Healthcare Informatics: Data Quality, Warehousing and Mining Applications

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Presentation Outline

- Architecture
- Model
- Standards
- Integration
- Integrity
- Items
- Warehouse
- Customers
- Use

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Architecture and Model

- Result of our history and business consolidation
- Limit of technology at time capital/systems were acquired
- Changing Market and Strategic drivers
- Separate Member Organization and corporate silos
- (Non) Optimized relationships with customers and sponsors
  - ↙ Business domain sponsorship (Finance and Operations)
  - ↙ Corporate Office customers
  - ↙ Member Organization customers

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DSS requirements can be stratified into local, shared, and corporate. Differences between member organizations are based on geographic location, size, strategies, and product lines

Local
Local requirements are focused on integrating operational information and monitoring on a daily basis

Shared System-Wide
Shared requirements are focused on establishing standards that enable summarization for monitoring the 'State of the System' as well as providing internal and external benchmark information

Corporate
Corporate requirements are focused on monitoring the 'State of the System' and is a summary of monthly or quarterly, local and shared information

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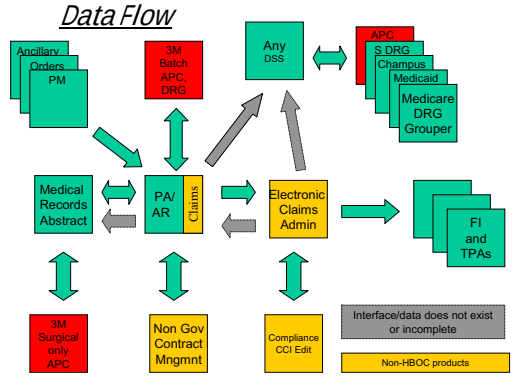
Data Flow



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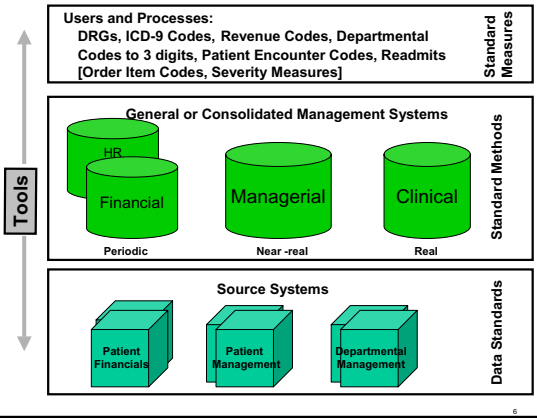

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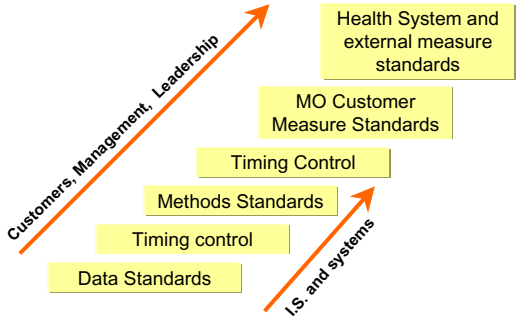
Building on the Basics



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Standards

- Need to solve 'we get different answers depending on where we look'
- Work on realigning the source data so that ALL downstream and dependant administrative, financial and clinical processes say the same thing
- The code cannot be 'reused' or meaning changed
- Business or Knowledge Domain manages process flow, methods, measures across systems
- **The end domain controls the standard and the source system enforces the standard**
- Data is controlled at the source (journal entries are bad)
- Computer Systems don't solve integration, they enable

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Principles

- *Mathematically, a unit is an integer, and can not be divided.*
- Consequently, the ordered item number has a unit value of one; meaning that each item is a unity of one:
  - Changes to or modifications of the meaning, results in the coded number losing integrity.
- Thus divide the meaning (e.g., dosage), the item can no longer be counted, you can only sum and extrapolate.
- (Another example, you will not find a family with 2.3 children, only Solomon was willing to do that).

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Standards Applied

Usability vs. Maintainability

- Creation of summary tables
- Need for decode tables
- Prevention of meaningless joins
- Application of business logic
- Amount of training required

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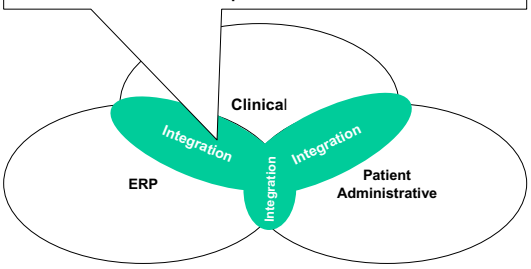
Integration is accomplished by standardizing functions, data and business processes and is critical to achieving customer priorities



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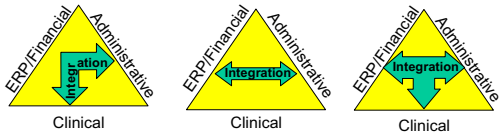
Integration is critical to achieve customer priorities for a new Information Model and integrity through standard function, data, and business process are critical to achieve integration



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Decision Support Integration

- The following slides represent the integration of financial and administrative decision support:
  - Integration of the data, measures, and results of the two DSS domains provide a consistent presentation of information for measure, analysis, and management
  - Integration of the domains leave the source of data at the source without duplication. For example, do not duplicate the GL in another DSS reporting environment
  - Integration of the data using a single or standard workload statistic computes a consistent outcome for all management measures; e.g.,
    - GL stats
    - Item level unit Costs
    - Departmental work load unit cost
    - Departmental productivity units
    - Departmental volume adjusted earned and budget costs
    - Provider, product, payor, performance

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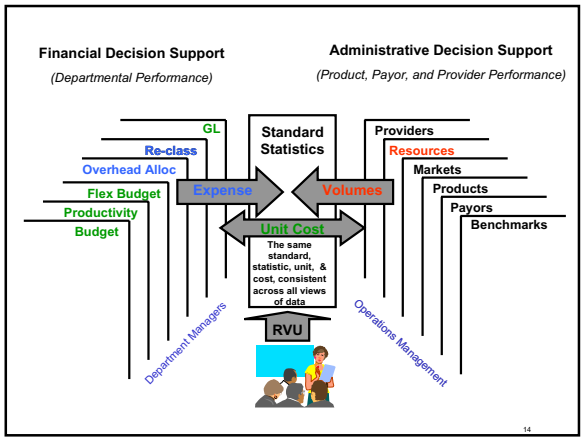

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Summary of Key Points….

- Streamline the summarization and aggregation of information. **Summarized and shared information should be a by-product of the operational process**, not an added step.
- The new information model needs to provide efficient methods to:
  - **Integrate** ERP and patient administrative data with clinical data
  - **Integrate within a Member Organization** and across the system
  - **Provide access** to customized information in one location
  - **Provide proactive and actionable information** at the time of decision-making.
- **Data, business process, and core function standards** are necessary to provide integrated information and to aggregate information across the system: Guidelines and standards need to determine what is core and what is optional to each member organization.
- **Plan for some component of variability** in implementing standards across the system; secondary systems will be necessary to map non-standard data to standards for shared and summarized reporting.

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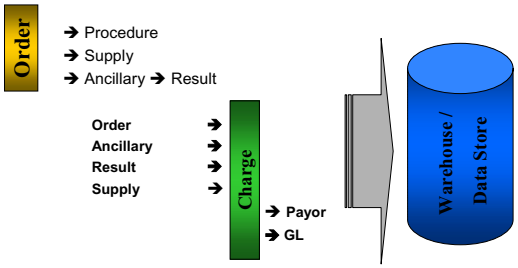
'Go with the Flow' - Item Flow



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Options

- Use of Item Type in the code - (maybe)
  - Procedure — Supply
  - Drug — Panel
  - Statistic — Other
- CPT code with the modifier - (no)
- Straight number sequence - (no)
- Use 'Consultant best practice' as standard - (won't fit)
- Combine department and item as item - (conflicting or limited value, what department?)
- One to one relationship Order, ancillary, supply and CDM - (geometric item master growth; which is to say the item master grows at a geometric rate)
- Change warehouse (DSS) to capture Order and Ancillary Detail - (maybe)

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To the Warehouse

- Order - the clinical item code
  - Clinical item (CBC)
  - The type: lab, image, pharmacy, etc
  - The sub-type: pathology, chemistry... for lab, or drug type, etc.
  - The status: complete, cancel, expired, resulted
  - The result: code and value
  - Clinical order item utilization (Location)
  - Clinician
- Charge - The financial item code
  - Revenue Department - GL
  - Expense Department - where the expense was incurred
  - Site - GL
  - Item Utilization (Location)
  - Financial Class

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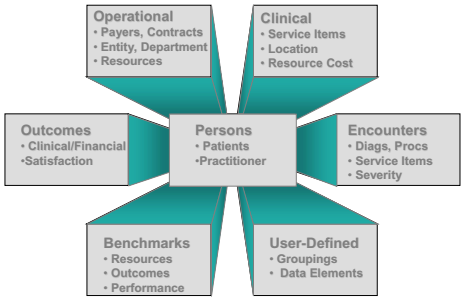
Key Data Subject Areas - The Customers View of Data



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DSS Activities

- Database administration
- System acquisition, enhancement, maintenance, and operation
- Software conversion
- User training
- Decision-maker training
- User support
- Project Leadership
- Accessibility and report design and production
- Data collection
- ROI measurement
- System, data, and application audits
- Application project sponsorship
- Direction and management of field responsibilities

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DSS Performance Measures

- Audit Results (accuracy, timeliness, relevance)
- ROI
  - Clinical Outcomes
  - Consumption
  - Cost
  - Quality
  - Competitive position
  - Satisfaction
  - Variances

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Purpose of Severity Measurement

- Primarily used for equitable measurement and reimbursement
- Improving resource utilization
  - Reduce variation
  - Benchmarking
  - Target improvements
- Physicians to see other physician practice patterns
- Comparing outcomes across practitioners, providers
- Negotiations with Third-party Payors
- Improving Competitive Positioning

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Underlying Causes of Clinical Quality Problems (After Chassin)

- Overuse [inappropriate or unnecessary services or where providing a service when its risk of harm exceeds its potential benefit].
- Underuse [failure to provide a service when it would have produced favorable outcomes].
- Misuse [avoidable complications of appropriate care].

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Identification of Undesired Variation

- Multiple successive sieve drilldown
- Descriptive statistics for identification of baseline
- Drills and data mining for patterns
- Misuse identification
- Opportunities, performance and change management

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Statistically Driven Drilldown Approaches to Variation Analysis

Multiple Successive Sieve Methodology [1,2]:

Identify Patterns of Patient Outcomes	[Mortality, Morbidity, Disability, Cost]
By Constructing Analytic Files	[Comprised initially of administrative data]
In Reference to an Indexed Event	[Hospitalization, Outpatient or primary care]
For a Specific Condition	[Identified by DRGs or ICD-9 or CPT codes]
Classified in a Certain Manner	[Severity Adjustments]
With Concomitant Characteristics	[Comorbidities and Complications]
Which are Medically Served	[Procedures, Treatments and LOS]
In Various Populations	[Age, sex, other demographics, payers]
By Distinct Providers	[Physicians and their subspecialties]
Using Specific Resources	[Pharmacy, Supplies. ICU/CCU, etc.]
Which can be further stratified	[by SIM: ACE inhibitors, re-intubation, etc.]
For Desired Outcomes/Variation	[Rates, Profiles and Patterns]
Using a Myriad of Tools	[Biostatistics, Multivariate Methods & SQC]

[1]Developed in part, *National Science Foundation Grant*, National Center for SuperComputing Applications, 1992. Piontek F.A., principal investigator.

[2]Zarling E. J., Piontek F.A., Polk R.,Vogel T.T., VanOsdol T., Groot H.J. Applications of a Decision Support System to Medical Staff Evaluations. *J of the American Medical Informatics Association*, 1997, Supplement, October, p. 1022a.

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Overuse #1

Statistics for DRG 14: Specific Cerebrovascular Disorders non TIA

	N			
	Valid	Mean	Median	Sum
C_ER	449	247.49	233.54	111124
C_ICU	449	659.79	.00	296245
C_LAB	449	217.56	110.83	97682
C_OTHER	449	574.67	538.79	258026
C_PHARM	449	370.41	143.32	166312
C_RAD	449	404.68	260.19	181701
C_ROOM	449	1290.76	1052.26	579550
C_SUPPLY	449	54.45	8.41	24447
C_SURG	449	19.62	.00	8807
C_THER	449	256.28	179.12	115070
EXP_COST	449	4307.63	4342.55	1934125
TOT_COST	449	4095.68	3209.47	1838958
EXP_LOS	449	4.647	4.840	2086.5
LOS	449	4.550	4.000	2043.0
EXP_MORT	449	.111403	8.91E-02	50.0201
MORT	449	9.350E-02	.000	42.0
COMP	449	.167	.000	75.0
N_CODES	449	8.198	8.000	3681.0
HI_COST	449	.327	.000	147.0
EXP_READ	449	.1085545	.1060200	48.74097
NEXT_IND	449	8.91E-02	.00	40

DRG_APS	HI_COST	cases N	tot cost Mean	los Mean	c icu Mean	c_pharm Mean	c rad Mean	c lab Mean	c_other Mean
140	0	132	2274	2.6	166	91	248	86	483
	1	68	4757	5.5	757	370	634	247	584
141	0	134	2703	3.2	195	143	332	147	475
	1	59	7149	8.5	1171	854	546	372	829
142	0	36	4355	4.5	777	513	368	289	581
	1	20	13728	11.8	4979	2058	794	878	1054

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Department Drill Hip Replacement with No CC

Overuse #2a

DEPART#	SIM_TYPE	qtypt hi Sum	qtypt lo Sum	costdiff Sum
BLOOD SERVICES	PACKED CELLS, PREP	0.85	0.43	-$59,741
LABORATORY	PROTHROMBIN TIME PROTIME	2.85	0.05	-$59,270
OPERATING RM SUPPLY	FEM STEM 9825-XX-XX-SPECIAL-A	0.52	0.03	-$163,095
OPERATING RM SUPPLY	5410-05 DEPUY LAMINAR FLOW HOOD	3.03	0.1	-$275,928
ORTHOPEDIC SURGERY	ADDITIONAL 1 MINUTE INCREMENTS	37.21	0.05	-$630,189
ORTHOPEDIC SURGERY	CLASS 5 SURGERY 1ST HOUR	0.97	0.05	-$757,089
PHARMACY	APAP/HYDROCODONE 5/500MG (VICODIN	11.79	0.1	-$281,715
PHARMACY	CEFAZOLIN 10G VIAL (ANCEF)	5.7	1.57	-$154,323
PHARMACY	MULTI VIT W IRON (STRESS W/IRON)	4.36	0.29	-$37,580
PHARMACY	ACETAMINOPHEN 325MG TAB (TYLENOL)	3.21	1.24	-$26,179
PHARMACY	NITROGLYCERIN 0.4MG SL TAB #25	2.33	1.48	-$19,035
PHARMACY	POTASSIUM CL 20MEQ TAB (K-DUR)	3.36	0.19	-$18,432
PHARMACY	PROPOXY/APAP N-100(DARVOCET N-100	2.97	0.05	-$17,755
PHARMACY	DOCUSATE CA 240MG CAP (SURFAK)	2.58	0.05	-$11,213
PHARMACY	NITROGLYCERIN 25mg/5ML VIAL	0.03	8.67	$10,081
PHARMACY	CEPHALEXIN 500MG CAP (KEFLEX)	0.18	10.14	$31,844
RADIOLOGY	HIP PORTABLE CHARGE	1.75	0.24	-$66,987
RADIOLOGY	ONE VIEW CHEST (PORTABLE)	0.42	0.05	-$11,453
RESPIRATORY THERAPY	OXYGEN DAILY (12 HRS OR MORE)	3.27	0.05	-$163,816
RESPIRATORY THERAPY	NEBULIZED MED SUBSEQUENT TREAT	2.39	0.24	-$103,732
RESPIRATORY THERAPY	INCENTIVE SPIROMETRY-TREATMENT	1.73	0.48	-$46,055
RESPIRATORY THERAPY	INIT INCENTIVE SPIROMETER TREAT	0.85	0.05	-$16,044
RESPIRATORY THERAPY	OXIMETER DAILY	0.42	0.05	-$10,627
SITTER SERVICE	AGENCY CARE ATTENDANT 1 HR	2.3	0.05	-$83,431
SITTER SERVICE	SPECIAL CARE ATTENDANT PER HR	1.64	0.1	-$50,061
SITTER SERVICE	NURSING CARE-CNA (PER HOUR)	6.06	0.1	-$935,128

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Misuse 1a

InPatient Cases CY 2000 w/wo Complications [after Iezzoni]

COMP	Cases N	Exp Cost Mean	Tot Cost Mean	Exp LOS Mean	LOS Mean	Exp Mort Sum	Mort Sum	SMR	Case Fatality	Exp Read Sum	Readmits Sum	Hi Cost > 0	High LOS > 0
none	22950	4180	4126	3.4	3.2	520.2951	316	0.61	1.4%	2637.98	1808	35.80%	39.10%
1	1725	9216	9699	7.2	7.7	203.0364	203	1.00	11.8%	312.52	217	38.30%	42.90%
2	409	14753	19364	9.9	11.9	102.7984	123	1.20	30.1%	72.86	59	52.60%	51.30%
3	122	21808	31866	13.1	17.9	44.9092	49	1.09	40.2%	20.31	11	62.30%	60.70%
4	39	22509	40366	13.4	23	19.8505	15	0.76	38.5%	8.14	10	79.50%	74.40%
5	13	20339	64163	12.3	28.6	6.5149	8	1.23	61.5%	1.10	0	76.90%	76.90%
6	3	22260	57848	11.3	29.3	1.0382	2	1.93	66.7%	0.00	0	100.00%	100.00%

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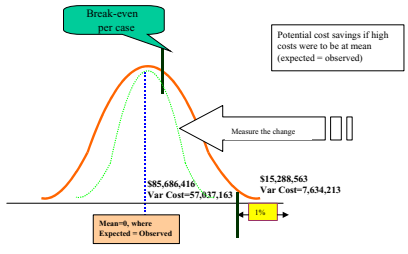
Costs



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Bibliography:

[1] Berwick D.M. Controlling Variation in Health Care: A Consultation from Walter Shewart. *Medical Care*, December 1991, Vol. 29, (12) pp. 1212-1225.

[2] Hand R., Piontek F. A., Walden L., Inczauskis D. Use of Statistical Control Charts to Assess Outcomes of Medical Care: Pneumonia in Medicare Patients. *Am J Med Sci*, May 1994, 307 (5), pp. 329-334.

[3] Kahn M.G., Bailey T.C., Steib S.A., Fraser V.J., Dunagen W.C. Statistical Process Control Methods for Expert System Performance Monitoring. *JAMIA*, July/Aug 1996, Vol. 3, (4), pp. 258-269.

[4] Chassin, M.R. Is Health Care Ready for Six Sigma Quality? *The Milbank Quarterly*, 1998, Vol. 76 , (4), pp. 565-591.

[5] Zarling, E.J., Piontek F.A. and Kohli R. The Utility of Hospital Administrative Data for Generating a Screening Program to Predict Adverse Outcomes. *American Journal of Medical Quality*, 1999, Vol. 14, (6), pp. 242-247.

[6] Iezzoni, L.I. The Risks of Risk Adjustment. *JAMA*, November 19, 1997-Vol 278, (19), pp. 1600-1607.

[7] Kohli R., Piontek F.A., Ellington T., VanOsdol T., Shepard M., Brazel G. Managing customer relationships through E-business decision support applications: a case of hospital-physician collaboration. *Decision Support Systems*, 2001, (32), pp. 171-187.

[8] Kohli R., Tan J.K., Piontek F.A., Ziege D.E., Groot H. Integrating Cost Information with Health Management Support Systems: An Enhanced Methodology to Assess Health Care Quality Drivers *Topics in Healthcare Information Management*, 1999, Vol. 20, (1), August, pp. 80-95.

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