


Models and Information
(Chaps 1 & 2)
 HINF1100
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Objectives


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

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Chapter 1

Models




Towards Models

- ❖ **Healthcare is based on concepts about**
 - ❖ Human body
 - ❖ Disease
 - ❖ Treatment
 - ❖ Nature—plants, chemicals, physics

Ideas from observation of the physical world
- ❖ **Informatics is based on concepts about**
 - ❖ Models
 - ❖ Data
 - ❖ Information
 - ❖ Systems

Abstract ideas

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Models

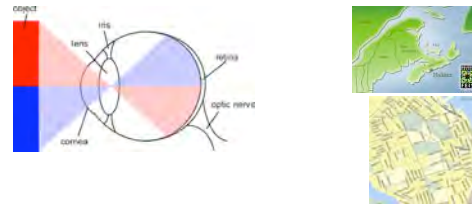
❖ Models

- ❖ 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

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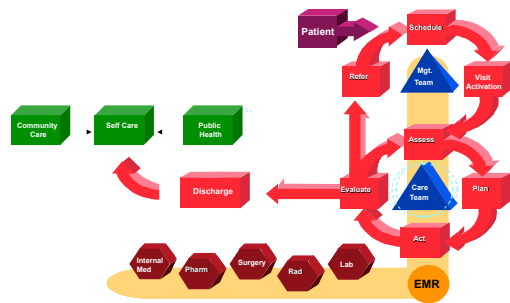
Models



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Models

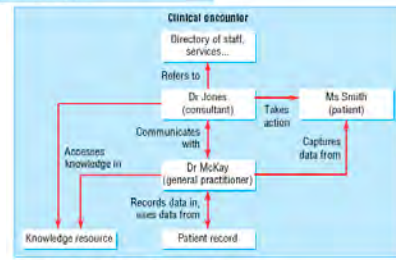


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Information Flow Model in a Clinical Environment

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



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Models in Healthcare

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

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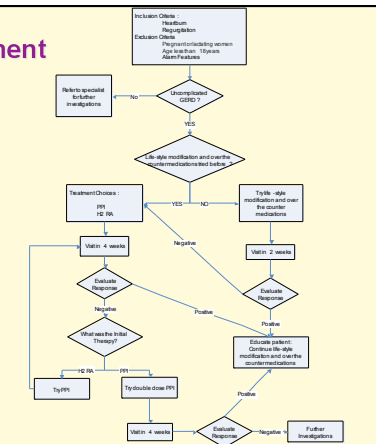
Patient Model



10 © Dr. Sy

Model of Treatment

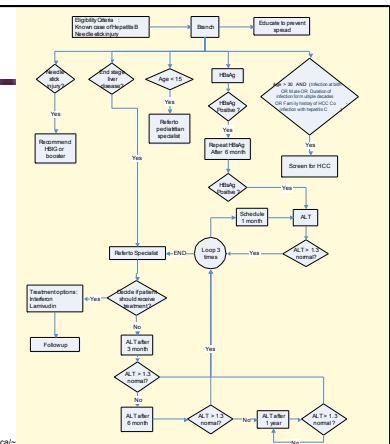
Clinical guideline on Treatment of Gastroesophageal Reflux Disease in Adults



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Model of Treatment

Clinical guideline on Clinical Management of Chronic Hepatitis B



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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

First name: _____ Date: _____
 Last Name: _____ Time of admission: _____
 BNO: _____ Time of onset of symptoms: _____
 CMI No: _____
 Attach Patient Label

Medication/Action	Time	Before admission	Withhold or not done (reason)
Aspirin 150mg chewed	Time	<input type="checkbox"/>	<input type="checkbox"/>
Single Dose	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Aspirin 81mg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Aspirin 325mg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ECG monitor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Medication	Time	<input type="checkbox"/>	<input type="checkbox"/>
Diagnosis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diagnosis 2 (if any)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cybernetic Risk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Estimated weight kg	Value	<input type="checkbox"/>	<input type="checkbox"/>

Back to A/C & ECG
 Back to A/C & ECG
 Back to A/C & ECG

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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

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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!

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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

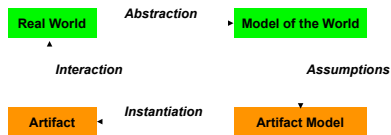
❖ Artifacts are created for a specific purpose

- ❖ Design assumptions

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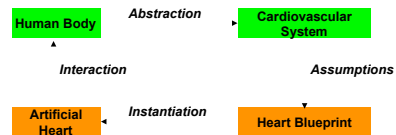
Models in Action



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Models in Action



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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

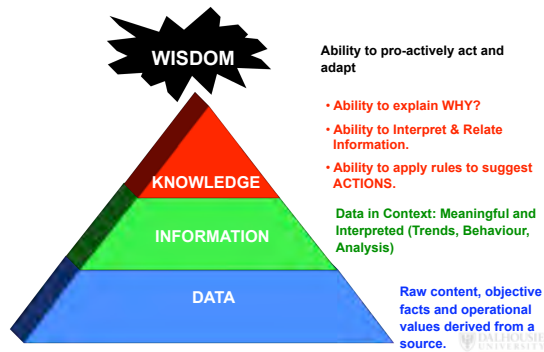
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Health Data & Information (Chapter 2) HINF1100



From Data to Wisdom



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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

```

103,volvo,gas,turbo,four,seadan,rwd,front,104.30,188.80,67.20,56.20,3045,ohc,four,
130,mpfi,3.62,3.15,7.50,162,5106,17,22,18420,-2
161,mitsubishi,gas,std,two,hatchback,fwd,front,91.70,157.30,64.40,50.80,2004,ohc,
four,92,2bbl,2.97,3.25,9.40,68.5500,51.56,8660,3
104,saab,gas,turbo,four,seadan,two,front,99.10,186.60,66.50,56.10,2883,ohc,four,
121,mpfi,3.54,3.07,9.00,160,5500,19,26,18620,2
134,toyota,gas,std,two,convertible,rwd,front,96.40,176.20,65.60,59.00,2975,ohc,2
our,146,mpfi,3.62,3.50,9.30,116,4800,24,30,17600,1
7,volkswagen,gas,std,two,convertible,fwd,front,94.50,169.30,64.20,55.60,2254,ohc,
four,109,mpfi,3.19,3.40,8.50,90,5500,24,29,11595,3
7,porsche,gas,std,two,hardtop,rwd,rear,89.80,168.60,65.00,51.40,2798,ohc,6,cyl,19
4,mpfi,3.74,2.90,8.90,207,3900,17,23,16328,3
108,nissan,gas,std,four,wagon,fwd,front,94.20,170.20,63.80,53.50,2024,ohc,four,9
7,2bbl,3.15,3.23,8.40,65,3200,31,37,7349,1
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four,90,apfi,3.03,3.25,7.60,102,5500,24,30,7800,1
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ur,152,4cyl,3.70,3.52,71.00,95,4150,28,33,13200,0
78,honda,gas,std,four,wagon,fwd,front,96.50,187.10,63.60,58.30,2024,ohc,four,52,
1bbl,2.92,3.41,9.20,76,6000,30,34,7295,0
    
```

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Data

```

103,volvo,gas,turbo,four,seadan,rwd,front,104.30,188.80,67.20,56.20,3045,ohc,four,
130,mpfi,3.62,3.15,7.50,162,5106,17,22,18420,-2
Attribute: Attribute Range
-----
1. speedlim: 41, 41, 61, 51, 51, 31
2. normalized-inaxes: continuous from 95 to 256
3. make: afa=renault, audi, bmw, chrysler, dodge, honda,
isuzu, jaguar, mazda, mercedes-benz, mitsub,
mitsubishi, nissan, peugot, plymouth, porsche,
renault, saab, subaru, toyota, volkswagen, volvo
diesel, gas
4. fuel-type: 800 turbo
5. application: four, two
6. sub-of-body: four, two
7. bodystyle: hardtop, wagon, sedan, hatchback, convertible,
4wd, fwd, rwd
8. drive-shaft: front, rear
9. engine-location: continuous from 96.4 to 9.
10. wheel-base: continuous from 241.1 to 209.1
11. length: continuous from 69.3 to 72.0
12. width: continuous from 47.8 to 58.4
13. height: continuous from 168 to 166
14. curb-weight: 480, 400, 31, ohc, ohc, ohc, ohc
15. engine-type: 4cyl, 6cyl, 4cyl, 6cyl, 6cyl, 6cyl
16. num-of-cylinders: 4cyl, 6cyl, 4cyl, 6cyl, 6cyl, 6cyl
17. engine-size: continuous from 81 to 326
18. fuel-system: 2bbl, 2bbl, 4bbl, 1bbl, 4bbl, apfi, apfi, apfi
19. fuel: continuous from 7.54 to 5.34
20. stroke: continuous from 2.07 to 4.17
21. compression-ratio: continuous from 7 to 14
22. horsepower: continuous from 46 to 206
23. peak-rpm: continuous from 4150 to 4600
24. city-mpg: continuous from 18 to 48
25. hwy-mpg: continuous from 16 to 34
26. price: continuous from 116 to 4340
    
```

24



Interpreting Data Models

16874	PatientID
54	Age
75	Weight
95	Systolic BP
95	Diastolic BP
240	Cholesterol
99	Temperature

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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

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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)

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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

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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
 - ❖ [Int'l 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) (<http://www.fetaldopplerfacts.org/facts/dopplers/fetal-heartbeat-doppler-sounds.php>), heartbeat
- ❖ Speech

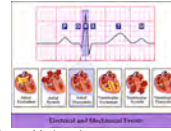
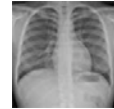


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Medical Data Modalities

Data Recording Mediums

- ❖ Electronic (Digital)
- ❖ Paper/Film based
 - ❖ Hand-written
 - ❖ Typed
 - ❖ Photograph
 - ❖ Image
- ❖ Analog signals (eg. ECG)



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