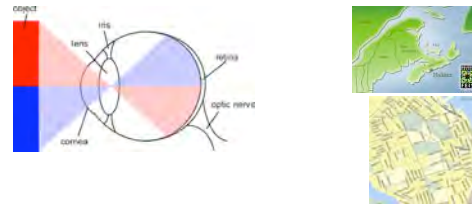 ❖ Information
  ❖ Systems

Models

❖ **Models**
  - ❖ An abstract (or actual) representation of an object or system from a particular viewpoint.

  - ❖ Define the way we learn about the world, interpret what we see, and apply our knowledge to effect change.
    - ❖ City map, Building design, Language!

  - ❖ A simpler copy of the world

- ❖ **Humans are good at making *Mental Models* of the world around them**

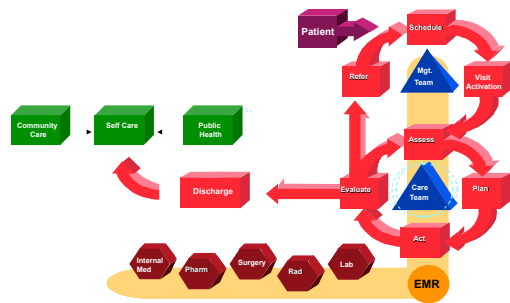© Dr. Syed Sibte Raza Abidi, (www.cs.dal.ca/~sraza)

Models

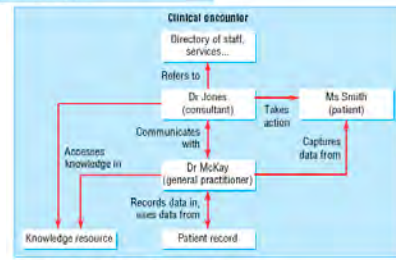© Dr. Syed Sibte Raza Abidi, (www.cs.dal.ca/~sraza)

Models

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Information Flow Model in a Clinical Environment

Ms Smith is a 58 year old florist with a 15 year history of renal impairment caused by childhood pyelonephritis who is experiencing tiredness and muscle cramps. She has sought medical attention for similar problems in the past, and is considering doing so again

© Dr. Syed Sibte Raza Abidi, *Information flows in a clinical environment*

Models in Healthcare

- ❖ **Model of patient**
- ❖ **Model of the disease**
- ❖ **Model of the diagnosis and treatment**
- ❖ **Model of the healthcare delivery process**

Patient Model

Model of Treatment

Clinical guideline on Treatment of Gastroesophageal Reflux Disease in Adults
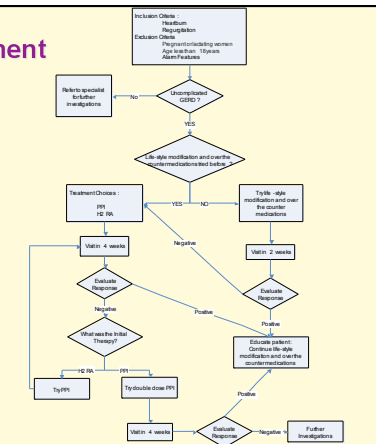
Model of Treatment

Clinical guideline on Clinical Management of Chronic Hepatitis B
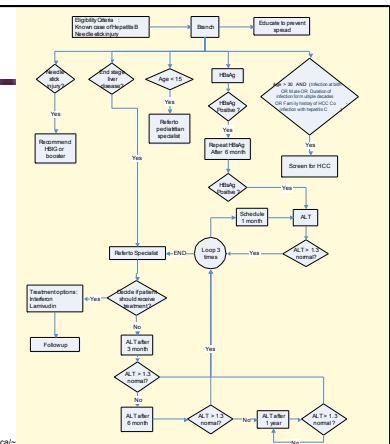
Model of Care Process

Clinical Pathway

Acute Coronary Syndrome Pathway

Eligibility
Patients presenting with chest pain at rest for greater than 15 minutes or suspected acute MI

Abstraction

- ❖ **The process of creating a model of the world is called** *abstraction*

  - ❖ Model is a simplification of the real concept or object
  - ❖ Model is a relative distortion of the real concept or object
    - ❖ Data is lost in the abstraction process
  - ❖ Model can be created from different perspectives of the real concept or object
    - ❖ Abstraction imposes a specific view of the object/concept
    - ❖ Specific point of views are possible
      - Physician sees a patient as client, person in need, a task, an interruption, a disease, a problem, a billing opportunity????

  - ❖ Model is a static representation of the real concept or object (the real object may change with time)

- ❖ **Models are created for a specific purpose**

Models as Templates

- ❖ **Models can be used as** *Templates* **to develop new concepts/objects called** *artifacts.*
  - ❖ Airplane engine model
    - ❖ Create different aircrafts
  - ❖ Tall building design model
    - ❖ Create different skyscrapers
  - ❖ Biochemical and pharmacological model of a biological organism
    - ❖ Create different drugs
  - ❖ Clinical care model for a disease
    - ❖ Create specialized clinical protocols for specific hospitals
  - ❖ DNA as model
    - ❖ Different humans!

Instantiation

- ❖ **Instantiation: The process of building a new** *artifact* **(as an instance of the model) using the model as a template to guide the development process.**

  - ❖ Artifacts may add data to the actual model
    - ❖ Artifact may be more complex than the model
    - ❖ Artifact may be an extension of the model

  - ❖ No two artifacts are the same
    - ❖ Variations to the actual model lead to differences in artifacts
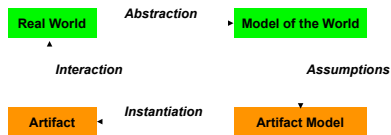
  - ❖ Artifact may change with time

- ❖ **Artifacts are created for a specific purpose**
  - ❖ Design assumptions

Models in Action

Real World → *Abstraction* → Model of the World

Interaction *Assumptions*

Artifact ← *Instantiation* ← Artifact Model

Models in Action

Human Body → *Abstraction* → Cardiovascular System

Interaction *Assumptions*

Artificial Heart ← *Instantiation* ← Heart Blueprint
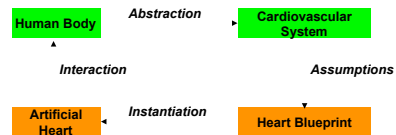
Health Informatics and Models

- **Health Informatics involves**
  - Abstracting health and healthcare delivery models
    - Information flow model
    - Resource planning model
    - Medical knowledge model
    - Business model

  - Instantiating healthcare models to develop health informatics systems
    - Health information systems
    - Clinical decision support systems
    - Medical knowledge-bases
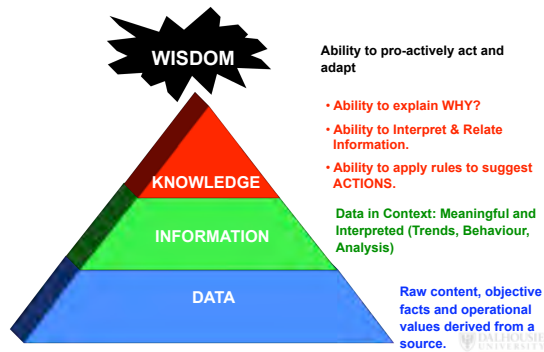   - Patient education systems
    - Medical imaging systems

Health Data & Information
(Chapter 2)
HINF1100

From Data to Wisdom

WISDOM

Ability to pro-actively act and adapt

- Ability to explain WHY?
- Ability to Interpret & Relate Information.
- Ability to apply rules to suggest ACTIONS.

KNOWLEDGE

Data in Context: Meaningful and Interpreted (Trends, Behaviour, Analysis)

INFORMATION

DATA

Raw content, objective facts and operational values derived from a source.

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From Data to Knowledge

- **Data**
  - Facts about the world

- **Information**
  - Data in context--tells something about the world
  - Obtained by applying knowledge to data

- **Knowledge**
  - Relationships between data
    - If patient's BP is greater than 135/95 then the patient is hypertensive

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Data ….

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Data ….

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Interpreting Data Models

16874	PatientID
54	Age
75	Weight (kg)
135	Systolic BP
95	Diastolic BP
240	Cholesterol
99	Temperature

Data

Language

Medical Data

All healthcare activities involve the generation, collection, analysis and the usage of data!

❖ Patient care
  ❖ **Identifying the health problems of a patient**
  ❖ **Categorizing the patient (ill vs. sick)**
  ❖ **Deciding what additional information is needed**
  ❖ **Assisting physician's actions**
  ❖ **Managing the treatment of the patient**

❖ Medical research (eg. clinical trials)
❖ Medical education
❖ Healthcare administration
❖ Hospital management

Medical Datum to Medical Data

Medical datum is a single observation of a patient's attribute:
❖ Temperature reading
❖ RBC count
❖ BP value
  120/80 (systolic = 120 ; diastolic = 80)

Medical datum can be defined by four elements:
❖ The patient being observed
❖ Some attribute of the patient being observed (eg. Temperature, BP, etc.)
❖ The value of the attribute being observed (eg. Temperature = 98.6 F)
❖ The time-stamp of the observation (eg. 10 am on Jan 7, 2003)

Medical Datum to Medical Data

Medical data are multiple observations :
❖ Multiple attributes of a patient observed over a period of time.
❖ Single attribute over *n* patients
❖ Multiple attributes over *n* patients

Types of Medical Data

Variety of medical data types:
- ❖ Narrative
    - ❖ **"The patient is suffering from acute cardiovascular pain …."**
- ❖ Numerical measurements
    - ❖ **Blood Pressure = 80/120; Pulse = 75**
- ❖ Textual codes
    - ❖ **Intl Classification of Diseases (ICD-9)**
    - ❖ http://icd9cm.chrisendres.com/
    - ❖ Logical Observation Identifiers Names and Codes (**LOINC**
- ❖ Signals
    - ❖ **ECG, EEG**
- ❖ Images
    - ❖ **X-Ray**
- ❖ Audio
    - ❖ **Ultrasound (http://www.fetaldopplerfacts.org/facts/dopplers/fetal-heartbeat-doppler-sounds.php) , heartbeat**
- ❖ Speech

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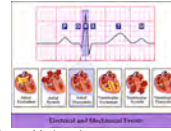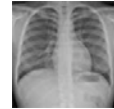
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Medical Data Modalities

Data Recording Mediums
- ❖ Electronic (Digital)

- ❖ Paper/Film based
    - ❖ **Hand-written**
    - ❖ **Typed**
    - ❖ **Photograph**
    - ❖ **Image**

- ❖ Analog signals (eg. ECG)

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