

Introduction to e-Health and Biomedical Informatics

Information Systems 90069 2020

Brian E. Chapman, Ph.D.

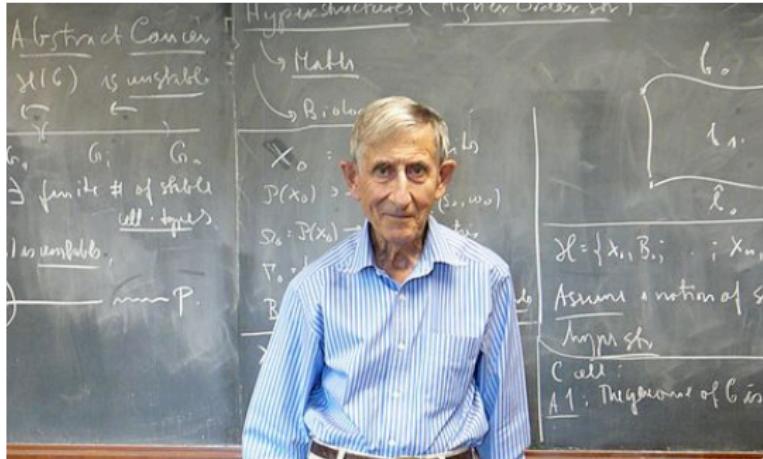
University of Melbourne

Biomedical Informatics as Rebellion



Figure 1: Portrait of the Instructor as an angry Young Man

In honor of Freeman Dyson
1923-2020



The framework for this lecture comes from an essay “The Scientist as Rebel” Professor Dyson published in the New York Review of Books in 1995 and later republished in his collection of essays, also title *The Scientist as Rebel* (2006 New York Review of Books)

Who Was Freeman Dyson?

One of the most influential physicists of the 20th century who made important contributions to¹

- ▶ quantum electrodynamics
- ▶ solid-state physics
- ▶ astronomy
- ▶ nuclear engineering.

¹Wikipedia

Science as rebellion:

Dyson's ideal Scientist as
Rebel was Benjamin Franklin



Figure 3: Painting by Benjamin West

"Benjamin Franklin combined better than anyone else the qualities of a great scientist and a great rebel. As a scientist, without formal education or inherited wealth, he beat the learned aristocrats of Europe at their own game. . . .

“Franklin’s triumph as a rebel resulted from the fact that his rebellion was not impulsive but was carefully thought out over many years.”²

²Dyson 2006 p. ix

“If science ceases to be a rebellion against authority, then it does not deserve the talents of our brightest children.”³

³Dyson 2006, p. 7

Successful Rebellion Requires Judiciousness

“Franklin became a rebel only when he judged the time to be ripe and the costs to be acceptable. As a rebel he remained a conservative, aiming not to destroy but to preserve as much as possible of the established order of society.””

Is Anyone Born to Rebel?

"One of the most authoritative and important treatises in the history of the social sciences." —Edward O. Wilson, author of *On Human Nature*

BORN TO REBEL

*Birth Order, Family Dynamics,
and Creative Lives*



Not Firstborns!

At least according to the historian of science
Frank J. Sulloway

- ▶ Benjamin Franklin was not a first born child.

Two Medical Informatics Rebels

- ▶ Homer Warner
- ▶ Larry Weed

Is Rebellion a Relevant Term?

Thesis

Biomedical Informatics is a rebellion against the status quo of the health care system regarding:

- ▶ Who has information
- ▶ How the information is used
- ▶ What information is used

Who are the Protagonists and Antagonists in this Revolution?

What are the Weapons of this Informatics Rebellion?

Digital computers and communication
technologies

What are the Ideologies Behind the Revolution

- ▶ The unaided human mind is ill suited for practicing modern medicine
- ▶ Effective and efficient healthcare is fundamental need for human flourishing

Homer Warner, M.D., Ph.D.



Figure 5: Official Homer Warner portrait

Homer Warner, Rebel?

- ▶ Eldest Child
- ▶ High school and university quarterback
- ▶ Navy pilot

HW: Rebellion against *His* Ignorance

- ▶ “When I finished medical school I thought I knew everything. . . .”

HW: Rebellion against *His* Ignorance

- ▶ “When I finished medical school I thought I knew everything. . . .”
- ▶ “But when I finished my internship I realized I didn’t know anything. . . .””

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- ▶ “When I finished medical school I thought I knew everything. . . .”
- ▶ “But when I finished my internship I realized I didn’t know anything. . . .””
- ▶ “And I didn’t want to be in that state.”

HW: Rebellion against *His* Ignorance

- ▶ “When I finished medical school I thought I knew everything. . . .”
- ▶ “But when I finished my internship I realized I didn’t know anything. . . .”
- ▶ “And I didn’t want to be in that state.”
- ▶ Went to pursue PhD at the University of Minnesota

HW: Rebellion with Curiosity

- ▶ Analog computers to analyze cardiac pressure waveforms
 - ▶ Taught him more of his ignorance
 - ▶ Studied engineering math
- ▶ In 1960 University of Utah gets first digital computer
 - ▶ “How can I justify learning how to program?”

HW: Rebellion with Digital Computer

- ▶ Model (sacred domain of) diagnostic process
- ▶ Bayesian diagnosis of congenital heart problems
- ▶ JAMA 1961
 - ▶ First paper describing computer-aided decision support with real patient data

HW: Rebellion against *Others'* Ignorance

Homer's most important contributions were rooted in a chance encounter with a nurse in an ICU

One day Warner went down to visit the ICU and there was a nurse over one of the beds pumping up a blood pressure cuff on the left arm of a patient who had a catheter in the artery on the right arm to monitor the pressure.

*There was a yellow light on the panel.
The nurse was embarrassed when she
saw him watching her and explained
she didn't know what to do next.*

They sat down at the computer terminal and looked at all the data both in the computer and in the chart. They called the resident and jointly decided that the patient probably was having a cardiac tamponade.

*They called the surgeon who
promptly took the patient back to
the operating room.*

Eureka Moment

“It was clear to him that just providing data and displaying it in a variety of ways may not be an adequate solution to the decision-making problem.

“This nurse clearly needed help in the interpretation of the data and that interpretation required more data than just the hemodynamic measurements in the computer....[M]ost of all it required that the **computer have some medical knowledge.** They needed to build some intelligence into the system.”

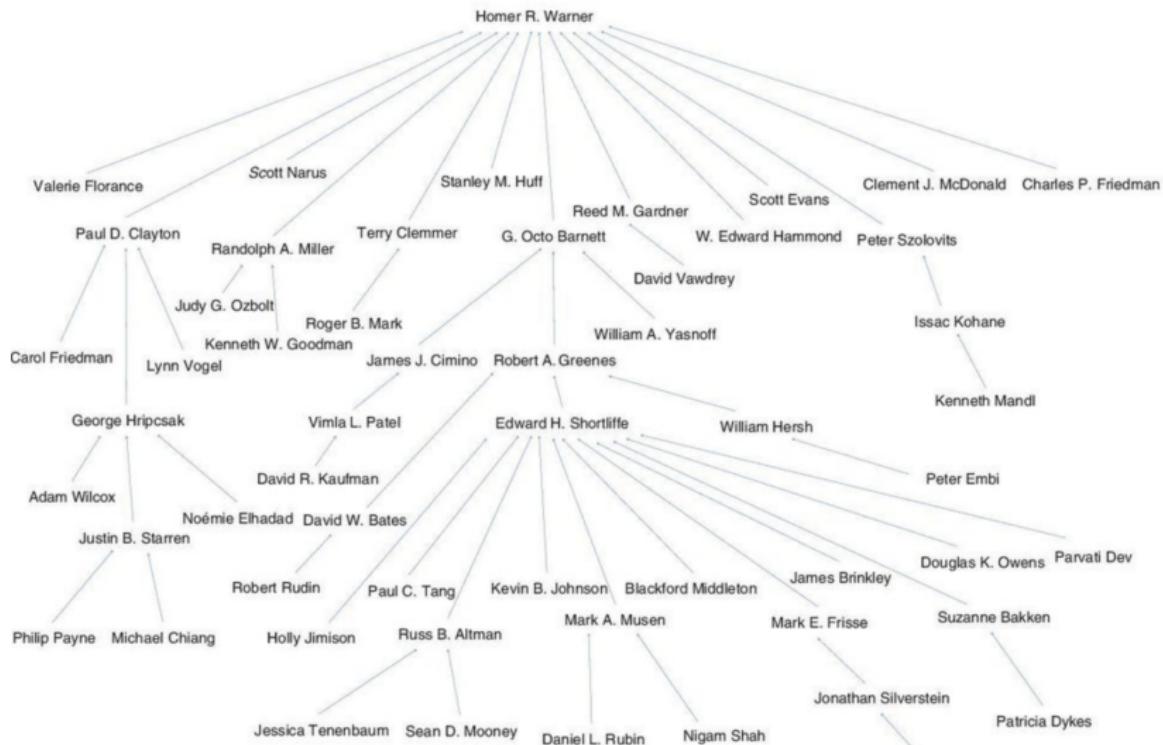
HELP

- ▶ Health Evaluation Through Logical Processing (HELP)
- ▶ An electronic medical record explicitly to facilitate decision support

The heresy of HELP

- ▶ Use computers to bring “expert” knowledge to “lower level” providers
 - ▶ Knowledge near the patient
- ▶ Flatten the hierarchy

James J. Cimino Edward H. Shortliffe



Homer and Socrates

“Well, although I do not suppose that either of us knows anything really beautiful and good, I am better off than he is, —for he knows nothing, and thinks that he knows; I neither know nor think that I know. In this latter particular, then, I seem to have slightly the advantage of him.”

(Apology)

Larry Weed⁴

⁴This introduction to Larry Weed is taken from The Economist's "The Computer Will See You Now"

Where Did Reed's Rebellion Originate?

The contrast between

- ▶ The careful, thoughtful methodology of his basic science lab work: “I worked with one or two problems until I understood them, wrote up my findings, and got them published in a journal.”
- ▶ And the chaotic, frantic, multitasking of the clinic

"The beginning clinical clerk, the new intern, and the practicing physician are confronted with an apparent contradiction. Each is asked, as a 'whole' physician, to accept the obligations of meeting many problems simultaneously and yet to give to each the single-minded attention that is fundamental to developing and mobilizing his or her enthusiasm and skill—for these two virtues do not arise except where an organized concentration upon a particular subject is possible."

Don Detmer⁵ on Larry Weed



“[Larry Weed] is one of the giants of the last 500 years in medical thinking.”

Figure 7: Don Detmer

⁵Don Detmer, M.D. Medical Director for Advocacy and Health Policy of the American College of Surgeons Professor Emeritus the University of Virginia



Figure 8: Larry Weed⁶

⁶Lancet obituary

C. Safran⁷ Introducing Larry Weed



Figure 9: Charles Safran

⁷Harvard Medical School

“In the mid-19th century, the mortality rate from puerperal (or “childbed”) fever at Vienna General Hospital’s maternity ward was so high that many women, it is said, preferred to give birth in the street.

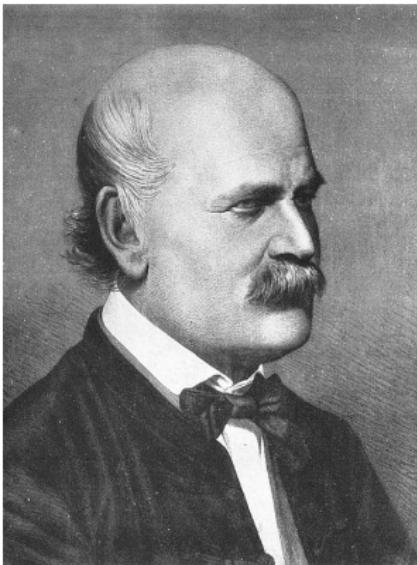


Figure 10: Ignaz Semmelweis

“Then a doctor called Ignaz Semmelweis achieved a dramatic reduction in deaths by insisting that doctors wash their hands between autopsies and obstetrical examinations.

“But other doctors refused to believe that their own hands transferred disease. Besides, they grumbled, hand-washing was far too time-consuming. Dr Semmelweis was widely ridiculed and eventually fired.”

Interesting Introduction?

SOAP Documentation

Larry Weed became famous in the 1960s by tackling the non-scientific nature of medical documentation. He introduced the SOAP (Subject, Objective, Assessment, Plan) method of documentation. That is now almost universally used in medicine.

SOAP Notes

- ▶ Subjective: What the patient says about herself and her condition
- ▶ Objective: What the physicians observes/measures about the patient
- ▶ Assessment: Summary of patient, differential diagnoses
- ▶ Plan: Next steps in workup or therapy

Are SOAP Notes Why Medicine Disliked Weed?

$$\frac{\text{Semmelweis}}{\text{Handwashing}} = \frac{\text{Weed}}{\text{Medical Documentation}} = ?$$

Why was Weed so Concerned About Documentation?

- ▶ The medical record is the **database** from which medical reasoning proceeds
- ▶ Without an accurate, searchable (discoverable) database there can be **no scientific reasoning about a patient**

Weed the Caustic Rebel

Weed Challenged the Fundamental Assumptions of Medicine

“The unaided human mind is not a reliable instrument for this processing of information in the solution of patients' problems. Yet medical education and licensure permit physicians to try exactly that.”

“Psychologists proved in the 50's that doctors cannot do their job.”⁸

⁸paraphrase of Weed talk I heard while in graduate school

“The diplomas [medical schools] grant and the licensing exams the [governments] give could not possibly mean and guarantee what the public thinks they mean.”

Who Inspired Weed?

Homer Warner, Francis Bacon, Alfred North Whitehead,

Francis Bacon's Idols of the Mind

- ▶ Universal mental limitations “inherent in human nature”



Francis Bacon's Idols of the Mind

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Francis Bacon's Idols of the Mind

- ▶ Universal mental limitations “inherent in human nature”
- ▶ Acquired beliefs of human problem solvers “corrupts the light of nature”
- ▶ The limits of language “throw everything into confusion”
- ▶ Developed systems of thought “which have become inveterate by tradition, implicit credence and neglect.”⁹

⁹“For the past 40 years, research by psychologists has confirmed the writings of Bacon.”

Alfred North Whitehead

“It is a profoundly erroneous truism -that we should cultivate the habit of thinking about what we are doing. The precise opposite is the case. Civilization advances by extending the number of important operations which we can perform without thinking about them.””

Robyn Dawes

“The greatest obstacles to using external aids may be the difficulty of convincing ourselves that we should take precautions against ourselves.”

The Last Three Slides
Provide the Intellectual
Framework for this Course!

Did Warner and Weed Have Bad Timing?

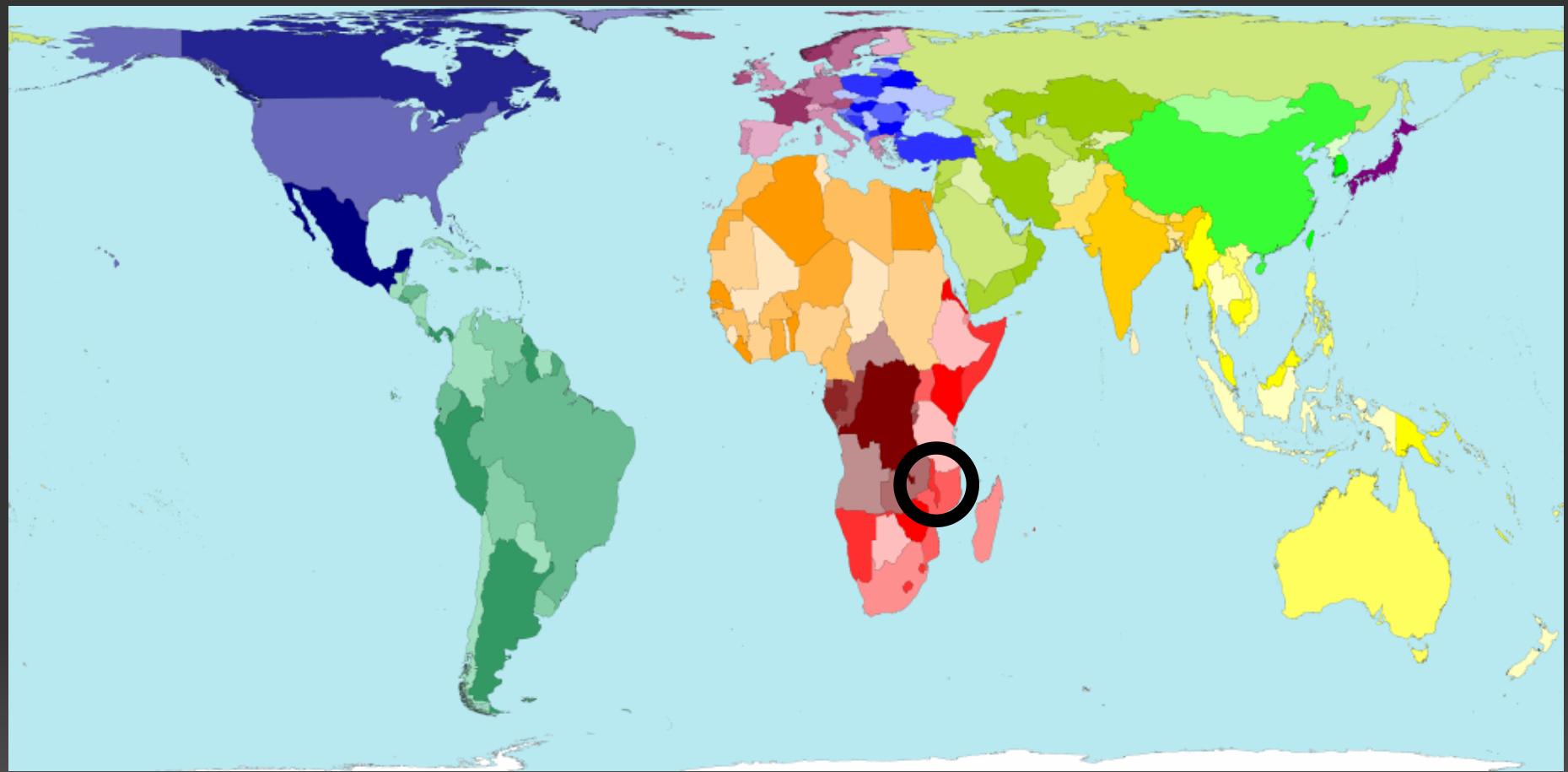
- ▶ Franklin revolted when he “judged the time to be ripe and the costs to be acceptable.”
- ▶ Their heyday of Warner and Weed’s work was 50 years ago
- ▶ Was the time ripe?
- ▶ Were the tools of the revolutionaries sufficient?

Measuring Efficiency of Use in an EMR Developed in Malawi: Comparing Novice Performance to a Prediction of Skilled Use

Zach Landis Lewis, M.L.I.S
Gerald Douglas, M.S.I.S.
Valerie Monaco, Ph.D, M.C.H.I.



University of Pittsburgh
Department of Biomedical Informatics



Background: Malawi

	Pennsylvania	Malawi
Area	119,282 km	118,484 km
Population (2007 est.)	12.4 million	13.6 million
Life expectancy	77.8	43.5
Number of people living with HIV/AIDS	18,000 (0.15%)	900,000 (8%)
Number of doctors	35,000	250



Clinical environment

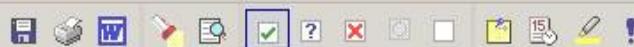
- task shifting
- high staff turnover
- no computing experience



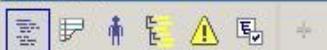
Goals

- To improve patient care and public health
- To create an EHR that is sustainable





Overviews

**Patient history:**

- Gastrointestinal tract:
 - **Acute abdominal pain:**
 - Localization: periumbilical
 - Chronology:
 - Current episode since: 2 hours [2 - 3]
 - Course:
 - Paroxysmal: Duration paroxysm 5 minutes [5 - 10]; Frequency 4 /hour [4 - 5]
 - Past episode(s): absent

Navigator

- Patient history
 - + General symptoms
 - + Respiratory tract
 - + Circulatory tract
 - Gastrointestinal tract
 - Description
 - + General feeding pattern
 - + Food intolerance/ allergy
 - + Swallowing difficulties
 - + Pyrosis
 - + Vomiting
 - + Nausea
 - + General defecation pattern
 - Acute abdominal pain
 - Description
 - + Localization: Perumbilical
 - Chronology
 - Current episode since: 2 hours [2 - 3]
 - Course
 - Paroxysmal
 - + Duration paroxysm: 5 minutes [5 - 10]
 - + Frequency: 4 /hour [4 - 5]
 - Continuous
 - + Past episode(s)
 - Description
 - Influential factors

Entry form

← ↑ ↓ → ↻ Acute abdominal pain ↺ ↻

Acute abdominal pain: Description: **Localization**

- Perumbilical
- Upper right
- Upper left
- Upper middle
- Lower right
- Lower left
- Lower middle

Current episode

- Current episode since: hours
- Course
- Paroxysmal
- Duration paroxysm: minutes
- Frequency: /hour
- Continuous

Past episode(s)

- Total number: []
- Frequency: /month
- Time since last episode: month
- Severity:
- Treatment received: ...

Associated manifestations

- Description: ...
- Fever

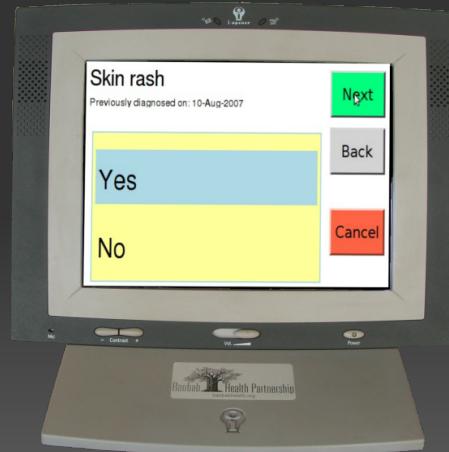
Physical examination

- General
- Abdomen



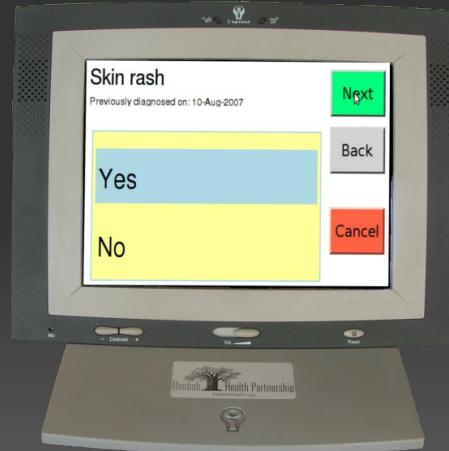
Efficiency of use

How efficient are novices in comparison with skilled users?



Research Question

How efficiently do novices perform tasks using the touchscreen interface, relative to a prediction of skilled use?



Death of an African Child

Case Study

**Developed by
Rashid Deula & Gerry Douglas**



Gerry Douglas
Center for Health Informatics for the Underserved
Department of Biomedical Informatics
University of Pittsburgh

Presentation Outline

- The Death of an African Child (the case)
- Analyze each step of the management of the patient
- Determine what problems occurred

The Death of an African Child

- Prior to arrival at the hospital
 - mother brought the child very late
 - tried several alternative forms of treatment prior to coming which delayed treatment
- On arrival at the hospital
 - assessed in reasonable time
 - started on appropriate medications
 - appropriate tests ordered

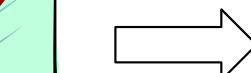
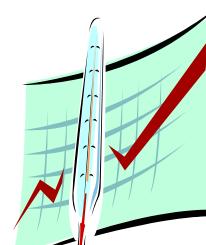
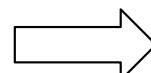
What went wrong?

What went wrong?

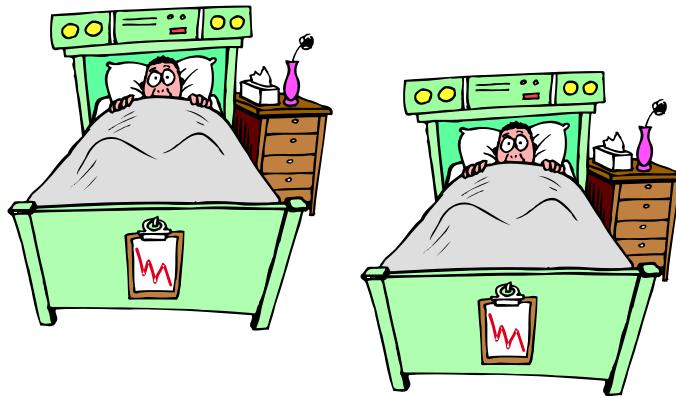
- The patient's management broke down when it came to the diagnostic tests that were ordered, summarized as follows
 - Poor specimen handling
 - Poor specimen labeling & documentation
 - Inability to track specimens effectively as they moved through the testing process
 - No mechanism for knowing when results are available

Review of Diagnostic Workflow

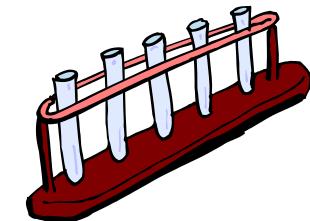
Doctor initiates the order by writing it in the patient's chart



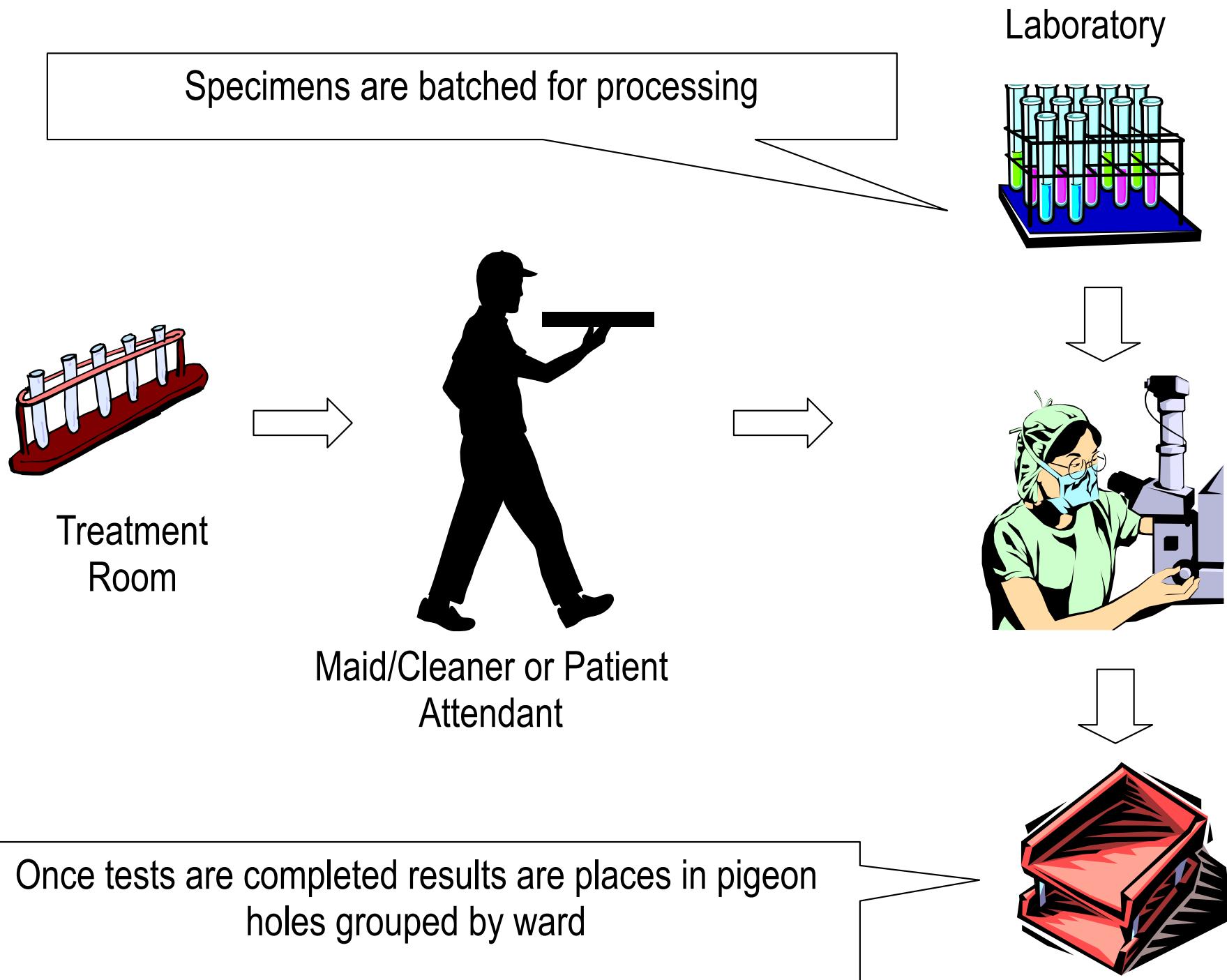
Patient's Chart



Ward



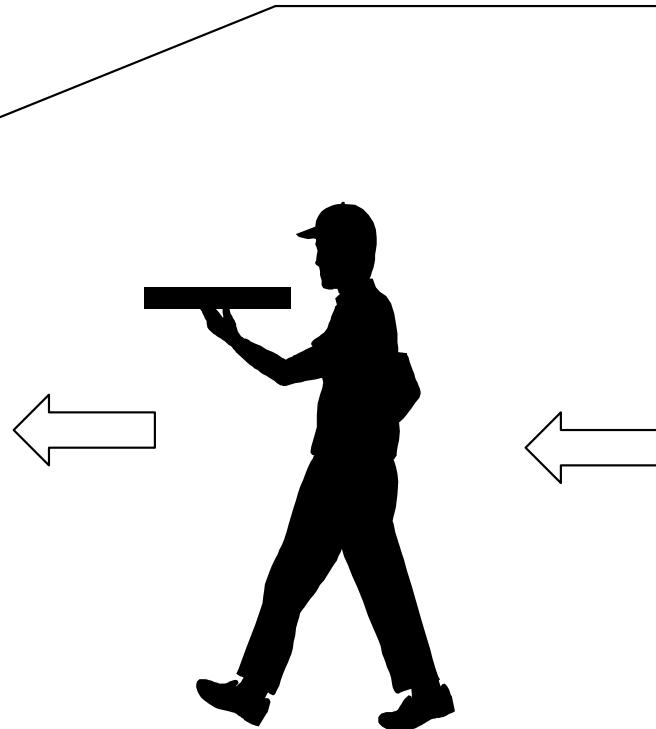
Treatment Room



Results are collected from the lab in batches and stored at the nursing station



Nursing Station

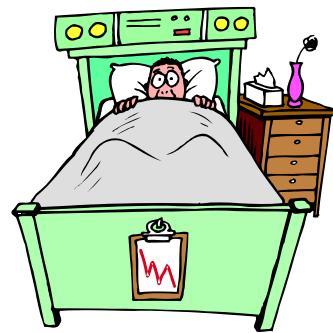


Maid/Cleaner or Patient Attendant

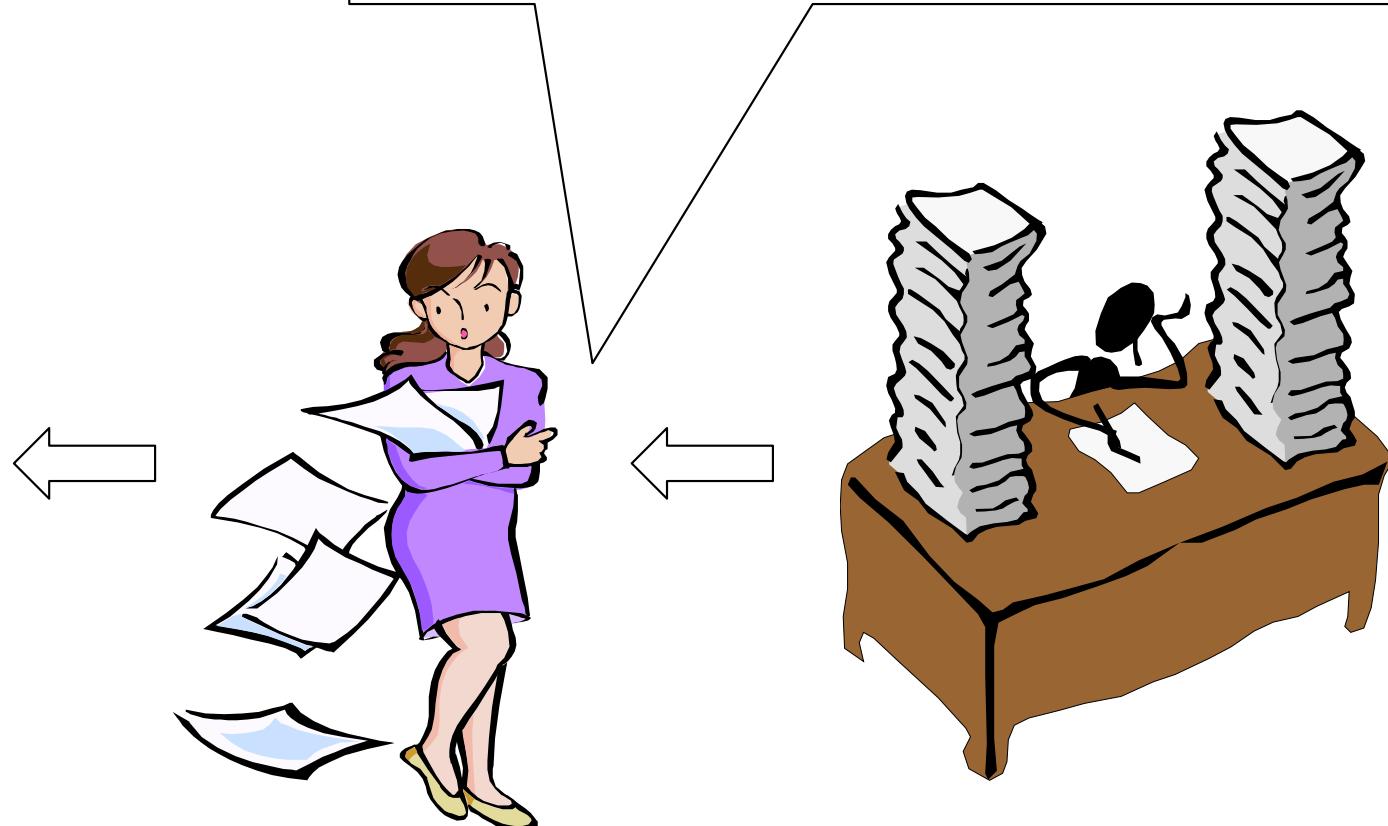


Laboratory

Results are periodically distributed to patients on the ward



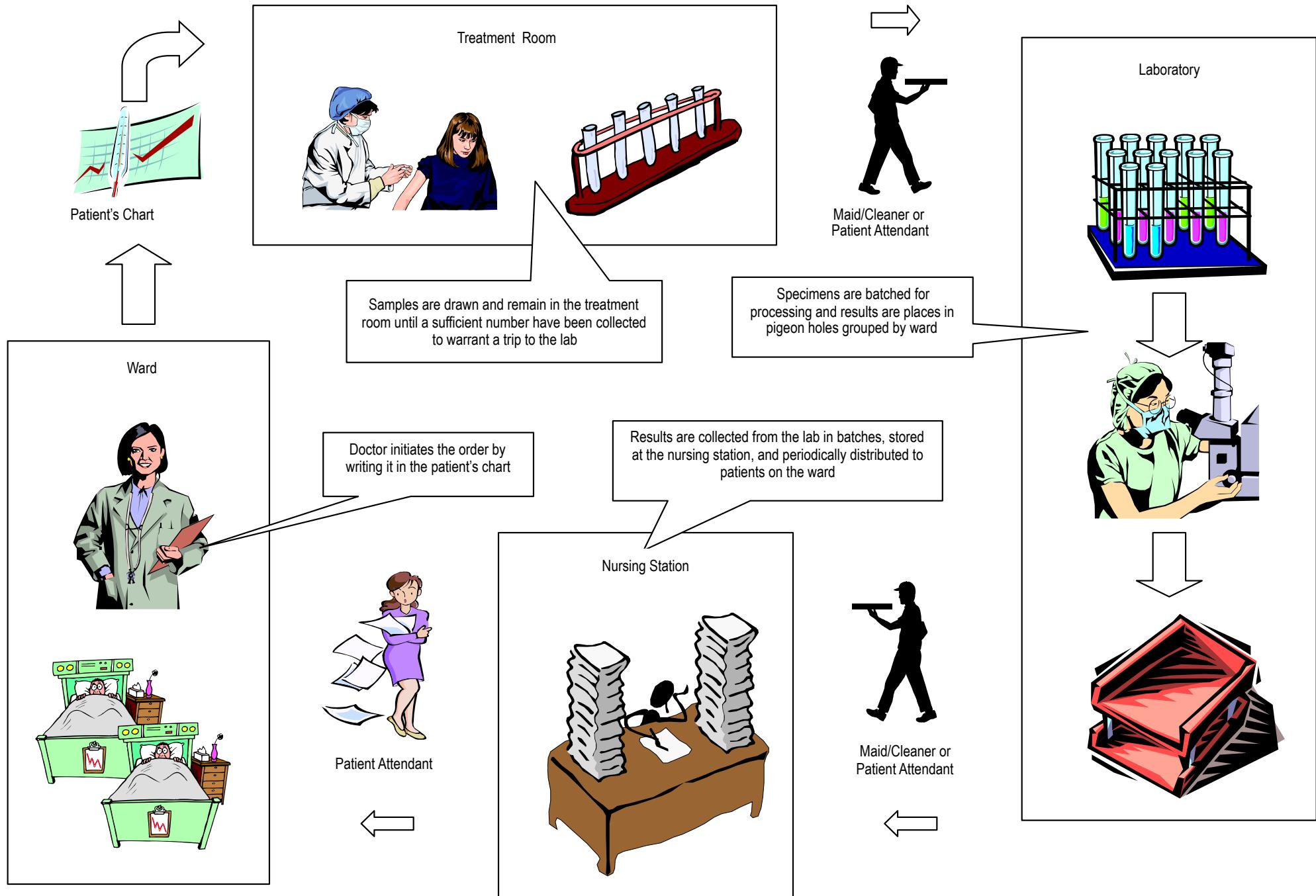
Ward



Patient Attendant

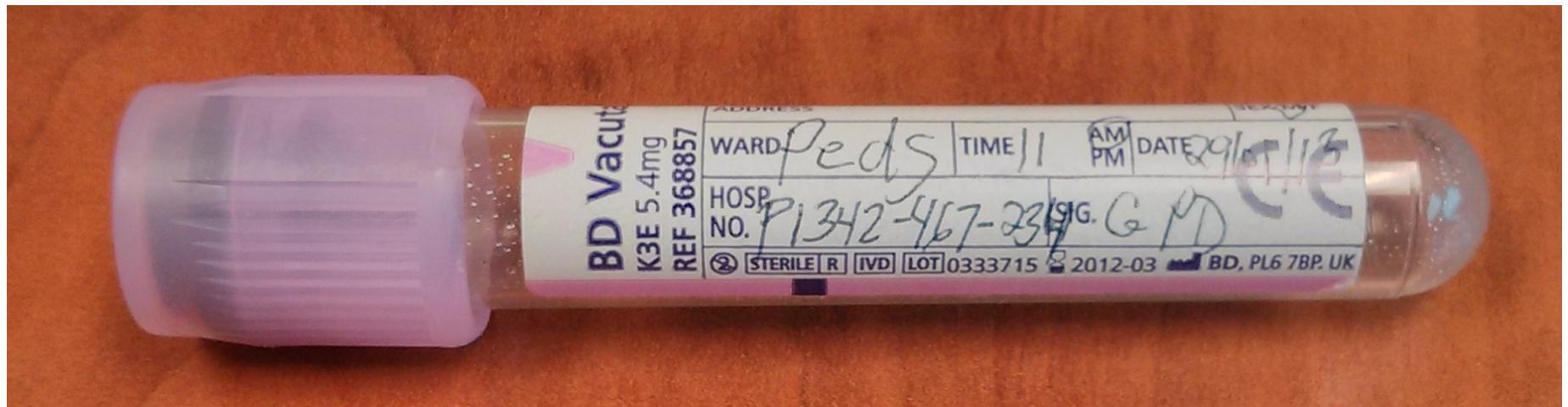
Nursing Station

Flowchart of Specimen Ordering, Testing and Results Reporting Process



Labeling & Documentation

- Labels on specimen tubes were hand written and hard to read
- Patient identifying indicators were sometimes omitted from labels



Labeling & Documentation

- Lab order forms suffered from similar problems, particularly the absence of clinical data about the patient

Name of Patient			Clinical Data/History		Exam Requested
[REDACTED]	[REDACTED]	[REDACTED]	headache , reactive pt		Microscopy India Ink Glucose protein cell count (smear) WET FILM culture
Age	Sex	Date Collected	Time collected	Clinician Name & Signature	
Nature of specimen		24/7/07	10 AM	J.B.	
<input type="checkbox"/> Current Antibiotics List:					
<input type="checkbox"/> Prior Antibiotics List:					
o CSF / Ascitic Fluid / Pleural Fluid					
<input checked="" type="radio"/> Clear		<input type="radio"/> Cloudy	<input type="radio"/> Bloodstained		
<input type="radio"/> Colourless			<input type="radio"/> Xanthochromic fluid	<input type="radio"/> GRAM STAIN	
<input type="radio"/> W.B.C.s	nil	/cmm	<input type="radio"/> Protein	mgms%	
<input type="radio"/> R.B.C.s	nil	/cmm	<input type="radio"/> Globulin		
<input type="radio"/> Lymphocytes		%	<input type="radio"/> Glucose	18	mgms%
<input type="radio"/> Polymorphs		%	<input type="radio"/> Chloride	mgms%	
<input type="radio"/> CULTURE			<input type="radio"/> SENSITIVITY		
			Dept	Ward	Lab Number
			A		B - 104

Ministry of Health – Kamuzu Central Hospital
Bacteriology

Specimen Handling

- When blood is allowed to sit for a long time without being agitated it can clot, preventing tests from being performed
- Anticoagulant is added to certain test tubes, but still has to be thoroughly mixed with the blood sample to be effective
 - Specimen tubes are differentiated by using different colors for the top of the tube.

Inability to Track Specimens

- Once a specimen is drawn there is no mechanism to track it as it moves from the ward to the lab, through the batching and testing process, and know when results are available
- Manual tracking of specimens is required in emergencies and proves to be very labor intensive

Availability of Results

- Results are reported back to the ward on paper
- Results come back in batches, sometimes causing a delay in reporting abnormal results
- Forms are unsorted making it hard to find results for a specific patient
- Nobody is specifically assigned to collect the results, often maids are sent to the lab

How Can Information Technology Help?

How Can Information Technology Help?

- Generate legible and complete lab orders and specimen labels
- Assign accession numbers to each specimen and use the number to track specimens electronically
- Identify specimens that appear to be “missing” i.e. didn’t make it to the lab
- Disseminate test results electronically



Specimen Labeling System (2003)

Nurses & clinicians use a touchscreen clinical workstation in the treatment room to generate orders and barcoded specimen labels
All information is stored in the specimen tracking database

Blood

CSF

Urine

Aspirate

Stool



Full blood count

Malaria parasite

Group & cross match

Urea & Electrolytes

Fasting blood sugar



Print

Clear

Finish



Cancel

Blood
CSF
Urine
Aspirate
Stool



--



Print

Clear

Finish

Cancel

Memory Tambala

04-Sep-02 / 8:35:30 AM

P/27708/02 (F) 36mo

MP

Paediatrics - Isolation

Blood
CSF
Urine
Aspirate
Stool



Print

Clear

Finish

Cancel

Memory Tambala
04-Sep-02 / 8:35:30 AM
P/27708/02 (F) 36mo
MP, FBC
Paediatrics - Isolation

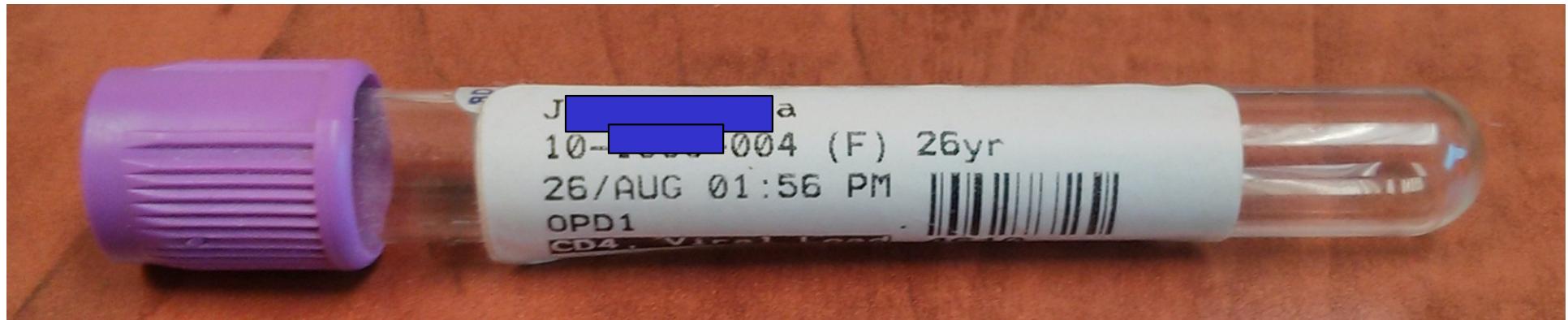
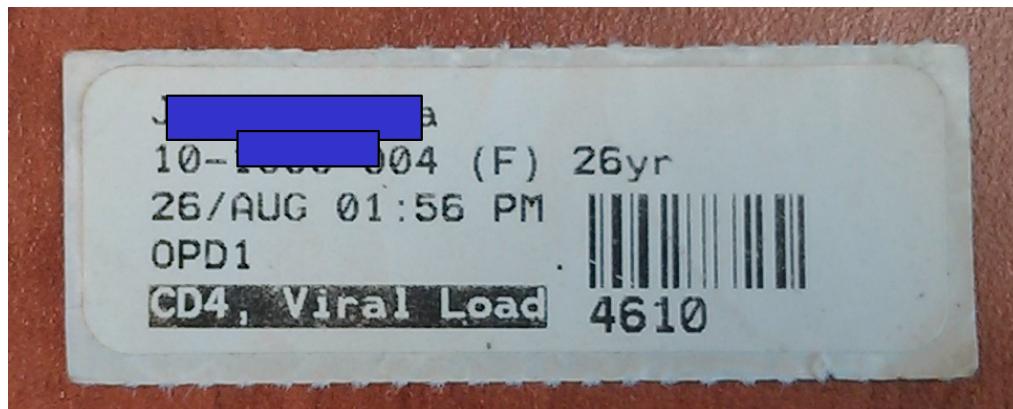
Memory Tambala
04-Sep-02 / 8:35:30 AM
P/27708/02 (F) 36mo
G/XM
Paediatrics - Isolation

Memory Tambala
04-Sep-02 / 8:35:30 AM
P/27708/02 (F) 36mo
Urinanal
Paediatrics - Isolation



A Strategy for Specimen Tracking

- A barcoded label is affixed to all samples
- Samples can be scanned at each stage of the process – drawing the sample, receiving it in the lab, batching it for processing, conducting the test
- Automated checks can be incorporated



Disseminate Results Electronically

- Once test results become available in the lab they can be immediately transmitted to the ward electronically
 - Much faster
 - Reduces the chance of the paper-based report being misplaced
- Results can be printed on a label at the nursing station and affixed to the patient's medical record

Scenario 1: for Printing Results

- Once results become available in the lab they are sent electronically to the ward
 - results immediately print automatically on a label printer located at the nursing station
 - when the nurse sees the printed label she calls the guardian to bring the medical record
 - the nurse affixes the results label in the chart and sends the patient for review if appropriate

Scenario 2: for Printing Results

- Once results become available in the lab they are sent electronically to the ward
 - the names of patients for whom results are available are displayed on a dedicated clinical workstation at the nurses station
 - when the nurse sees the results on the screen she calls the guardian to bring the patient's record
 - when the chart arrives, the nurse prints the results label, affixes it in the chart and sends the patient for review if appropriate

Compare the Two Scenarios

- When comparing, consider issues of
 - patient confidentiality
 - specimen tracking
 - consumption of labels

Second Scenario Preferred

- Increases confidentiality of lab data
- Increases the likelihood that results will not get lost (labels misplaced)
- Allows us to track and timestamp the fact that the patient actually received results
- Reduces number of labels printed unnecessarily
- Automatic alerts can be generated

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Where to Start?

- ▶ Technical issues, definitely

Where to Start?

- ▶ Technical issues, definitely
- ▶ But we can't start there

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- ▶ But we can't start there
- ▶ For good technical solutions

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- ▶ But we can't start there
- ▶ For good technical solutions
 - ▶ Must understand the social objectives

Where to Start?

- ▶ Technical issues, definitely
- ▶ But we can't start there
- ▶ For good technical solutions
 - ▶ Must understand the social objectives
 - ▶ The lived experience of the domain

Definitions

What's in a name? that which we call a rose
By any other name would smell as sweet;

~Shakespeare, "Romeo and Juliet"

AMIA Definition of Biomedical Informatics

Biomedical informatics (BMI) is the interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem solving, and decision making, motivated by efforts to improve human health.

e-Health and Health¹

¹This section is based largely on *Care and Cure: A Philosophy of Medicine* by Jacob Stegenga and “The Philosophy of Medicine” in the Stanford Online Encyclopedia of Philosophy.

How Would You Define Health?

Is health simply the absence of disease?

This definition of health is known as *neutralism* and seems to correspond to the common usage of “health”.

Is health something more than the absence of disease?

Here is how the World Health Organization (WHO) defines health:

*Health is a state of complete physical, mental and social well-being and **not** merely the absence of disease or infirmity.*²

²What is the WHO definition of health? accessed 24/02/2020)

How easy or hard is it to
define “well being”?

Who gets to say if I'm healthy or not?

- ▶ Me (subjectivism)?

Who gets to say if I'm healthy or not?

- ▶ Me (subjectivism)?
- ▶ Facts of nature (objectivism)?

Who gets to say if I'm healthy or not?

- ▶ Me (subjectivism)?
- ▶ Facts of nature (objectivism)?
- ▶ How about in Australia's Medicare system?

Boorse's Biostatistical Theory of Health



Figure 1: Christopher Boorse

*To be healthy... is to have statistically normal biological functions: one's physiological parts and processes must operate with at least typical efficiency. A reference class must be specified in order to determine what typical efficiency is for a particular person.*³

³Stegenga, Jacob. *Care and Cure* (Kindle Locations 243-254). University of Chicago Press. Kindle Edition.)

How Could Informatics be Relevant Here?

- ▶ This definition needs appropriate reference classes
- ▶ How do we define these reference classes and how do we collect and measure the relevant data?

Example: Pediatric BMI

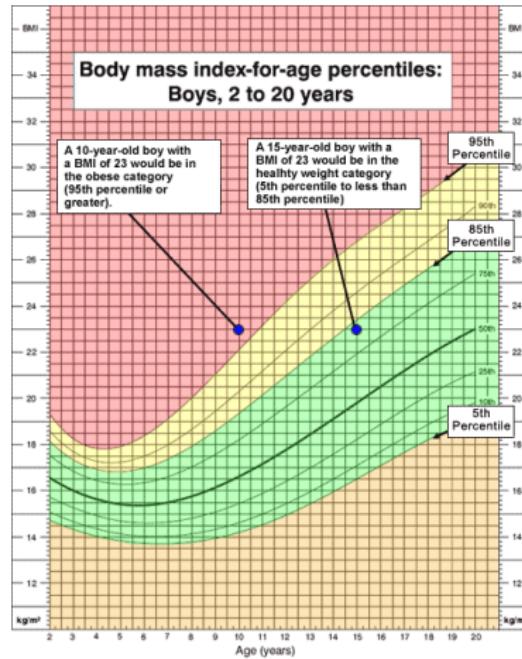


Figure 2: CDC Pediatric Body Mass Index

Example: Mark Eaton



Figure 3: Mark Eaton and Friends

What is notable about Mark Eaton?

- ▶ He is 224 cm (7'4") tall

What is notable about Mark Eaton?

- ▶ He is 224 cm (7'4") tall
- ▶ Is he healthly?

Disease

How Would You Define
Disease?

Some Common Definitions

- ▶ *naturalism*: dysfunctioning physiological systems

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 - ▶ Does the dysfunction matter?

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Some Common Definitions

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- ▶ *eliminativism*:

Is being 224 cm tall a disease?

- ▶ Shorter life expectancy?⁴

⁴<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5624604/>

Is being 224 cm tall a disease?

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- ▶ Harder to fly in commercial airlines

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Is being 224 cm tall a disease?

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Is being 224 cm tall a disease?

- ▶ Shorter life expectancy?⁴
- ▶ Harder to fly in commercial airlines
- ▶ Harder to be anonymous
- ▶ Earned a (relatively) lot of money

⁴<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5624604/>

Why might we consider an excessive BMI a disease but not excessive height?

In a garden there are some plants, and some are weeds. What makes a weed a weed, and not just some other plant? Nature does not label some plants as weeds and others as not weeds. So how do we determine which plants in a garden are weeds? . . .

*A simple answer is this: weeds are those plants that are not wanted in the garden. Weeds are disvalued plants. Similarly, diseases are like weeds: diseases are disvalued physiological conditions.*⁵

⁵Stegenga, Jacob. Care and Cure (Kindle Locations 542-545). University of Chicago Press. Kindle Edition.

Moving On...

Biomedical

Of or relating to biomedicine; of or relating to both biology and medicine.

Biomedicine

The branch of medicine concerned with the application of the principles of biology, biochemistry, etc., to medical research or practice.

Medicine

- ▶ “The science or practice of the diagnosis, treatment, and prevention of disease (in technical use often taken to exclude surgery).”⁶
- ▶ “The medical establishment or profession; professional medical practitioners collectively.”⁶

⁶OED

Does the “medical” in
“Biomedical Informatics”
include other professions,
such as nursing, pharmacy,
physiotherapy?

Does it include patients?

Patient

2009 Tanner Lecture on Human Values - Uwe Reinhardt - 01/09/09

THE DEFINITION OF A “PATIENT”

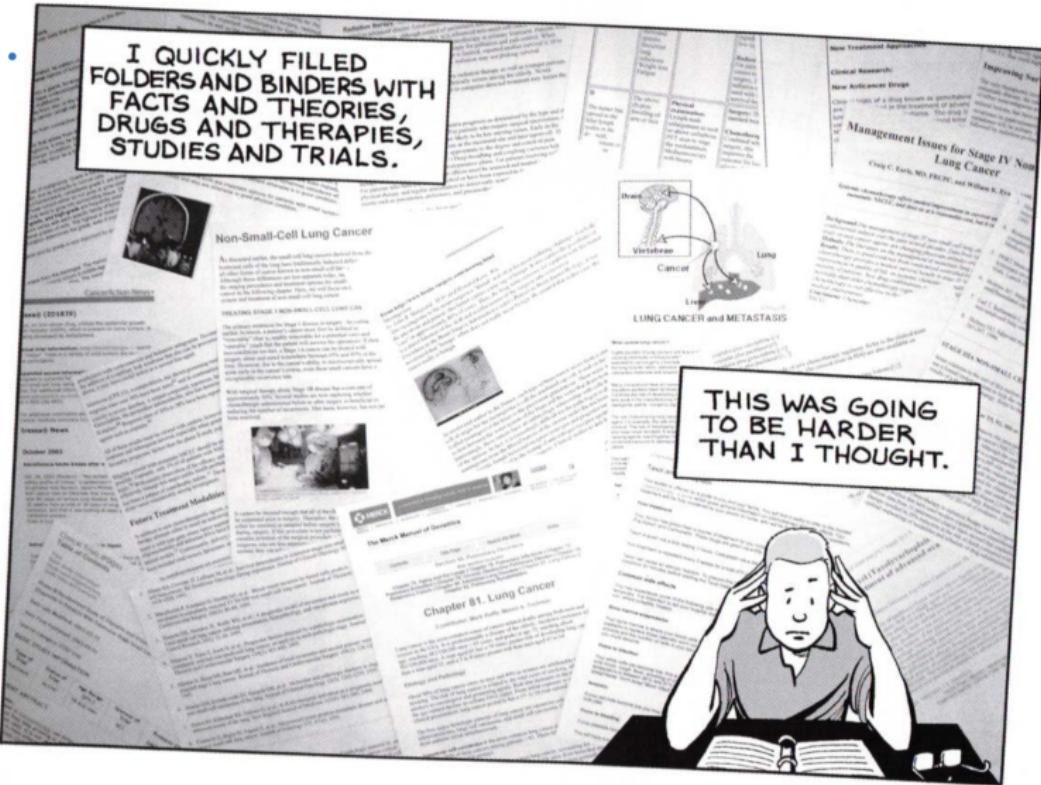
patient (pa'shent) - *n.* 1. A person under medical treatment. [Middle English *pacient*, from old French *patient*, from Latin *patients*, from *pati*, to suffer.] 2. A *biological structure yielding cash [BSYC]*.

M

Figure 4: Uwe Reinhardt definition of patient

Patients' Lived Experiences





How would you define it?

Did the cancer jump anywhere else in my body?

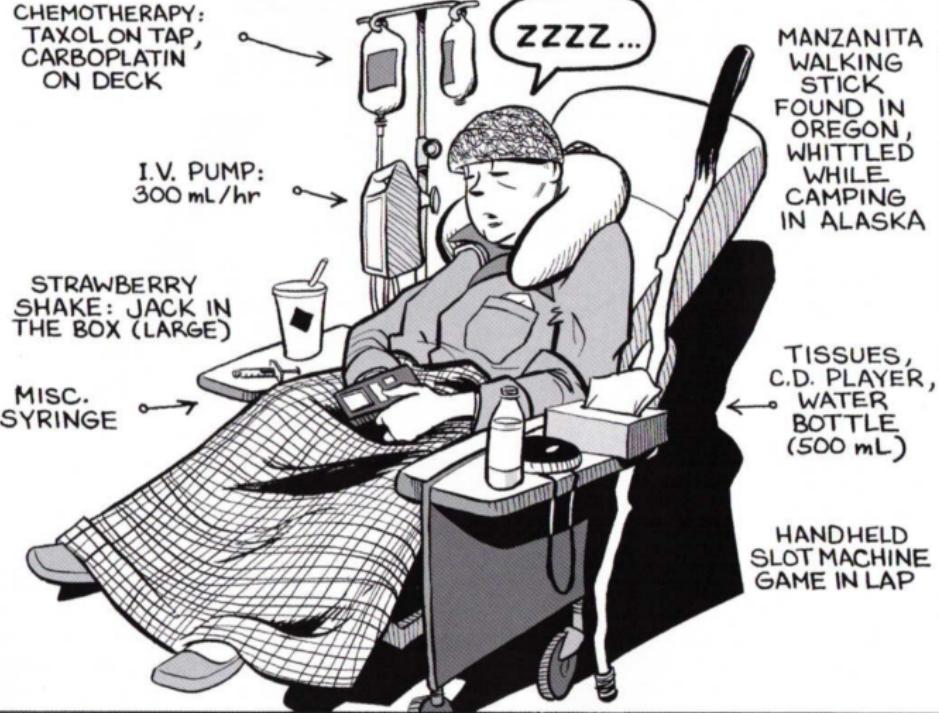
Is there a chance that some cells are wandering
in my body that haven't been detected?

What are my next steps?

Why do I need chemo?



ARRANGEMENT IN GREY AND BLACK



33

10

Informatics

Etymology: < *informat-* (*in information n.*) + *-ic* suffix (see *-ic* suffix 2), originally after Russian *informatika* (A. I. Mixailov et al. 1966, in *Naučno-texničeskaja informacija* 12 35). Compare German *Informatik* (K. Steinbuch 1957, in *SEG-Nachrichten* 5 171), French *informatique* (1962); it is likely that the Russian, German, and French nouns were coined independently of each other.

The three foreign-language nouns were originally semantically distinct: German Informatik originally denoted the automated processing of information, French informatique the branch of study dealing with information processing in general (although especially by automated means), and Russian informatika the theory of scientific information. However, in later use they also came to be used to denote the academic subject which is called computer science in English.

*With singular or (rarely) plural agreement.
The branch of study that deals with the
structure, properties, and communication
of information and with means of storing
or processing information.*¹¹

¹¹taken from OED Feb 24, 2020

1967 FID News Bull. 17 73/2

Informatics is the discipline of science which investigates the structure and properties (not specific content) of scientific information, as well as the regularities of scientific information activity, its theory, history, methodology and organization.

Fourman, 2002

*Informatics is the science of information. It studies the representation, processing, and communication of information in natural and artificial systems. **Since computers, individuals and organizations all process information, informatics has computational, cognitive and social aspects.***

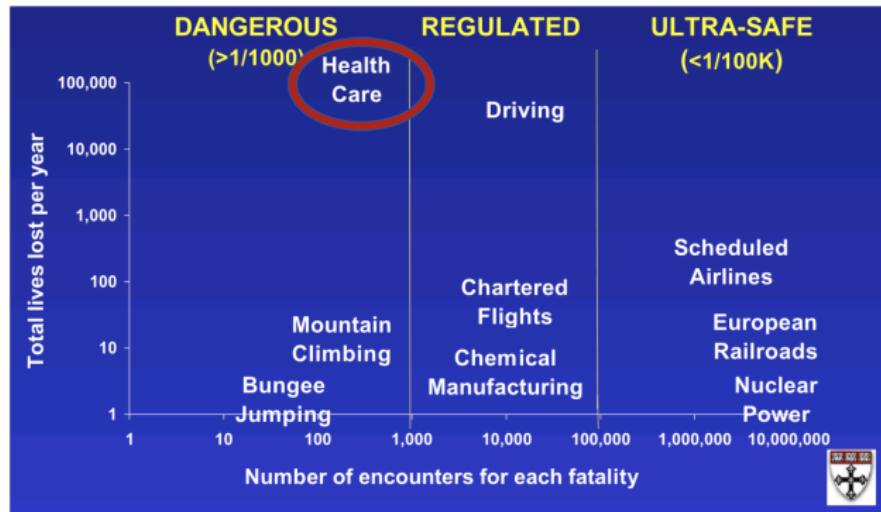
Why Should You Be Interested in e-Health and Biomedical Informatics?

Health is Key to an Abundant Life

- ▶ The Opportunity for Impact is Immense

Medicine is Dangerous

Hazards of health care

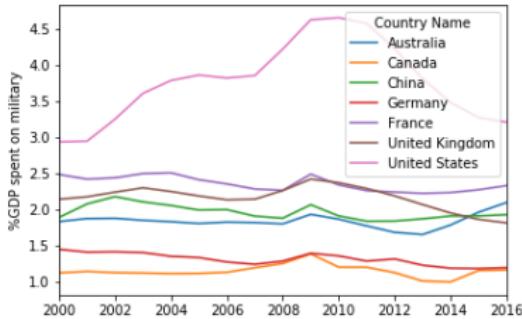
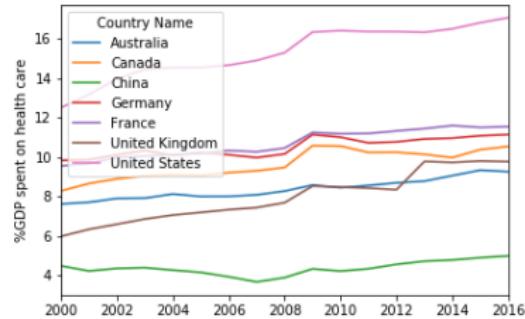


Leape, CDC 2003

12

¹²From Rob El-Kareh, UCSD

Medicine is Expensive: It Needs Informatics



13