Nature of Medical Data

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Peter Szolovits

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Outline

- Recall context of current medical practice
- History of medical record keeping
- Organization of medical records
- Computerized medical records
  - Why
  - Key issues
  - Failures and successes
- Current approaches

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Implications of Health Care Organization for Informatics

- Money determines much
  - Medicine spends 1-2% on IT, vs. 6-7% for business overall, vs. 10-12% for banking
  - "Bottom line" rules, therefore emphasis on
    - Billing
    - Cost control
    - Quality control, especially if demonstrable cost savings
    - Retention and satisfaction (maybe)
  - Management by accountants

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Why Keep Records?

- Basis for historical record
- Communication among providers
- Anticipate future health problems
- Record standard preventive measures
- Identify deviations from the expected
- Legal record
- Basis for clinical research

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Who Keeps Records?

- Doctor
- Nurse
- Office staff, admissions
- Administrator
- physical therapist
- lab personnel
- radiologist
- pharmacist
- patient

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Forms of Clinical Data

- Numerical Measurements
  - Lab data
  - Bedside measurements
  - Home instrumentation
- Recorded signals (e.g., ECG, EEG, EMG)
- Images (X-ray, MRI, CAT, Ultrasound, Pathology, …)
- Genes (SNPs, expression arrays, pedigrees, …)
- Coded (?) discrete data
  - Family history
  - Patient's medical history
  - Current complaint
    - Symptoms (patient)
    - Signs (doc)
  - Physical examination
  - Medications
- Narrative text
  - Doctor's, nurse's notes
  - Discharge summaries
  - Referring letters

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Organization of Data

- Doctor's journal (traditional)
- Time order of collection, per patient (Mayo)
- Source of data
- Problem-Oriented Medical Record (POMR) (L. Weed, 1969)
  - Notes organized by problems
  - SOAP: subjective, objective, assessment, plans

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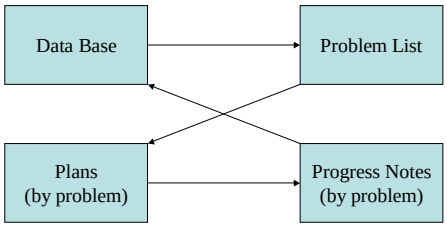
POMR



diagnostic, therapeutic, patient education

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The Data Base

- Identifying information (name, age, sex, race, religion, insurance info, etc.)
- Patient profile (occupation, education, marital status, children, hobbies, worries, moods, sleep patterns, habits, etc.)
- Medical history
  - Chief complaints
  - History of present illness
  - Past medical history
  - Review of systems
  - Family history
  - Medications
- Physical examination
- Laboratory data and physiologic tests (complete blood count, electrocardiogram, chest x-ray, creatinine, urinalysis, vital capacity, tonometry, etc.)

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The Problem List

- "those features in the patient's psychobiological makeup that require continuing attention"
  - Social history
  - Risk factors
  - Symptoms
  - Physical findings
  - Lab tests
- Causally organized; e.g., GI bleeding caused by duodenal ulcer appears under the ulcer

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Example Problem List

No	Active	Date	Inactive	Date
1	Hypertension	1953		
2	Recurrent bronchitis	1958		
3	Penicillin allergy	1958		
4			S/P pyelonephritis	1960
5	Gallstones	Oct 1972	→Cholecystectom	Mar 1973
6	Arthralgias	Mar 1973	~~→~~#9	June 1973
7	Pleurisy	Mar 1973	→#9	June 1973
8	Proteinuria	Apr 1973	→#9	June 1973
9	SLE	June 1973		
10	Unemployment	Nov 1973		

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Problem-Related Plans

- Diagnostic: lab tests, radiology studies, consultations, continued observations, …
- Therapeutic: medications, diet, psychotherapy, surgery, …
- Patient education: instruction in self-care, about goals of therapy, prognosis, …

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Plans per problem

1. Diarrhea

   Dx:
   - stool for occult blood, culture, ova, and parasites, microscopic fat; and muscle fibers
   - Sigmoidoscopy
   - Barium enema if persistent

   Rx: Avoid foods that exacerbate

   Ed: Informed that more info is needed to make a diagnosis, will aim for symptomatic therapy for now.

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Plans per problem (cont.)

2. Pyuria

   Dx:
   - BUN
   - Repeat urinalysis
   - Urine culture

3. Obesity

   Rx: 1500 kcal diet, Weight Watchers

   Ed: Dangers of obesity cited. *Goal*: 170 lbs.

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Progress Notes

- Subjective: interval history, adherence to program
- Objective: physical findings, reports of lab, x-ray, other tests
- Assessment: Appraisal of progress, interpretation of new findings, etc.
- Plan: Dx, Rx, Ed.

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Example SOAP Note

#3 RHD with mitral stenosis

S: 2 flight dyspnea, mild fatigue. No orthopnea, hemoptysis, ankle edema. Child has strep throat.

O: BP 120/70. P 78 regular
Neck veins normal, lungs clear.
Grade iii diastolic rumble, wide opening snap, P_2 slightly ↑

A: Stable. Catheterization still not indicated. Risk of strep throat present.

P: Dx: Cardiac fluoroscopy

Rx: Continue chlorothiazide and penicillin V 250mg b.i.d.—2 weeks

Ed: Reinstructed about antibiotic coverage for tooth extractions,
sched. for next month. (Will contact oral surgeon.)

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POMR characteristics

- Augment with data flow sheets
- Importance of clinical judgment
- Benefits:
  - Communication among team members, explicitness
  - Education and audit
  - Clinical research

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POMR evidence

- Difficult adoption
- Some duplication
- Some doctors liked it
- Paper-based POMR slow, computer-based maybe faster
- Demand-oriented MR: by time, by source, by problem, etc. Dynamic arrangement.

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Mayo experience

- Paper records, mostly
- Pneumatic tube delivery, therefore limited size
- Formal procedures for reaping and organizing records at discharge
- Comprehensive index

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The Computer-based Patient Record

- IOM Study: Dick, R. S. and Steen, E. B., Eds. (1991). *The Computer-Based Patient Record: An Essential Technology for Health Care*. Washington, D.C., National Academy Press.
- Made strong case for CPR
- Recommended CPRI (Institute), but it never caught on
- Today's standards grow more out of communication standards: HL7 (labs) and DICOM (digital images)

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Paper record: Strengths

- Familiar; low training time
- Portable to point of care
- No downtime
- Flexibility; easy to record subjective data
- Browsing and scanning
  - Find information by unanticipated characteristics (e.g., Dr. Jones' handwriting)

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Paper record: Weaknesses

- Content: missing, illegible, inaccurate
  - E.g., one hospital study: 11% of tests were repeats to replace lost information
  - Too thick (1.5 lbs avg.)
  - Fail to capture rationale
  - Incomprehensible to patients and families

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Sample paper record defects

- 75% of face sheets had no discharge disposition, 48% no principal Dx
- Agreement between encounter (witnessed) and record: 29% med hx, 66% Rx, 71% info re current illness, 72% tests, 73% impression/Dx, 92% chief complaint
- 20.8% of Medicare discharges coded incorrectly (DRG inflation)

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More paper record defects

- Unavailable at up to 30% of patient visits
  - Two clinic visits in a day
  - Docs keep records in their office
  - Failure to deliver
  - Misfiled in file room
- Discontinuity across institutions
  - In/outpatient records separate

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Ethnographic Design

- Xerox PARC analysis of office work
  - Sociologists, Anthropologists, Engineers
  - Much of work is
    - communication,
    - assignment of responsibilities,
    - problem solving

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Medicine is an Information Industry

- 35-39% of hospital operating costs due to professional and patient communications
- Physicians spend 38%, nurses 50% of their time charting
- Exponential growth of medical knowledge and literature

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Individual Users of Patient Records

- Providers
  - Chaplains
  - Dental hygienists
  - Dentists
  - Dietitians
  - Lab technicians
  - Nurses
  - Occupational therapists
  - Optometrists
  - Pharmacists
  - Physical therapists
  - Physicians
  - Physician assistants
  - Podiatrists
  - Psychologists
  - Radiology technologists
  - Respiratory therapists
  - Social workers
- Management
  - Administrators
  - Financial managers and accountants
  - Quality assurance managers
  - Records professionals
  - Risk managers
  - Unit clerks
  - Utilization review managers
- Reimbursement
  - Benefit managers
  - Insurers (Fed, State, private)
- Other
  - Accreditors
  - Gov't policymakers, legislators
  - Lawyers
  - Health care researchers, clinical investigators
  - Health Sciences journalists and editors
  - Patients, families

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Institutional Users of Patient Record

- Healthcare Delivery
  - Alliances, associations, networks, systems of providers
  - Ambulatory surgery centers
  - Donor banks (blood, tissue, organs)
  - HMO's
  - Home care agencies
  - Hospices
  - Hospitals
  - Nursing homes
  - PPO's
  - Physician offices, group practices
  - Psychiatric facilities
  - Public Health Departments
  - Substance abuse programs
- Management and Review
  - Medicare peer review organizations
  - Quality assurance companies
  - Risk management companies
  - Utilization review/management comp.
- Reimbursement
  - Business Health coalitions
  - Employers
  - Insurers
- Research
  - Disease registries
  - Health data organizations
  - Health care technology developers and manufacturers
  - Research Centers
- Education
  - Allied health professional schools, medical, nursing, public health schools
- Accreditation
  - Accreditation organizations
  - Inst. licensure agencies
  - Prof. Licensure agencies
- Policymaking
  - Fed, State, Local gov't agencies

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Primary Uses of Patient Record

- Patient care delivery (Patient)
  - Document services received
  - Constitute proof of identity
  - Self-manage care
  - Verify billing
- Patient care delivery (Provider)
  - Foster continuity of care
  - Describe diseases and causes
  - Support decision making about Dx and Rx
  - Assess and manage risk
  - Facilitate care via Clin. Practice Guidelines
  - Document patient risk factors
  - Assess and document patient expectations and satisfaction
  - Generate care plans
  - Determine preventive advice
  - Remind clinicians
  - Support nursing care
  - Document services provided
- Patient care management
  - Document case mix
  - Analyze severity of illness
  - Formulate practice guidelines
  - Manage risk
  - Characterize use of services
  - Basis for utilization review
  - Perform quality assurance
- Patient care support
  - Allocate resources
  - Analyze trends and develop forecasts
  - Assess workload
  - Communicate between departments
- Billing and reimbursement
  - Document services for payment
  - Bill for services
  - Submit insurance claims
  - Adjudicate insurance claims
  - Determine disabilities (workmen's comp)
  - Manage & report costs
  - Perform actuarial analysis

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Secondary Uses of Patient Record

- Education
  - Document health care professional experience
  - Prepare conferences and presentations
  - Teach students
- Regulation
  - Evidence in litigation
  - Foster postmarketing surveillance
  - Assess compliance with standards
  - Accredit professionals and hospitals
  - Compare health care organizations
- Policy
  - Allocate resources
  - Conduct strategic planning
  - Monitor public health
- Research
  - Develop new products
  - Conduct clinical research
  - Assess technology
  - Study patient outcomes
  - Study effectiveness and cost-effectiveness of care
  - Identify populations at risk
  - Develop registries and databases
  - Assess cost-effectiveness of record systems
- Industry
  - Conduct R&D
  - Plan marketing strategy

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User Requirements

- Record Content
  - Uniform core data elements
  - Standardized coding systems and formats
  - Common data dictionary
  - Information on outcomes of care and functional status
- Record Format
  - "Front-page" problem list
  - Ability to "flip through" the record
  - Integrated among disciplines and sites of care
- System Performance
  - Rapid retrieval
  - 24/7
  - Available @ convenient places
  - Easy data input

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User Requirements (cont.)

- Linkages
  - To other info systems (e.g., radiology, lab)
  - Transferability of information among specialties and sites
  - With relevant literature
  - Other registries and institutional databases
  - To records of other family members
  - E-billing
- Training and Implementation
  - Minimal training required
  - Graduated implementations
- Intelligence
  - Decision support
  - Clinician reminders
  - "Alarm" systems, customized
- Reporting
  - "Derived documents", e.g., insurance forms
  - Easily customized output, UI
  - Standard clinical reports, e.g., discharge summary
  - Custom and *ad hoc* reports
  - Trend reports and graphics
- Control and Access
  - Easy patient access
  - Safeguards of confidentiality

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Why is this hard?

- Characterize edema:
  - Where?
  - When?
  - How often?
  - Temporal variation?
  - Severity
  - Symmetry
  - What other characteristics?
- *Uncertainties* in all of the above

- Thousand diseases, syndromes, clinical states
- Few thousand symptoms, signs, observables
- Few thousand specific lab tests
- Thousands of meds, variations, combinations, routes, dosage schedules, …
- ??? Treatments

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