Role of IT in Dialysis and How it has evolved

George Rovegno
MIQS Software
Why we need IT/EMRs
Medical Record Architecture
Traditional Record Evolved

- Functional
- Time Oriented
- Problem Oriented
- Note intensive
- An EMR cannot and should not be a digitized paper record
A new architecture

- Patient-centered NOT user-centered
- All data available at the point of care
- In a single place
- Single entry
- Deliver care + maintain data + drive revenue
- Serve medical, nursing, administrative and financial needs
We spend 80% of our health care dollars on chronic diseases but EMRs overwhelmingly focus on acute care and office-based practices.
An Integrated Approach

A Process-Oriented Medical Record...

Relate Treatments to Outcomes to Cost

Implement & Monitor Quality Control Daily, Weekly & Monthly

Develop & Refine Protocols Iteratively, Continuously

Clinical Care

Administration

Financial Management
Dialysis IT

- Dialysis was too small to cause specialized technology “inventions”
- Dialysis exploited the evolution, availability and power of tech advances.
Exploit technology advances

- 1972 – relational database “invented” to improve flat field data collection/storage
- “Main Frame” computers too expensive for clinical use
- Minicomputers arrive in the 1970s – Digital Equipment PDP-8 then PDP-11
- Late 1970s Commodore, Sinclair, Radio Shack, APPLE
Exploit technology advances (2)

- 1981: The IBM PC
- Medium sized machines like the CDC VAX and HP “minis”
- “Terminals” to access databases - terminal/server application Menu driven – text
- GUIs – Mac & Windows
- Late 1980s – Client/Server applications
- Each advance was applied to healthcare
Exploit technology advances (3)

- Prices dropped
- Good supply of skilled developers from educational programs
- Scanners, Printers, laptops, hand held devices
- Java, web apps
- Ubiquity of computers in the hands of all
- “You ain’t seen nothing yet"
EMR Technology evolution & MIQS


New computer medical record 1976–1981

PDP 11/70 with 256,000 bytes of memory
A resource-sharing time-sharing extended (RSTS/E) system available 24 hours a day, seven days a week.
The language is BASIC+.

Pollak, VE. Arch Int Med 137:446-456, 1977
EMR Technology evolution & MIQS

New computer medical record 1982–90

- Digital Equipment VAX 11/780
- Memory 4MB increased to 8MB
- Disc storage 636MB
- VT240 terminals

Custom developed software of Dialysis Clinics, Inc.

- The language is BASIC+

Data analysis: Digital Equipment Datatrieve

Prerequisites for a New Record
Exploiting what’s available

- Client/server architecture with distributed processing
- Relational database
- Centralized database available to all users, with remote access
- User friendly for physicians, nurses, and other caregivers
- Fast workstations
- Open systems to facilitate data transfer to and from other databases
- High level of security for clinical and financial information
- Integrated electronic mail for secure communication about patients
Benefits of CPR for Dialysis

- Radically reduced paperwork, with integrated, single-entry data management
- Complete elimination of double-entry and hand transfer of data
- Legible orders immediately available anywhere, displayed automatically
- Elimination of need to seek data stored separately on paper; immediate access to stored documents
- Immediate access to entire patient record in dialysis unit, hospital, office, home
- Automated download of laboratory tests eliminates time wasted in calling for, entering and checking lab results
- Automated generation of dialysis schedules
- Automated notification of needed future actions (e.g., chest X-ray in a year)
EMR Technology evolution & MIQS

1990–Present
Client–Server using relational database
Sybase® SQL Server/Adaptive Server Enterprise
MAC and Windows Clients
TCP/IP
Power of hardware, functionality of software explloads
Dialysis equipment

- Inherent use of therapeutic equipment makes connection of machines and EMRs mandatory.
- Saves staff time & effort
- Improves accuracy & care quality
- Other medical equipment interfaced with computers is largely diagnostic & not “real-time”
Workflow management

- Guided by the computer
- Follow the tabs
- Enforces consistent procedures
- Prevents overlooking details
Many entries are made from standard or user defined pop-up lists (▼)

“Target or Desired” orders make it possible to measure performance delivered against performance expected: Weight, BP, Blood Processed, Kt/V & URR
HD Treatment Screens -1
HD Treatment Screens -2

![HD Treatment Screen](image-url)

- **Orders**
  - Shift: Shift III
  - Chair: 33
  - Machine type: Fresenius
  - Machine ID number: Fresenius
  - Dialyzer 1: Fresenius Optiflux 160NR
  - Dialyzer 2: Fresenius Optiflux 160NR

- **Actual**
  - Shift: Shift III
  - Chair: 2 Rogosin-Manhatt
  - Machine ID number: F20 Rogosin-Manhatt
  - Dialyzer 1: Fresenius Optiflux 160NR
  - Dialyzer 2: Fresenius Optiflux 160NR

- **Disinfectant (prior to rinse)**
- **Residual disinfectant test**
- **Witness**
- **Alarms tests**
- **Dialyzer pressure test**
  - Dialysate 1: Regular - 2.0K+ 10 min
  - Dialysate 2: Regular - 2.0K+ 10 min
  - Dialysate flow: 700 ml/min
  - Conductivity
  - Dialysate pH
  - Dialysate temperature: 36.5 °C
  - Sodium variation type
  - Sodium & Bicarb settings

- **Completed by**: Dee Je LPN, Feb 25 2010 3:00pm ET
HD Treatment Screens -3
HD Treatment Screens -4
# HD Treatment Screens -5

## Patient Info | Machine Set-Up | Pre-HD | HD Tx 1 | HD Run | Post-HD | Summary

<table>
<thead>
<tr>
<th>Time</th>
<th>Medication/Fluid</th>
<th>Strength</th>
<th>Route</th>
<th>Dose ordered</th>
<th>Dose given</th>
<th>Signed</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Cathflo Activase</td>
<td>2 mg</td>
<td>intracat</td>
<td>2 mg</td>
<td>as needed in each po</td>
<td></td>
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<tr>
<td></td>
<td>EpoGen</td>
<td>2000 units/ml</td>
<td>1/3</td>
<td>5500 units</td>
<td>3/week</td>
<td></td>
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<tr>
<td></td>
<td>Hectorol</td>
<td>2 mcg/ml</td>
<td>IV</td>
<td>4 mcg</td>
<td>3 times weekly</td>
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<tr>
<td>New</td>
<td>heparin sodium (porcine)</td>
<td>1,000 USP Units/ intralum</td>
<td>4,000 u</td>
<td>every dialysis 2cc in e</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New</td>
<td>Venofer</td>
<td>100 mg/5ml</td>
<td>IV</td>
<td>200 mg</td>
<td>q month with monthly</td>
<td></td>
</tr>
</tbody>
</table>

## Time | Weight | Temp | BP | BP stand | BP sit | BP sup | Pulse | Pump | BFR | Art p | Ven p | UFR | TMP | Cond | Kt/V | BP leg | Gluc | HCT | %BV | Salt
<table>
<thead>
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<tbody>
<tr>
<td>pre</td>
<td>70.5</td>
<td>98.6</td>
<td>198/107</td>
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</tbody>
</table>

## Time | Initials | Event/Complication/Prophylaxis | Svry | Treatment | Treatment | Treatment
|-------|----------|-------------------------------|------|-----------|-----------|-----------|

## HD Run comments

- Real-time Monitoring
- Troubleshoot
- Save and Refresh this Page
- Write a Note

Completed by: [Signature]
Giving EPO During HD Run

An EPO Order on the HD Run Screen

Nurse records either dose given or reason not given, and signs off
Real-Time Monitoring Made Simple
from Any Dialysis Machine

Used to Monitor Patients Dialyzing
- In the dialysis unit
- At home, by nocturnal self dialysis
- In the ICU / CCU, from the main hospital unit
- In distant “satellite” units, from the main dialysis unit

Disease Manager Plus
HD Monitoring w/ Data Capture

Blood Processed

Date

11/11/02 11/18/02 11/25/02 12/2/02 12/9/02 12/16/02 12/23/02 12/30/02 1/6/03 1/13/03 1/20/03 1/27/03 2/3/03 2/10/03 2/17/03 2/24/03

In Center HD  Home Nocturnal HD

Target blood processed
HD Treatment Screens - 6
### HD Treatment Screens - 7

![HD Treatment Screen](image)

**Patient Info**
- Date: 02/25/2010

**Orders**
- Duration: 240 min
- Blood pump setting: 400 ml/min - avg
- Blood flow rate: ml/min - avg
- Blood processed: liters
- Arterial pressure: mmHg - avg
- Venous pressure: mmHg - avg
- Blood pressure: mmHg - avg
- Kt/V (ID)

**Actual**
- Duration: min
- Blood pump setting: ml/min - avg
- Blood flow rate: ml/min - avg
- Blood processed: liters
- Arterial pressure: mmHg - avg
- Venous pressure: mmHg - avg
- Blood pressure: mmHg - avg

**Events/complications documented**

**Special orders**
- Please tell patient if more than 1kg of weight is to be removed

**Tickler items**
- Every Tuesday PT, PTT INR

**HD comments**
- ***PRE***
  - Pt. alert with no s.o.b. and no complaints. Dressing changed, no s/s of infection. JD LPN

**Created**
- Feb 25 2010 2:55pm ET

**Modified**
- Feb 25 2010 5:00pm ET

**Signed off**

**By**
- Automated Dialysis Interface

**By**
- Automated Dialysis Interface

---

33
A warning appears if something was ordered and not recorded as given.
Some “Recent” Billing issues in Dialysis

• Demands coordination of clinical and administrative staff
• Jan ‘98 - Place URR on the dialysis bill
• Jul ‘03 - Place Hct on bill for patients on EPO
• Jan ‘04 - Document & bill for MCP capitation (MDs)
• Jan ‘05 - Place height & weight on dialysis bill
• Apr ‘05 - Case mix payments for services
• Late ‘05 - Other mandates under CMS conditions for coverage

Billing requires patient-specific time-sensitive clinical data
- and the complexity of data needed is increasing.
CMS issued two new regulations on January 29, 2010. These will require providers to report dialysis adequacy, infection, and vascular access results and values on all ESRD claims with dates of service on or after July 1, 2010.
Bundling

- January 1, 2011?
- Final regulations?
- Requirements met to be properly paid
- 26 CPMs – CrownWeb
- Accountable through incentives and penalties for e.g. low fistula rates and high central venous catheter rates.
Monitoring Outcomes and Alerts
Clinical Performance Measures

Example of Clinical Performance Measures

1. Extract data
2. Chart performance measures
3. Monitor & Improve patient care
EMRs have something for everyone

- Dietician
- Social Worker
- Repair/Service Technician
- Reuse Tech
- Patient Care Technician
- Physician & Nursing staff
- Integrated single database – the whole choir sings from the same hymnal
Dietician

- Diet Orders
- Assessments
- Plan of Care
- Care Plan reviews
1.2 Gm/Kg Pro, 2Gm K, 2Gm Na, 1L per day No concentrated sweets if diabetic

No Restrictions
80 80 gm Protein
70 70 gm Protein
60 60 gm Protein Diet
40 40 gm Protein
None No Concentrated Sweets
low Low Fat Low Cholesterol
Social Worker

- Assessments
- Plan of Care
- Care Plan reviews
Repair/Service Technician

Dialysis Machine

- **Location**: UMDC
- **ID number/name**: 1550 # 2
- **Description**:
- **Date began using**: 08/03/1994
- **Manufacturer**: Baxter
- **Serial number**: 050761
- **Machine type**: Baxter SPS 1550
- **CentrNet/Phoenix CCM ID**: (not Station ID)
- **IP address/port**:
- **Comment**: Preventive Maintenance (PM) records will be found in the “Service” box, and are designated by a blank space under the “Problem” heading.
- **Created**: Nov 16 1994 7:34am MT by Mark Bechtler
- **Modified**: Sep 22 1997 1:19pm MT by John Flynn

Dialysis type
- **chronic**
- **acute**

Positive hepatitis
## Dialysis Machine

### Services

<table>
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<tr>
<th>Date</th>
<th>Hours</th>
<th>Problem</th>
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<tbody>
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<td>1</td>
<td>Electronics</td>
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<tr>
<td>12/13/1994</td>
<td>1118</td>
<td>See problem text</td>
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<tr>
<td>03/13/1995</td>
<td></td>
<td>Mechanical</td>
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<tr>
<td>06/28/1995</td>
<td>2722</td>
<td>Mechanical</td>
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<td>08/17/1995</td>
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<td>Leak</td>
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<tr>
<td>12/04/1995</td>
<td>4556</td>
<td>UFC</td>
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<tr>
<td>03/02/1996</td>
<td>5541</td>
<td>Leak</td>
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<td>04/02/1996</td>
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<td>05/02/1996</td>
<td>6064</td>
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<tr>
<td>07/12/1996</td>
<td>6205</td>
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<tr>
<td>09/24/1996</td>
<td>7000</td>
<td>See problem text</td>
</tr>
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</table>
Service Record

Date: 12/13/1994
Hours: 1118
Parts cost: 0.00
Performed by: GL
Labor hours: 2

Machine problem: See problem text

Problem text:
Quarterly PM (1000-1200 hours)

Service performed:
The following areas are checked for operating integrity. See Baxter 1550 Technical Manual for detailed PM list.
- Blood pump occlusion
- Infusion pump

Parts used:

Created: Dec 15 1994 3:40pm MT by Mark Bechtler
Modified: Jun 7 1995 4:55pm MT by GI Lee

Delete
Greg Bogenschutz of software consulting company Sunbend Corp programmed the first commercial reuse software, Renalog for Renal Systems.

As a CDC developer he used Control Data's "Micro IPF“ relational database for Renalog I and II.

IPF stood for "Information Processing Family". When the Renatron connection features were added to Renalog II, a Control Data upgrade version called “IM” (Information Manager) was used.

Following slides compliments of Wayne Carlson Minntech
Active Patient Dialyzer Summary

<table>
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<tr>
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<tr>
<td>BA49934A3 T220</td>
<td>8069B</td>
<td>2</td>
<td>3</td>
<td>02/03/1997</td>
<td>Volume</td>
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<td>BA737D930 F80</td>
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<td>BA9D67B8D F80</td>
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<td>6</td>
<td>03/26/1997</td>
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<td>BA9FBE6DF F80</td>
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<td>8</td>
<td>04/02/1997</td>
<td>Volume</td>
</tr>
<tr>
<td>BAC35F243 F80</td>
<td>6M02308</td>
<td>6</td>
<td>7</td>
<td>04/21/1997</td>
<td>Volume</td>
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<td>9</td>
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<td>Volume</td>
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<tr>
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<td>5</td>
<td>05/30/1997</td>
<td>Volume</td>
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<tr>
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<td>7C00308</td>
<td>5</td>
<td>9</td>
<td>06/12/1997</td>
<td>Volume</td>
</tr>
</tbody>
</table>

Average Uses: 41.00  Average Rep.: 41.00  Number of Dialyzers: 1

Average Uses: 5.73  Average Rep.: 7.45  Number of Dialyzers: 11
RenalogRM - Minntech
Number of Failures per Fail Code

Failure Description:

- Appearance
- Blood kble
- Clotted
- Dick's network
- Maximum usage
- Miscellaneous
- No power
- Patient applied
- Pressure
- Rlease disconnected
- Transient
- Visual failure
- Volume

Fail Date from 1/1/2006 through 12/31/2006

Dialyzers

0 50 100 150 200 250 300

- Appearance
- Blood kble
- Clotted
- Dick's network
- Maximum usage
- Miscellaneous
- No power
- Patient applied
- Pressure
- Rlease disconnected
- Transient
- Visual failure
- Volume

Export Type: Excel

Export
Zoom In
Zoom Out
Print
Close
State of the Art Reuse Labels circa 1985
(Compliments of Vern Taaffe)
Administrators/Financial Managers
Why an EMR?

- Internal controls
- Bill & collect all revenue properly due
- Capture charges
- Bill secondary claims
- Compliance
Capture & Enter charges

- Do it right the first time
- Avoid rejections
- 15 billion health claims annually – 30% are rejected by payers
- Of the 30%, 15% are never resubmitted even though there is a payer. (Smith, BT: APA Matrix 16:2 2001)
- 4.6 claims per MD per week are denied due to bad claims (MGMA Center for Research, 2003)
Independent Dialysis Unit #1

Net Collected Revenue per HD Treatment

Disease Manager Plus Implemented

Pre Implementation

Month 1: $328
Month 2: $323
Month 3: $319
Month 4: $323
Month 5: $316
Month 18: $325
Month 21: $355
Independent Dialysis Unit #2

Disease Manager Plus Implemented

Pre Implementation

Net Collected Revenue per HD Treatment

- Month 1: $234
- Month 2: $320
- Month 18: $394
- Month 21: $401
Hospital Dialysis Unit

MIQS Implemented in January 2004

Net Collected Revenue per HD Treatment

- $60 in October '04
- $43 in November '04
- $35 in December '04
- $42 in January '05
- $39 in February '05
- $41 in March '05

Year 2003
CMS payment rules require a 25% reduction in EPO & Aranesp dosage when Hb and/or Hct exceed the levels indicated.
CMS payment rules for EPO & Aranesp require reporting an Hb and/or Hct level measured in each calendar month.
CMS payment rules for dialysis treatments require that the patient’s height be reported on the bill.
CMS payment rules for dialysis treatments require an “adjusted height” in lower limb amputees (ICD V49.7X)
What do you want to know?

- Who do you want to know it about?
- Who wants to know?
- Cohort selection – by unit, by nephrologist, by diagnosis, by meds, by lab tests
- Very difficult
Users of MIQS Software Include…

<table>
<thead>
<tr>
<th>Physicians</th>
<th>Financial counselors</th>
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<tr>
<td>Nurses</td>
<td>Schedulers</td>
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<tr>
<td>Nurse practitioners</td>
<td>Administrators</td>
</tr>
<tr>
<td>Physician assistants</td>
<td>Transplant coordinators</td>
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<tr>
<td>Patient care technicians</td>
<td>Research coordinators</td>
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<tr>
<td>Dialysis machine technicians</td>
<td>CQI personnel</td>
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<tr>
<td>Dialyzer reuse technicians</td>
<td>Facility billing personnel</td>
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<td>Dietitians</td>
<td>Physician billing personnel</td>
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<tr>
<td>Social workers</td>
<td></td>
</tr>
</tbody>
</table>
Data Analysis: Report Types

- **Wordprocessing reports**
- **Spreadsheet reports**
- **Graphic reports**
  - Single Patient
  - Multiple Patient
- **Tabular reports**
  - Single Patient
  - Multiple Patient
What do you want to know?

- Who do you want to know it about?
- Cohort selection – by unit, by nephrologist, by diagnosis, by meds, by lab tests
- Very difficult
Patient Selection Engine

Demographics

Selection can be by age, sex, ethnicity, alive or expired, hospitalized or not. Also, by physician, location, and by authorization of research use of data (HIPAA)
Patient Selection Engine

**Treatment Groups**

Selection can by inclusion or exclusion of 1 to 3 Treatment Groups. Treatment groups can be developed for various purposes by users (see next slide).
Selection can be by inclusion or by exclusion of 1 to 3 ICD-coded diseases and/or procedures.
Selection can also be by Lab test (including exception values) and by medications.
User: Hi, our printer is not working.
Tech: What is wrong with it?
User: Mouse is jammed.
Tech: Mouse? Printers don't have a mouse.
User: Well you’re wrong I will even send a picture to prove it.
The Proof