Nature of Medical Data

6.872/HST950
Lecture# 2

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

Who Keeps Records?

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

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

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

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
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

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.)

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

Example Problem List

<table>
<thead>
<tr>
<th>No</th>
<th>Active</th>
<th>Date</th>
<th>Inactive</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hypertension</td>
<td>1953</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Recurrent bronchitis</td>
<td>1958</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pencillin allergy</td>
<td>1956</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>S/P pyelonephritis</td>
<td>1960</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Gallstones</td>
<td>Oct 1972</td>
<td>Cholecystectomy</td>
<td>Mar</td>
</tr>
<tr>
<td>6</td>
<td>Arthralgia</td>
<td>Mar 1973</td>
<td>#9</td>
<td>1973</td>
</tr>
<tr>
<td>7</td>
<td>Pleurisy</td>
<td>Mar 1973</td>
<td>#9</td>
<td>1973</td>
</tr>
<tr>
<td>8</td>
<td>Proteinuria</td>
<td>Apr 1973</td>
<td>#9</td>
<td>1973</td>
</tr>
<tr>
<td>9</td>
<td>SLE</td>
<td>June 1973</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Unemployment</td>
<td>1973</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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, ...
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.

Plans per problem (cont.)

2. Pyuria
   Dx:
   • BUN
   • Repeat urinalysis
   • Urine culture

3. Obesity
   Rx: 1500 kcal diet, Weight Watchers

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.

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.
Graded diastolic rumble, wide opening snap, P2 slightly ↑
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.)

POMR characteristics

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

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.
### Mayo experience

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

### The Computer-based Patient Record

- 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)

### 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)

### 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

### 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)

### 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
Ethnographic Design

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

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
    - Appraisers
    - Gov’t policymakers, legislators
    - Lawyers
    - Health care researchers, clinical investigators
    - Health Sciences journalists and editors
    - Patients, families

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
  - 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
- Reimbursement
  - Utilization review/management comp.
- Other
  - Alliances, associations, networks, systems of providers
  - Business health coalitions
  - Employers
  - Insurers
- Research
  - Disease registries
  - Health data organizations
  - Health care technology developers and manufacturers
- Research Centers
- Education
  - Medical professionals schools, medical, nursing, public health schools
  - Accreditation
    - Accreditation organizations
    - Inst. licensure agencies
    - Prof. licensure agencies
- Polymythology
  - Fed, State, Local govt agencies

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 Di and Rx
  - Assess and manage risk
  - Facilitate via Clinical Practice Guidelines
  - Document patient risk factors
  - Assess and document patient expectations and satisfaction
  - Generate care plans
  - Patient care management
    - Document case mix
    - Analyze severity of illness
    - Formulate practice guidelines
    - Manage risk
    - Characterize use of services
    - Base on utilization review
    - Perform quality assurance
  - Patient care support
    - Allocate resources
    - Analyze trends and develop forecasts
    - Assess workload
    - Contractual agreements between departments
    - Billing and reimbursement
    - Billing and reimbursement
    - pointer for payment
    - Edit for services
    - Service utilization claims
    - Adjustable insurance claims
    - Determine database (password comp)
    - Manage & report costs
    - Perform statistical analysis

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
  - Accreditation organizations 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

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
## User Requirements

<table>
<thead>
<tr>
<th>Record Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniform core data elements</td>
</tr>
<tr>
<td>Standardized coding systems and formats</td>
</tr>
<tr>
<td>Common data dictionary</td>
</tr>
<tr>
<td>Information on outcomes of care and functional status</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Record Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Front-page&quot; problem list</td>
</tr>
<tr>
<td>Ability to &quot;flip through&quot; the record</td>
</tr>
<tr>
<td>Integrated among disciplines and sites of care</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System Performance</th>
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<tbody>
<tr>
<td>Rapid retrieval</td>
</tr>
<tr>
<td>24/7</td>
</tr>
<tr>
<td>Available @ convenient places</td>
</tr>
<tr>
<td>Easy data input</td>
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</tbody>
</table>

## User Requirements (cont.)

<table>
<thead>
<tr>
<th>Linkages</th>
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<tbody>
<tr>
<td>To other info systems (e.g., radiology, lab)</td>
</tr>
<tr>
<td>Transferability of information among specialties and sites</td>
</tr>
<tr>
<td>With relevant literature</td>
</tr>
<tr>
<td>Other registries and institutional databases</td>
</tr>
<tr>
<td>To records of other family members</td>
</tr>
<tr>
<td>E-billing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Training and Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal training required</td>
</tr>
<tr>
<td>Graduated implementations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intelligence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decision support</td>
</tr>
<tr>
<td>Clinician reminders</td>
</tr>
<tr>
<td>&quot;Alarm&quot; systems, customized</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Derived documents&quot;, e.g., insurance forms</td>
</tr>
<tr>
<td>Easily customized output, UI</td>
</tr>
<tr>
<td>Standard clinical reports, e.g., discharge summary</td>
</tr>
<tr>
<td>Custom and ad hoc reports</td>
</tr>
<tr>
<td>Trend reports and graphics</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Control and Access</th>
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<tbody>
<tr>
<td>Easy patient access</td>
</tr>
<tr>
<td>Safeguards of confidentiality</td>
</tr>
</tbody>
</table>

## Why is this hard?

<table>
<thead>
<tr>
<th>Characterize edema:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where?</td>
</tr>
<tr>
<td>When?</td>
</tr>
<tr>
<td>How often?</td>
</tr>
<tr>
<td>Temporal variation?</td>
</tr>
<tr>
<td>Severity</td>
</tr>
<tr>
<td>Symmetry</td>
</tr>
<tr>
<td>What other characteristics?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Uncertainties in all of the above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thousand diseases, syndromes, clinical states</td>
</tr>
<tr>
<td>Few thousand symptoms, signs, observables</td>
</tr>
<tr>
<td>Few thousand specific lab tests</td>
</tr>
<tr>
<td>Thousands of meds, variations, combinations, routes, dosage schedules, ...</td>
</tr>
<tr>
<td>??? Treatments</td>
</tr>
</tbody>
</table>