Clinical Data

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What are clinical data? [1]

- A datum is a single observation of a patient
- Clinical data are a collection of observations about a patient
- Each datum has five elements:
  - the patient (Amr Jamal)
  - the attribute (heart rate)
  - the value of the attribute (52 beats per minute)
  - the time of the observation (1:00 pm on 1/1/2015)
  - the method by which the attribute was obtained (heart monitor)

Types of clinical data [1]

- **Narrative:** recording by clinician- maternity history
- **Numerical measurements:** blood pressure, temperature
- **Coded data:** selection from a controlled terminology system example being the term MI that may mean myocardial infarction or mitral insufficiency
- **Textual data:** other results reported as text
- **Recorded signals:** EKG, EEG
- **Pictures:** radiographs, photographs, and other images

Use of clinical data [1]

- Form basis of historical record
- Support communication among providers
- Anticipate future health problems
- Record standard preventive measures
- Identify deviations from expected trends example being a growth chart
- Coding and billing
- Provide a legal record
- Support clinical research

Types of clinical data documents [1]

- **History and physical examination:**
  - by a clinician
- **Progress notes**
  - update of progress by primary, consulting, and ancillary providers
- **Reports**
  - by specialists, ancillary providers
- Typical paper chart maintains all patient notes in chronological order, sometimes separated into different components

Some complications of data [1]

- **Circumstances of observation**
  e.g., how was heart rate taken? pulse? EKG?
- **Uncertainty**
  how accurate is patient reporting, measurement, device?
- **Time**
  what level of specificity do we need?

Some complications of data[2]

- **Duplication**
  - e.g., multiple records in different departments
- **Outdated**

  e.g. missing values
- **Incorrectly formatted**

  does not follow standards

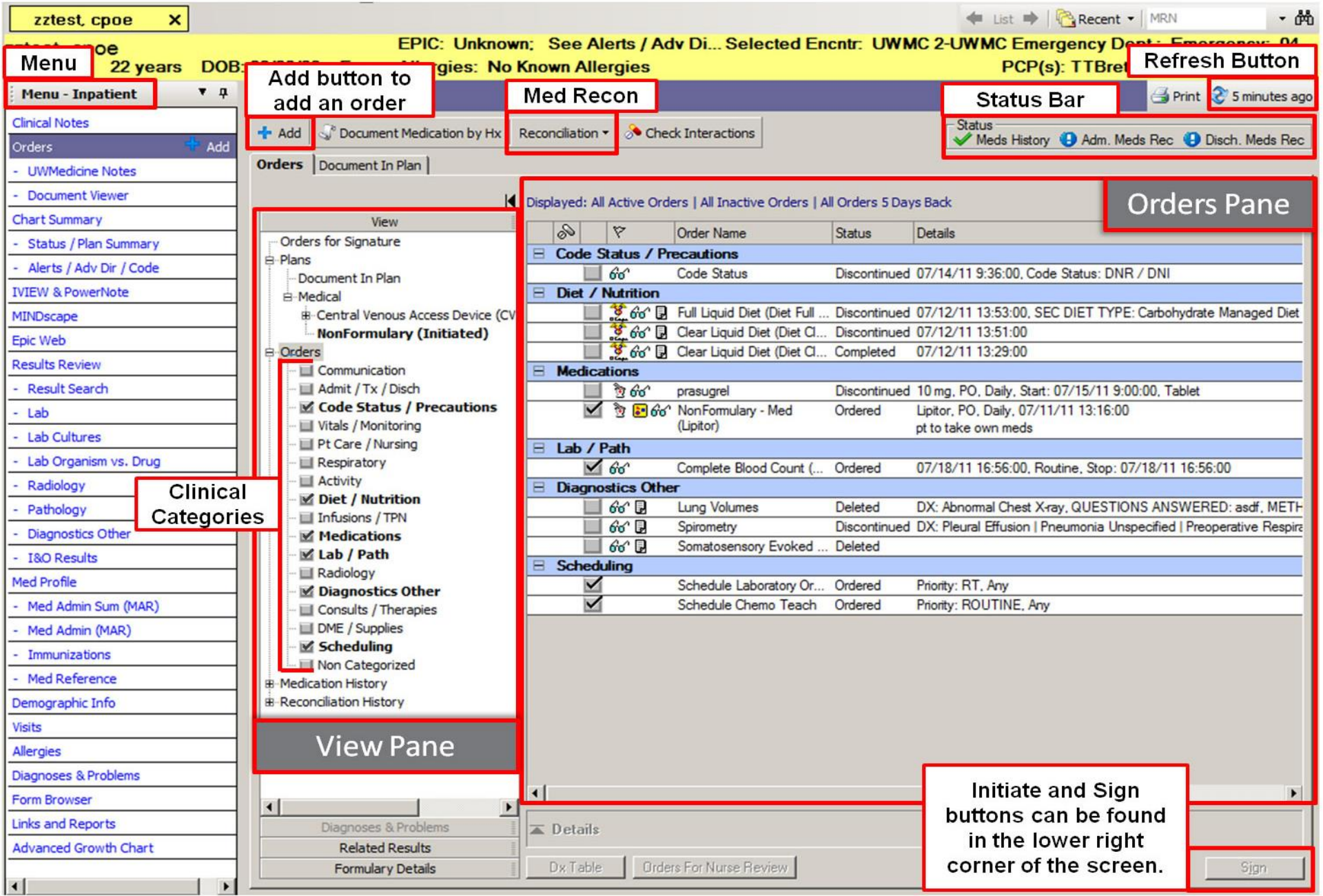
Structure of clinical data [1]

- Medicine lacks uniform structured vocabulary and nomenclature as does Physics and Chemistry
- Standardization and computerization of data is benefited by standard representations (Cimino, 2007)
- Counter-arguments are “freedom of expression” and “art of medicine”
- Narrative information when expressed in many ways can be ambiguous

Data entry [1]

- General categories of data entry:
  - **Free-form** entry by historical methods:
    - writing
    - dictation
    - typing
  - **Structured** (menu-driven) data entry by mouse or pen
  - **Speech** recognition for either of above

ORCA CPOE order screen

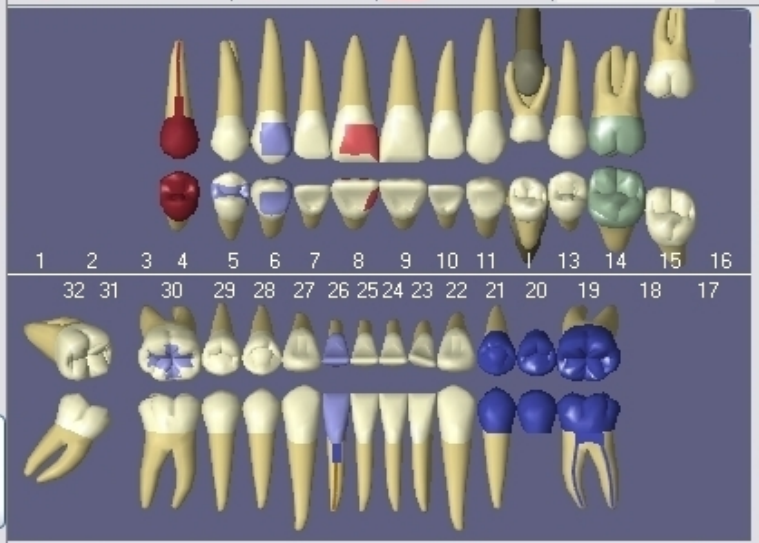


Jordan Sparks - Spander, Jason C

Log Off | File | Setup | Lists | Reports | Tools | Help

Select Patient | New Rx | Perio Chart | Tooth Chart

Appts | Family | Account | Treat' Plan | Chart | Images | Manage



PSR 233222
8-watch
15 unerupted
Patient wants his work all done before the middle of July!!!!
Talked about whitening

Patient Info

ABC0	A
Billing Type	Standard Account
Referred From	yellow pages
Date First Visit	03/17/2005
Pri Ins	Delta Dental of CA. (pending)
Sec Ins	
Med Urgent	
Medical Summary	Acid Reflux High BP
Service Notes	No Flo
Medications	none

Enter Treatment | Missing Teeth | Movements | Primary | Planned Appointment | Show

B F M O I D L

Entry Status: TP | C | Ex Cur | Ex Other | Referred

Today: 04/20/2006

Diagnosis: None | Caries | Recurrent (Car) | Incipient (Car) | Defect (or miss fill) | Missing (tooth struc | Irrevers. Pulp. | Revers. Pulp. | Necrotic | Apical Perio | Abscess | Carious Pulp Exp | Cracked Tooth

Priority: no priority

Procedure List | Or Type ADA Code | OK

Or Single Click:

Misc | Exams/Cleanings | Fillings | Dentures

Amalgam | Composite

Progress Notes

Date	Th	Surf	Dx	Description	Stat	Prov	Amount	ADA Code
04/05/2005	26		R	PFM Crown	C	DOC1	740.00	D2750
		bs.3 Carps 2%Lido/1:100k epi. Blue bite for temp, Prep, Integrity, 1/4 carp 2%Lido/1:50k epi around tooth, #2 cord, triple tray with PVS putty, PVS light body, Tempbond, PO instr, Shade "A4"						
04/21/2005				Clinical Note	EC	DOC1	0.00	Zclin
		In-Dup pano and bws for?						
04/26/2005	26		R	PFM Seat	C	DOC1	0.00	N4118
		Adjusted, polished, showed to pt, FujiCem. PO instr.						
05/03/2005	8	MF	R	Composite- 2 Surf, Anterior	TP	DOC1	140.00	D2331
		br...2 carps 2%Lido/1:100k epi. L-Pop, Z-250, Shade "A3.5"						
05/17/2005	5	MOD	R	Composite- 3 Surf, Posterior	C	DOC1	160.00	D2393
		In-3 carps 2%Lido/1:100k epi. L-Pop, Z-250, Shade "A3"						
05/17/2005	6	MFL	R	Composite- 3 Surf, Anterior	C	DOC1	175.00	D2332
		In-. L-Pop, Z-250, Shade "A35"						
05/24/2005	19			Bridge retainer-Porcelain Fused to Noble Metal	C	DOC1	710.00	D6752
		In-.3 Carps 2%Lido/1:100k epi. Blue bite for temp, Prep, Integrity, 1/4 carp 2%Lido/1:50k epi around tooth, #2 cord, triple tray with PVS putty, PVS light body, Tempbond, PO instr, Shade "A35"						
05/24/2005	20			Pontic-Porcelain Fused to Noble Metal	C	DOC1	710.00	D6242
05/24/2005	21			Bridge retainer-Porcelain Fused to Noble Metal	C	DOC1	710.00	D6752
06/07/2005				Clinical Note	EO	DOC1	0.00	Zclin
		In- Dup BW of #19-#21 for ins co.						
06/07/2005				Comm - Insurance				
		mb//sent xray along with claim requested by insurance for issue of pymt to be processed						
06/14/2005				Bridge Seat	C	DOC1	0.00	N4127
		br...Fuji Cem II, Fit Checker.						

All | BWs | FMXs | Panos | Photos

Structured or menu-driven data entry

- Can be done via mouse or pen, with typing
- Benefits
  - Data codified for easier retrieval and analysis
  - Reduces ambiguity if language used consistently
- Drawbacks
  - In general, more time-consuming
  - Requires exhaustive vocabulary
  - Requires dedication to use by clinicians

Speech recognition for data entry [1]

- Most common use is for narration
  - e.g., computer dictation of clinical notes
- An advantage is instant availability of dictated content
- Continuous speech recognition now is commercial reality
  - Speaker-dependent systems require user training
  - Speaker-independent are systems less accurate

Katelyn Gleason
Chart ID: GLKA000007
Gender: F
Age: 25
DoB: 02/15/1986
555-555-5555
Chief Complaint: unspecified pain or illness
Visit
Profile
History
H&P
SOAP
Custom
CC / History of Present Illness
Med / Fam / Social History
Medications & Allergies
Review of Systems
Physical Exam
Assessment
Plan
Billing
View Complete Note
Temperature
Pulse
Blood Pressure
Respiratory Rate
Oxygen Saturation
Height
Weight
BMI
Pain (1-10)
Smoking Status
Never Smoker
Clinical Checklist
General WNL
General Comments
HEENT WNL
HEENT Comments
Skin WNL
Skin Comments
coarse hair,
Speech to text in progress
0:00:08
Tap to end
Speech to Text
Lock
New eRx
eRx Refills
Chat
Help

Coded vs. free-text data [1]

Coded data:

Documentation of discrete data from controlled vocabulary

Free text:

Alphanumeric data that are unstructured, typically in narrative form

DE RMA CLINICS
DERMATOLOGY - PLASTIC SURGERY
HAIR TRANSPLANT - LASER CENTER

D RM

عيادات ديرما
امراض جلدية - جراحة تجميل
زراعة شعر - مركز العلاج بالليزر

وصفة طبية
Prescription

13 APR 2013

Date : .....

Name : Mamsha al rowailem M.R. No. : 134415

Age : ..... ☐ M ☐ F

Diagnosis : .....

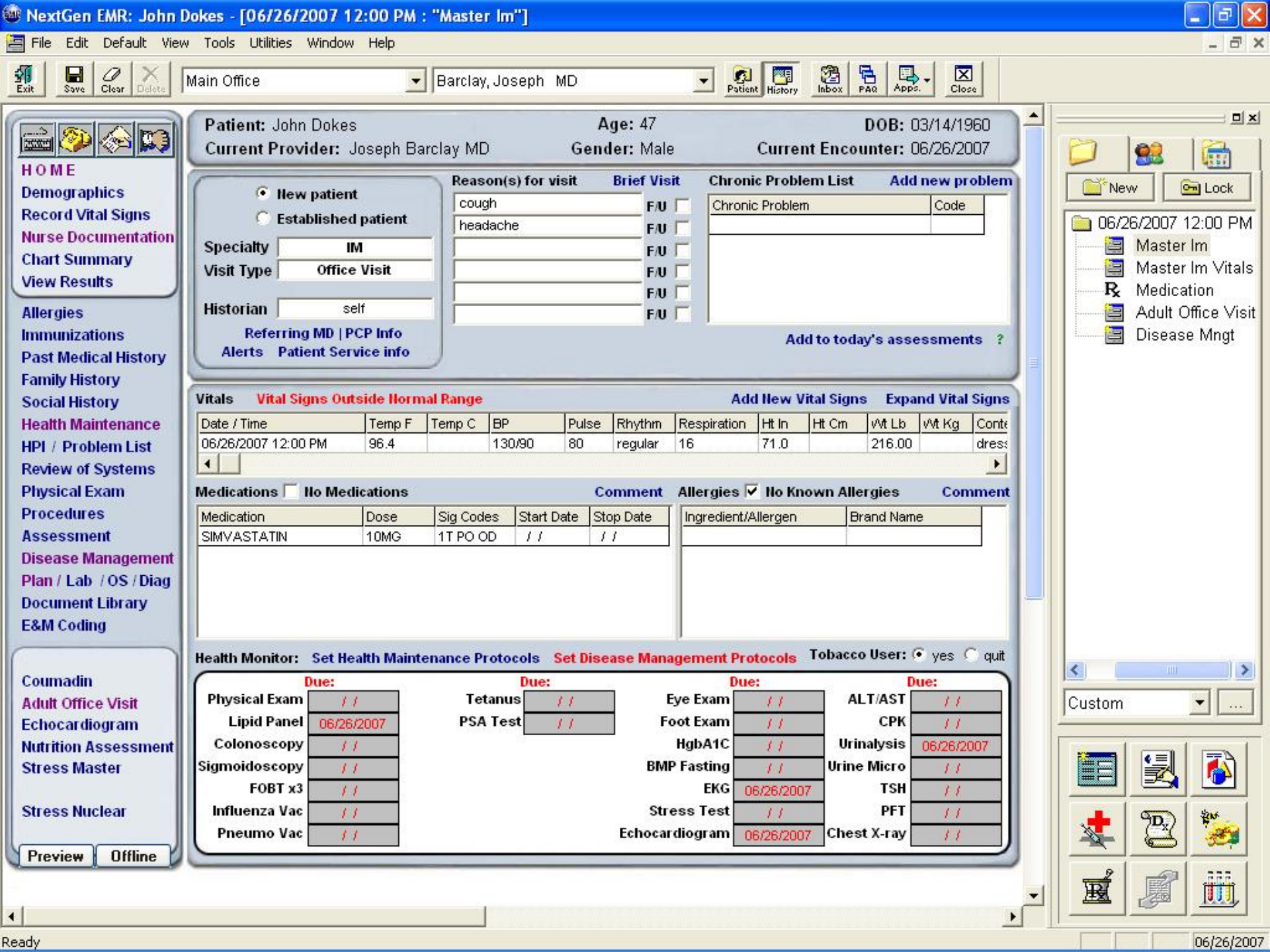
R_x

Docto

Signat

Narratives tell a story.

- **A narrative tells a story**
  - See the patient through a description
  - Complicated events are easier to describe in text
- **Undifferentiated problems**
  - Interpretation.
    - “only a human can prioritize and determine what the chief complaint really is”


NextGen EMR: John Dokes - [06/26/2007 12:00 PM : "Master Im"]
File Edit Default View Tools Utilities Window Help
Exit Save Clear Delete
Main Office
Barclay, Joseph MD
Patient History Inbox PAQ Apps. Close
HOME
Demographics
Record Vital Signs
Nurse Documentation
Chart Summary
View Results
Allergies
Immunizations
Past Medical History
Family History
Social History
Health Maintenance
HPI / Problem List
Review of Systems
Physical Exam
Procedures
Assessment
Disease Management
Plan / Lab / OS / Diag
Document Library
E&M Coding
Coumadin
Adult Office Visit
Echocardiogram
Nutrition Assessment
Stress Master
Stress Nuclear
Preview Offline
Patient: John Dokes
Age: 47
DOB: 03/14/1960
Current Provider: Joseph Barclay MD
Gender: Male
Current Encounter: 06/26/2007
New patient
Established patient
Specialty IM
Visit Type Office Visit
Historian self
Referring MD | PCP Info
Alerts Patient Service info
Reason(s) for visit
Brief Visit
cough
headache
F/U
Chronic Problem List
Add new problem
Chronic Problem
Code
Add to today's assessments ?
Vitals
Vital Signs Outside Normal Range
Add New Vital Signs
Expand Vital Signs
Date / Time
Temp F
Temp C
BP
Pulse
Rhythm
Respiration
Ht In
Ht Cm
Wt Lb
Wt Kg
Conte
06/26/2007 12:00 PM
96.4
130/90
80
regular
16
71.0
216.00
dress
Medications
No Medications
Comment
Allergies
No Known Allergies
Comment
Medication
Dose
Sig Codes
Start Date
Stop Date
SIMVASTATIN
10MG
1T PO OD
Ingredient/Allergen
Brand Name
Health Monitor:
Set Health Maintenance Protocols
Set Disease Management Protocols
Tobacco User: yes quit
Due:
Physical Exam
Lipid Panel 06/26/2007
Colonoscopy
Sigmoidoscopy
FOBT x3
Influenza Vac
Pneumo Vac
Tetanus
PSA Test
Eye Exam
Foot Exam
HgbA1C
BMP Fasting
EKG 06/26/2007
Stress Test
Echocardiogram 06/26/2007
ALT/AST
CPK
Urinalysis 06/26/2007
Urine Micro
TSH
PFT
Chest X-ray
New
Lock
06/26/2007 12:00 PM
Master Im
Master Im Vitals
Medication
Adult Office Visit
Disease Mngt
Custom
Ready
06/26/2007

Liverpool Hospital Neonatal Database - Clinical Data Entry

Ian TEST DOB 28/2/2008 GA 26+2 BW 1070

Liverpool 2170

MRN 123432

Day 33 - Corrected GA 31+0 1250g on 01/04

Log | Files (0) | Images (2) | Calculator

ATTENTION: Brain scan overdue:

Current Status

Respiratory Support
CPAP /5 , FiO2 29

Fluids / Feeds
160 ml/kg/day
TPN 10% Fat 3g
14x2 EBM 24cal (134)

Jaundice
09/03 SBr 135 Biliblanket ceased 08/03

Other
01/03 Mod PDA
POSSIBLE NEC

Treatments
Pentavite, Folic Acid
Longline,

Test Results
09/03 Na 136
09/03 Hb 135
09/03 Plat 265
02/03 HUS IVH II
01/04 Eyes ROP I

Opened 01 Apr 12:27

Add Twin

local form

Admissions | Respiratory | Nutrition | Other | Treatments | Test Results

Admission | Planning | Discharge

Liverpool Hospital

Admitted: 28/02/08 at 4 hours

Admission Age 0 Corr.GA 26 Weight 1070 76% HC 25.5 71% Length 35 56%

Date & Time 28/02/2008 16:30 Hospital Liverpool Hospital MRN 123432

Bed 01 To NICU Reason(s) for Admission Prematurity

Consultant Ian Callander Insurance Hospital Respiratory Distress

MATERNAL HISTORY
Ann is a 28 year old G2 P1 (now) woman whose blood group is O positive. She was booked to deliver at Campbelltown Hospital under the care of Kaisher however delivered at Liverpool Hospital under the care of Dr Peter Hammill. She had a history of essential hypertension. This pregnancy was complicated by hypertension of pregnancy, fetal growth restriction, Bilateral Renal Pelvis dilatation 5 - 10mm, GBS +ve swab, fever, abnormal Dopplers, prolonged rupture of membranes for 2 days, clinically suspected chorioamnionitis. Ann was treated with antenatal steroids, tocolytics, and antihypertensive drugs. Following the spontaneous onset of labour, she proceeded to a vaginal delivery. Antibiotics were given before delivery.

PERINATAL HISTORY
Ian was born at 13:00 hours with a birth weight of 1070 grams (76th centile). Apgars were 3 at 1 minute and 7 at 5 minutes respectively treated with intubation and ventilation. The arterial cord pH was 7.24 and the base excess -6. Ian was then retrieved to

Added to Worksheet 01/03

This is freetext

Orders on Worksheet 01/03

Freetext orders

(double click on text to delete)

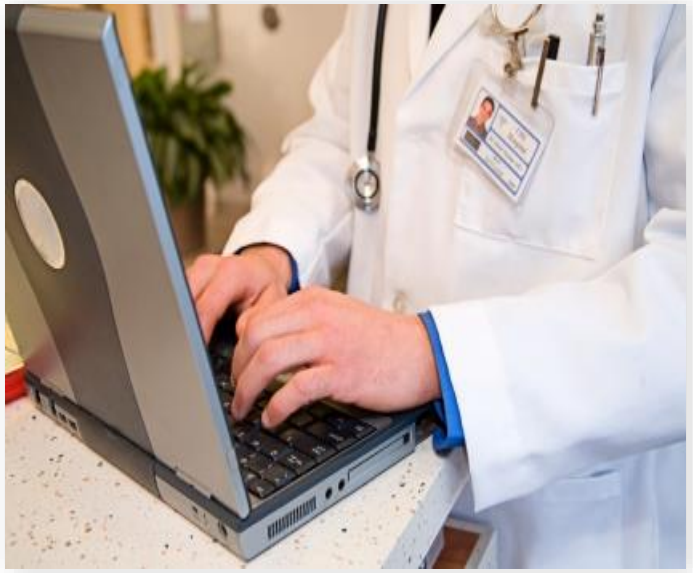
Hospital Episodes	MRN	Admitted	Discharged
Liverpool Hospital	123432	28 Feb 2008 16:30	
NETS	PD12345	28 Feb 2008 15:00	28 Feb 2008 16:30
Campbelltown Hospital	222222	28 Feb 2008 13:00	28 Feb 2008 15:00

Add Another Admission

Delete MRN .. then click again to Delete Episode

Issues with coded data

- "pick from a list" allows wrong selection
- compliance concerns
- over documentation for care
- cloning



Data Management [2]

File Organization concepts

- Database: A set of related files
- File: Collection of records of same type
- Record: A set of related field
- Field: Words and numbers

Database

File

Name	Age	Medical Summary
Abdullah AlSaif	21	BP
Khalid AlQahtani	34	Acid Reflux
Maryam Badr	42	Pneumonia
Reem Alowais	32	Allergies

Record

Name	Age	Medical Summary
Abdullah AlSaif	21	BP

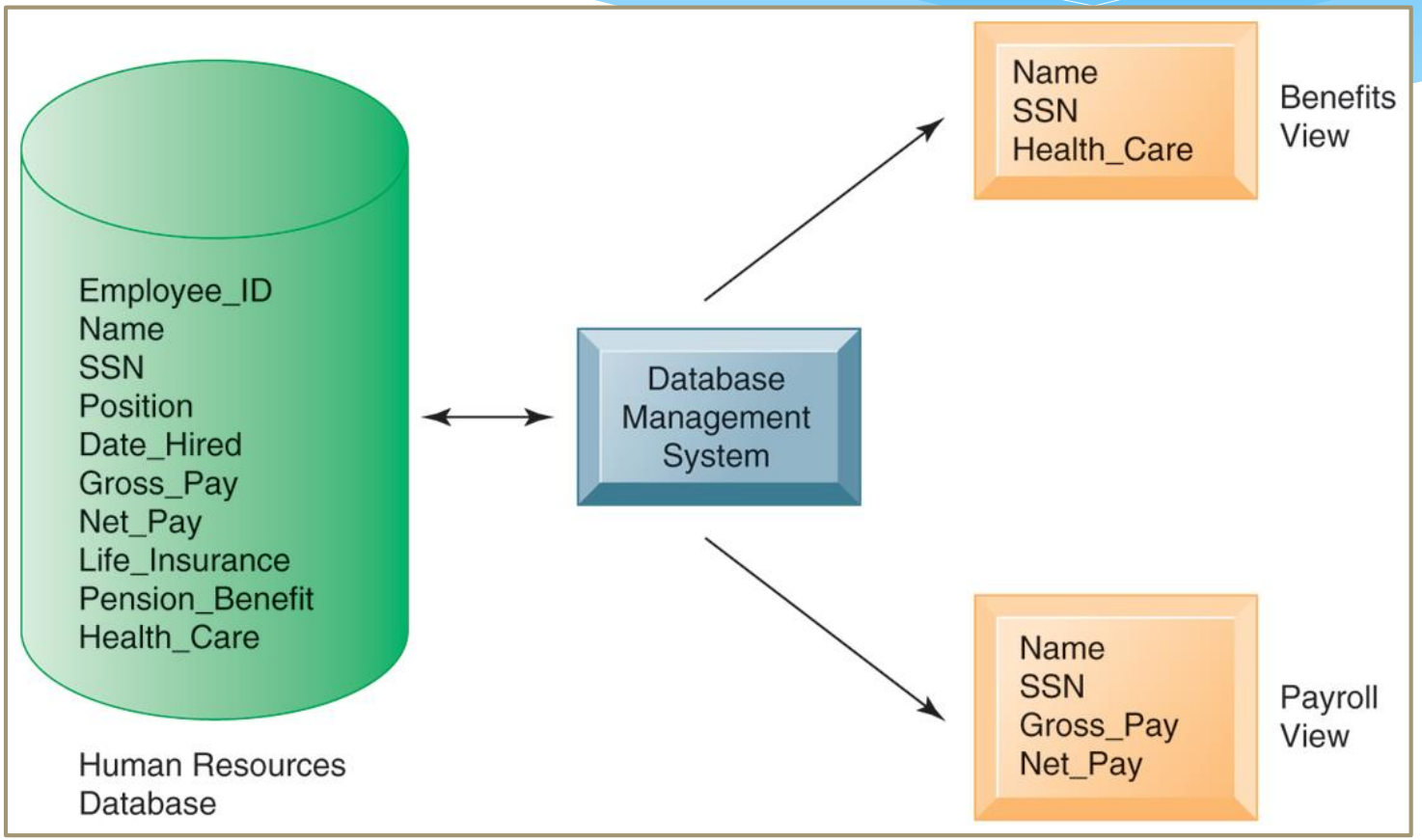
Field

BP (Medical summary field)

Relational DBMS [1]

- Relational model links records to tables
- Allows efficiencies
  - One-time information (e.g., demographics) stored only once
  - Complex queries easier to construct and carry out
- Most query capabilities are based on **Structured Query Language (SQL)**- special language in relational database

Relational DBMS [2]



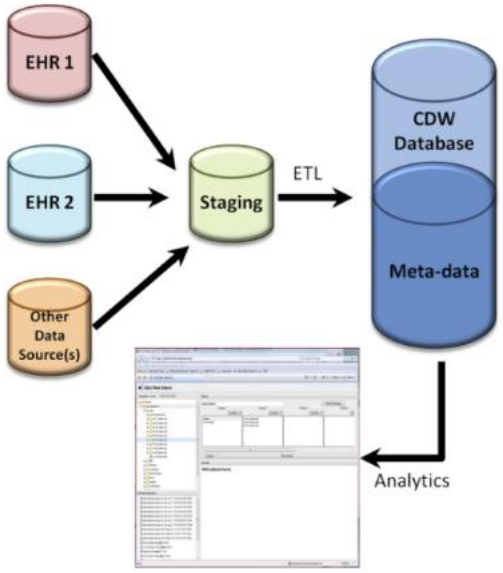
Clinical Data Warehouse [3]

- Data from EHRs, Radiology, Pathology, etc. are copied into a staging database where they are cleaned and loaded into another common database and associated with meta data (data that describes data). ICD-type data is an example of meta data
- Tools can be applied to the data in the CDW, such as simple descriptive analytics that reports the number of patients with breast cancer, their age, menopausal status, etc.
- CDWs do a better job of analyzing and reporting aggregate healthcare data than the average EHR, which tends to focus on the individual

Clinical Data Warehouse[3]

- CDWs can be used to evaluate a critical clinical process, cost estimates and they can analyze potential solutions
- CDWs are highly valuable for informatics and evidence based medical research
- CDWs can help track infections and report trends to public health

Clinical Data Warehouse[3]



ETL = extract, transfer and load

Acknowledgement

Notes are **adapted with permission** from Professor Hersh, Oregon Health and Science University (OHSU), Oregon, USA

References

[1] Hersh, W. (2014). Notes from 10x10 Medical Informatics certificate, Oregon Health & Science University

[2] Laudon & Laudon (2011), Management Information Systems, Prentice Hall

[3] Hoyt RE, Hersh WR. (2018) Health Informatics: Practical Guide 7th Edition, AMIA