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Using IT to control variability in practice and improve outcomes

William W. Stead, M.D.

Associate Vice Chancellor for Health Affairs
Chief Strategy & Information Officer
McKesson Foundation Professor of Biomedical Informatics and Medicine

Disclosures: I am a co-inventor of two patient medical record products — one licensed to McKesson, Inc., and one licensed to Informatics Corporation of America — from which I receive royalties through Vanderbilt University. I am a director of HealthStream, a public company, compensated by an annual option grant.

About Vanderbilt University Medical Center…

One of the nation's largest, fully integrated research intensive health systems on a university campus

- annual operating budget > $3.5B
- 4 Hospitals (1000 beds) – Children's, Adult, Psychiatric, Rehabilitation
- 20,000 faculty and staff – largest private employer of Tennessee citizens
- 3000 faculty (MDs, PhDs) – all medical disciplines and *sub-sub-sub* specialties
  - 53,000 inpatient discharges
  - 2 M ambulatory visits
  - 50,000 surgeries
- NCI-Designated Comprehensive Cancer Center, National Centers of Excellence for Heart, Trauma, Neurosurgery, Diabetes, Transplant, Children's care, many others…

- Discovery is Core. One of 10 largest NIH-funded biomedical research programs. Grants from government, industry exceed $0.5 B/yr
- University leader in HIT, nation's largest Informatics faculty (70) and over 500 staff
- Coordinating Center for $0.5 Billion NIH CTSA clinical research network (60 universities)

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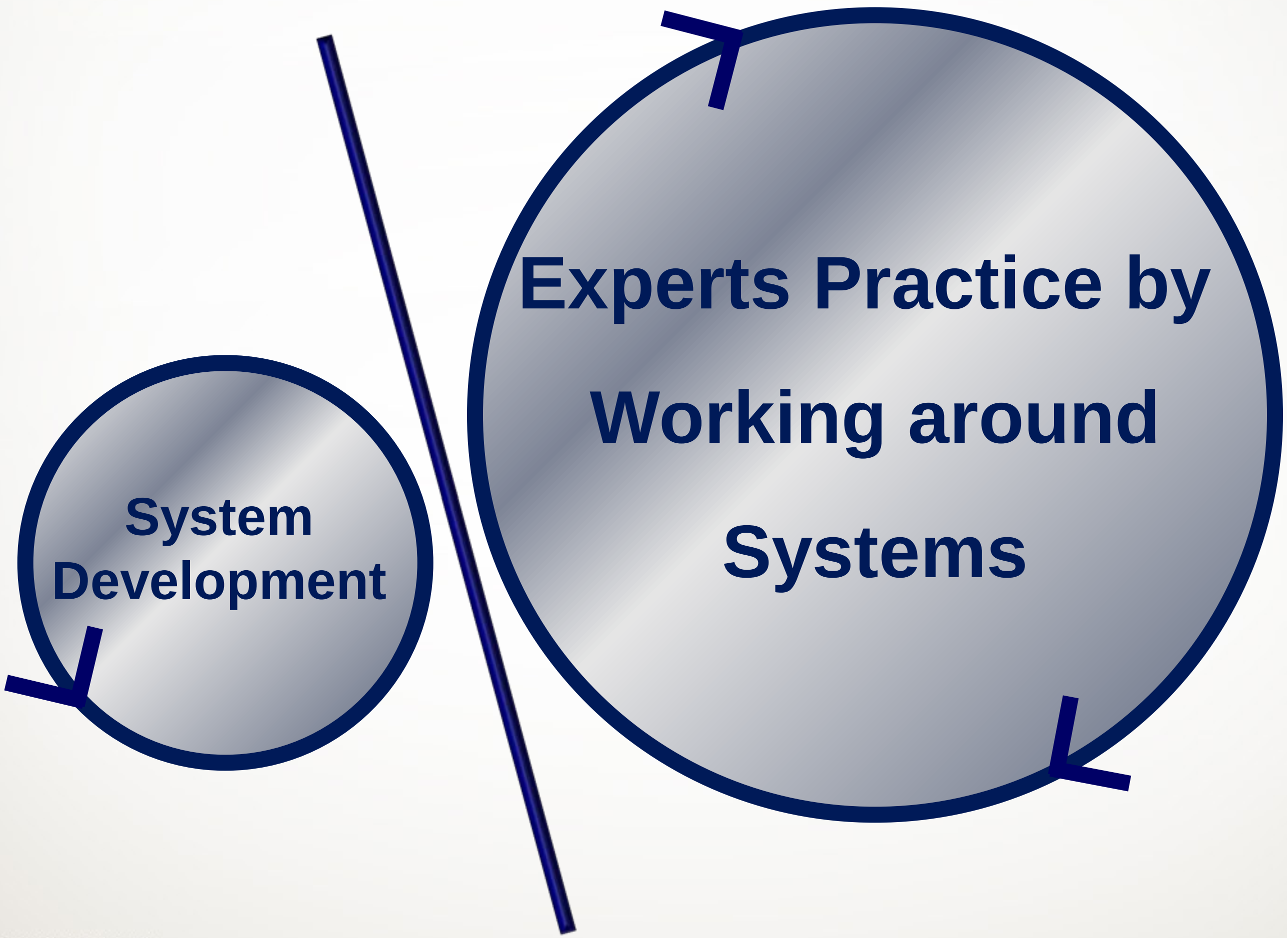
Outline

- Getting the care right
  - Gap between "point" improvement & "whole system" performance
  - Building blocks of a "systems approach to care"
  - Case study - Vanderbilt's approach to ventilator management
  - Applying systems engineering to healthcare
- Getting the technology right
  - Today's healthcare IT expectation gap
  - Matching computational approach to complexity of data
  - Using improvement science to adapt technology
- Take home messages

The Healthcare Non-system



If a unit performs each of 7 practices 90% of the time, what is the probability that they will perform all 7 for a patient?

A. 90%

B. 75%

C. 50%

D. 25%

Systems Approach to Care

People + Process + Informatics = Systems

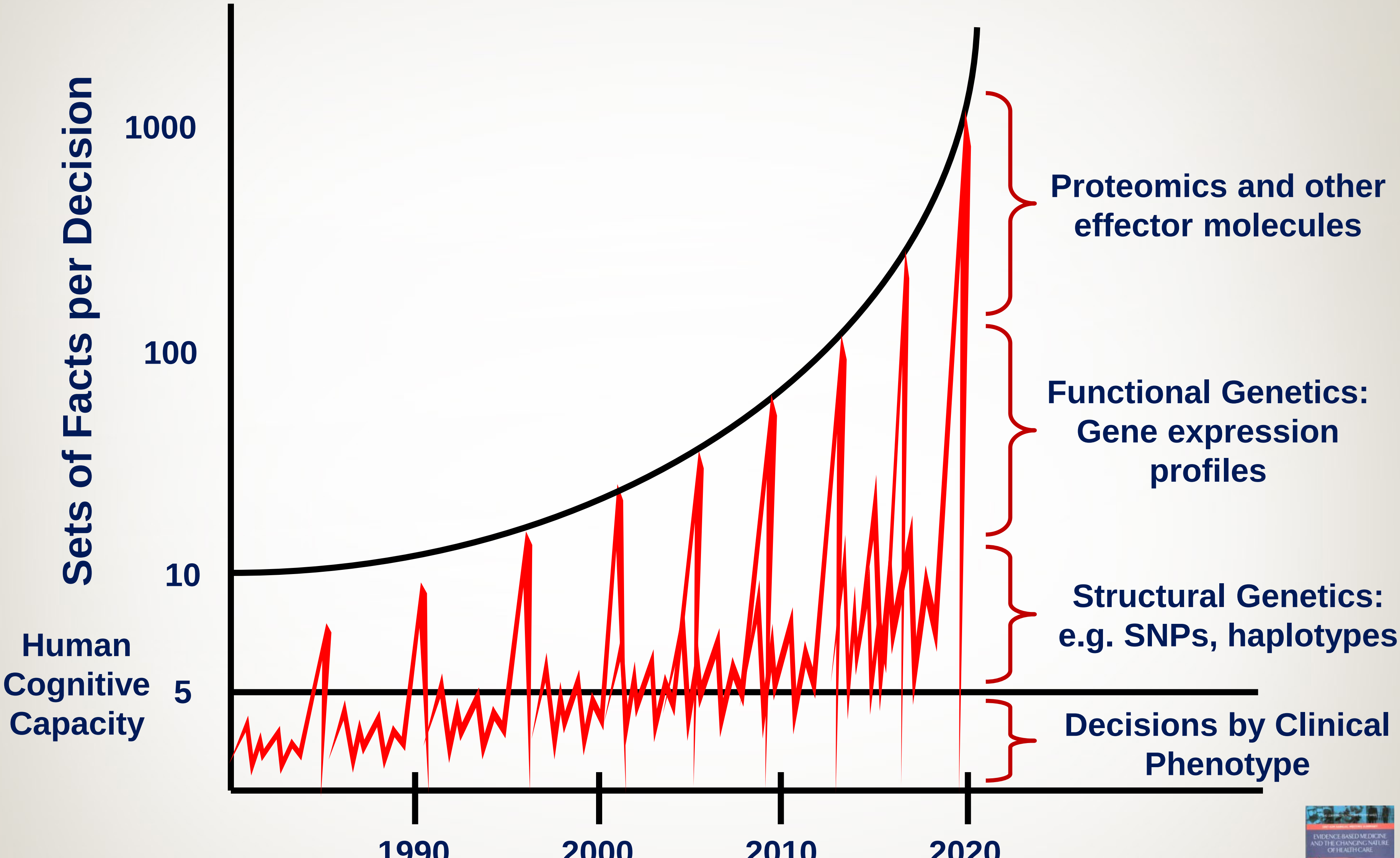
People
- Compassion
- Pattern Recognition
- Judgment

Process
- Simplification
- Standardization

Informatics
- ↓ Memory Dependence
- ↑ Forcing Function

Systems
- Reproducible Performance

Burning Platform: Overwhelming Complexity



(Adapted from) Stead WW. Beyond expert-based practice. IOM (Institute of Medicine). Evidence-based medicine and the changing nature of health care: 2007 IOM annual meeting summary, (Introduction and Overview, p. 19). Washington, DC: The National Academies Press 2008.

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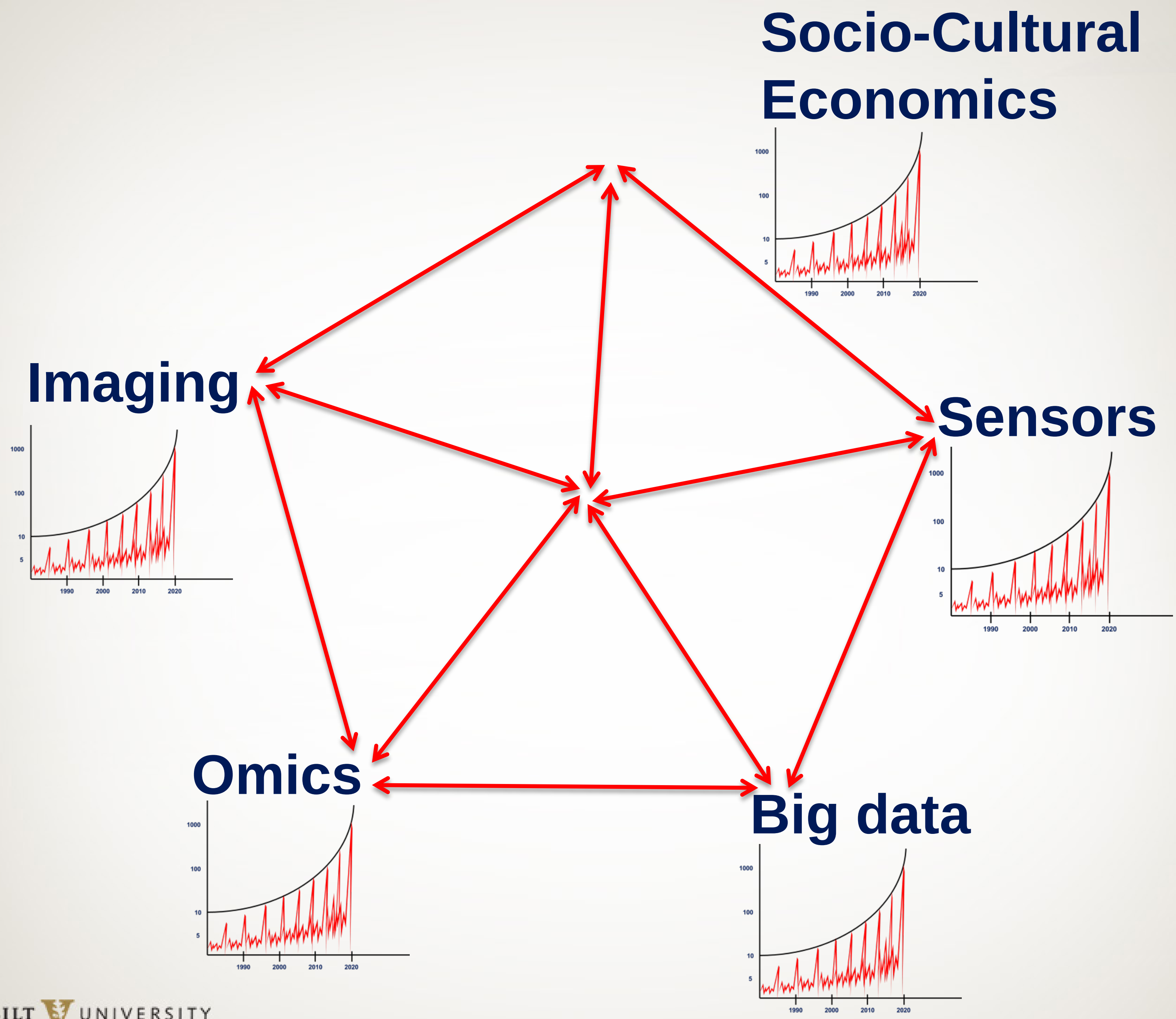

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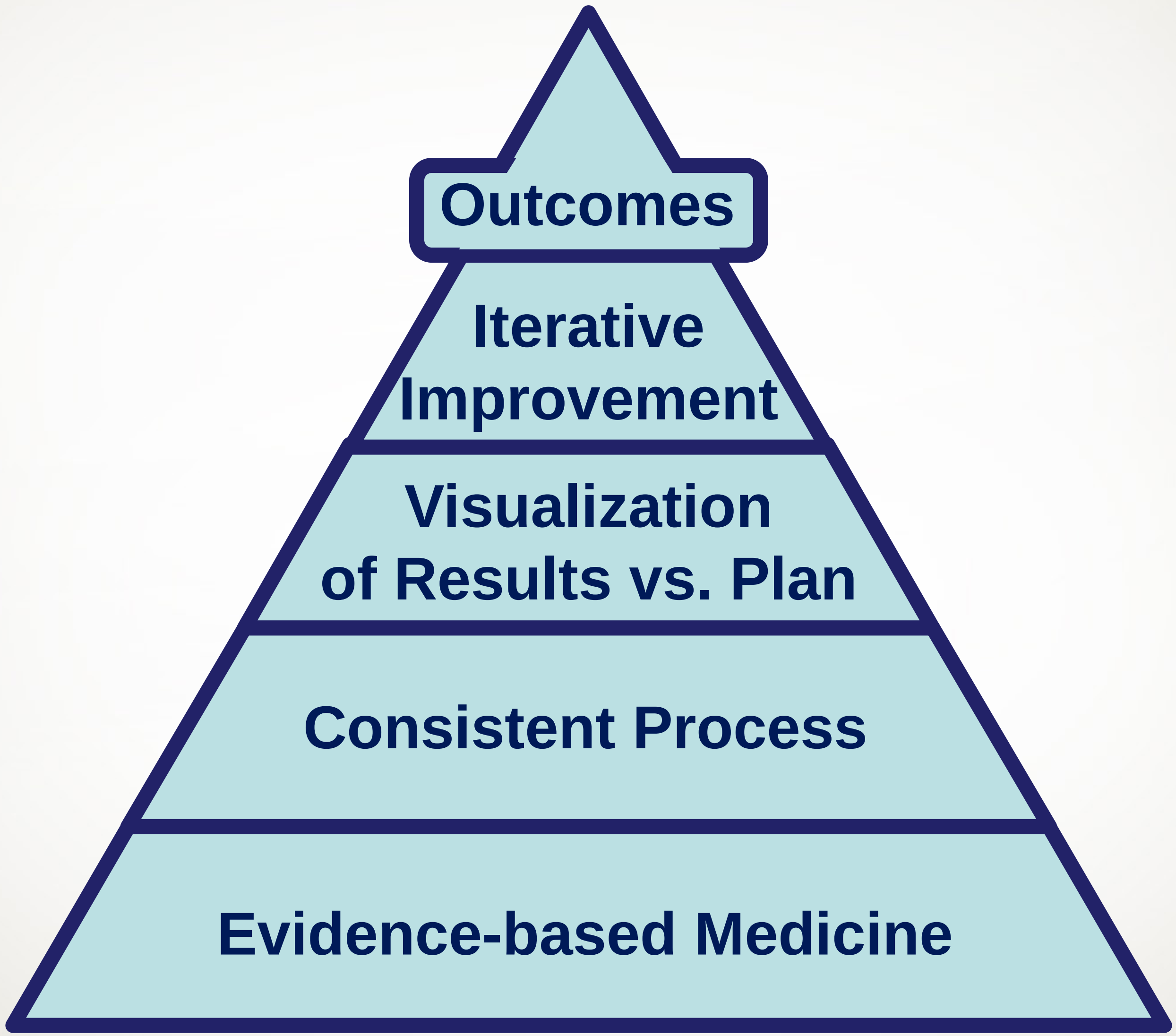
Systems Approach to Care



Vanderbilt Medical Center
Hearts and Minds

EvidenceWeb
Order Set Display

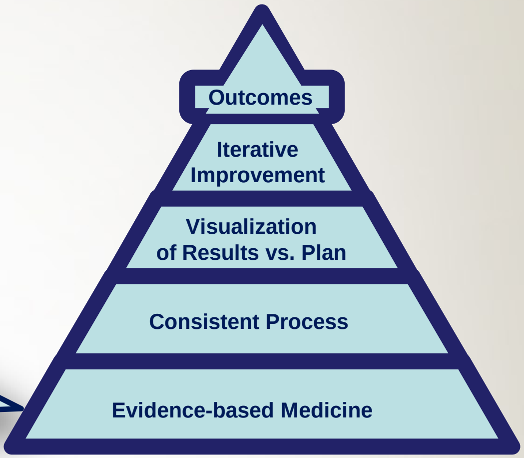
Mechanical Ventilation Orders

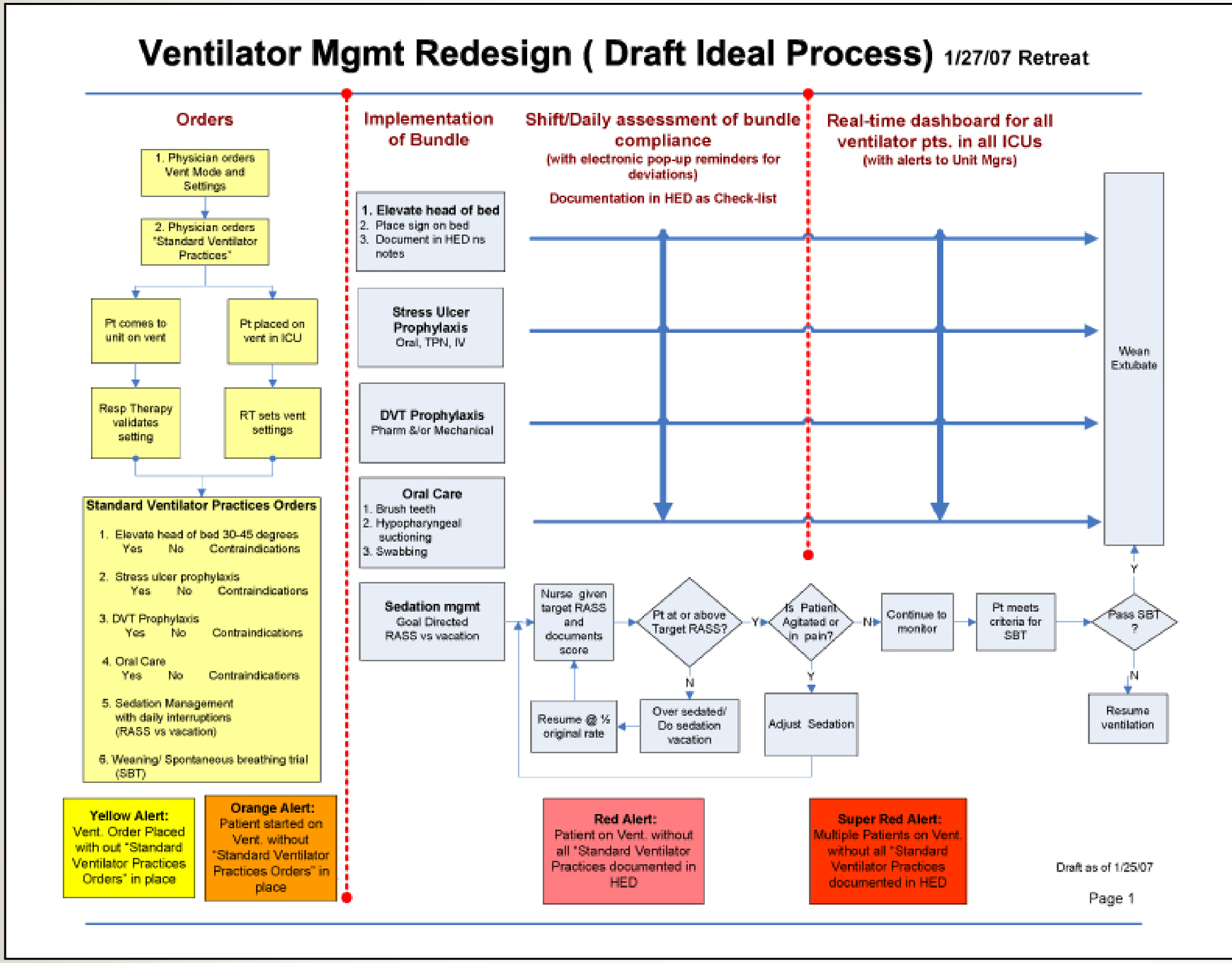
Last modified: 2007-03-13 14:25:27

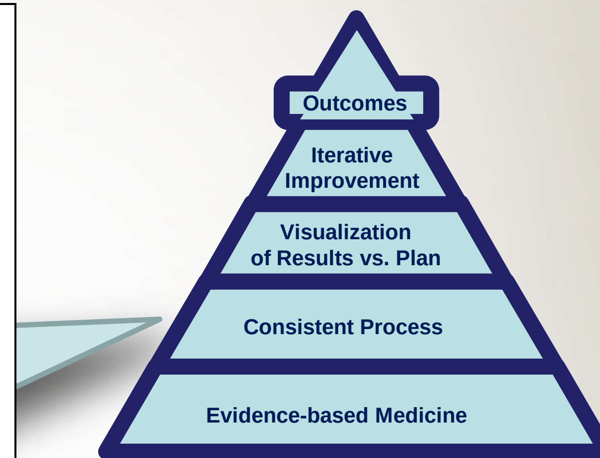
1. **VENTILATOR SETTINGS** CONTIN
   + **NURSING:** initiate ventilator associated pneumonia (VAP) weaning protocol (daily assessment of readiness to extubate)
2. **DVT PROPHYLAXIS**
3. **ICU Stress Ulcer Prophylaxis orders**
4. **SPECIFY TARGET RASS**
5. **ICU SEDATION PROTOCOL**

Nursing

6. **ELEVATE HOB** 30 degrees or greater
7. **mouth care q2h per VAP protocol** q2h per vap protocol
   + **NURSING:** Brush teeth q shift; oral suction swabs q2h; apply water -soluble mouth moisturizer PRN







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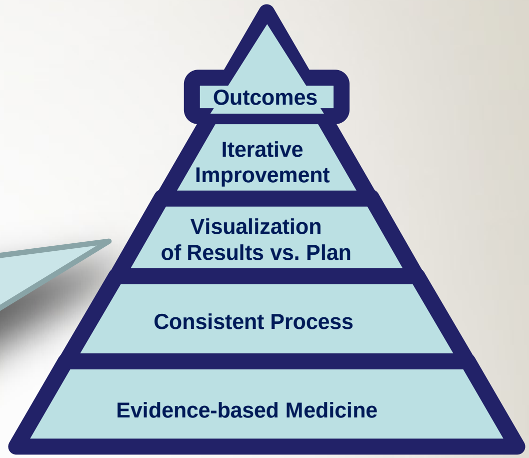
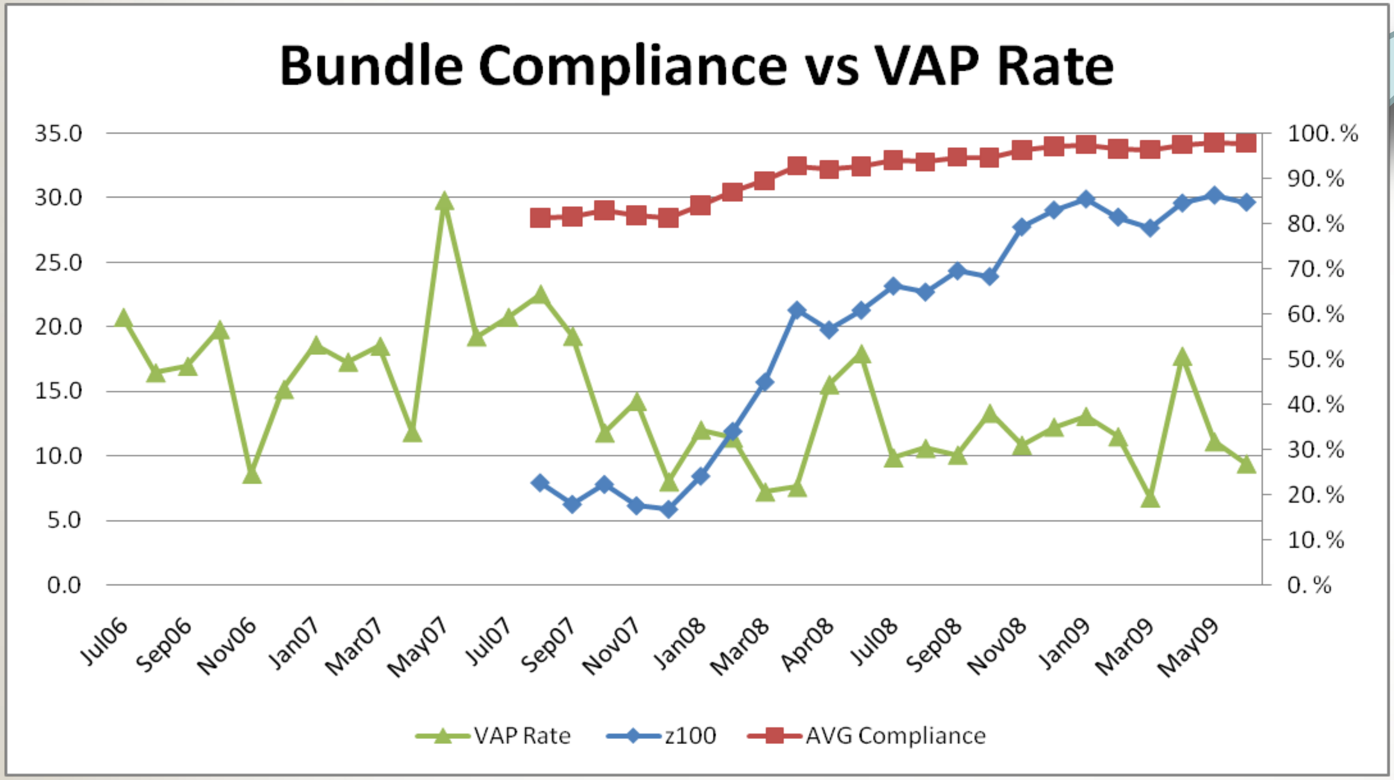
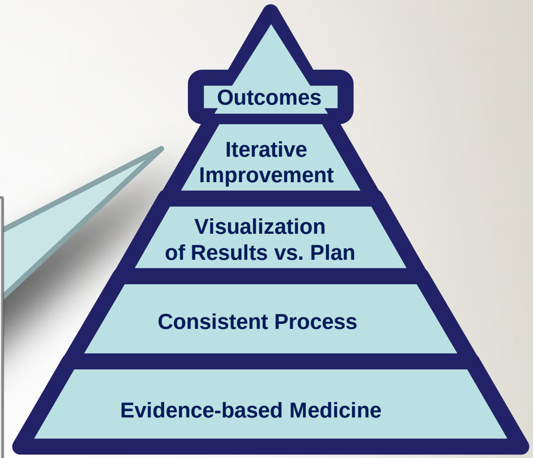
Bed	Patient name	Age	LOS	Orders				SBT				RASS					
							Vent	Scrn	Trial	DVT	SUP	Ord.	Pt.	HoB	swab	teeth	hySx
3002B	T, V W	72y	6 d		flowsheet	MAR	v	F		v	v	-4	-4	30			
3003X	N, D	60y	17 d		flowsheet	MAR	v	F		v	v	0	-2	45			
3004B	T, P L	64y	34 d		flowsheet	MAR	v			v	v	-1	-1	30			
3005A	C, D E	61y	7 d		flowsheet	MAR				v	v	0	-1	30	v	v	
3005B	B, J	66y	7 d		flowsheet	MAR	v	F		v	v	-1	-3	30			
3006X	W, A A	20y	66 d		flowsheet	MAR	v			v	v	-1	-2	30			
3007X	W, L E	49y	9:14		flowsheet	MAR				v		0	-1	30			
3008X	P, J L	69y	50 d		flowsheet	MAR	v	F		v	v	0	0	30			
3009X	R, C	72y	15 d		flowsheet	MAR	v	F		v	v	-1	-2	30			
3011A	P, J E	88y	9 d		flowsheet	MAR				v	v	0	0	45	v	v	
3011C	J, W D	69y	2 d		flowsheet	MAR				v	v	0	-1	30			
3011D	P, P J	55y	10 d		flowsheet	MAR	v	P	P	v	v	0	-3	30			
3011E	R, R E	74y	9 d		flowsheet	MAR				v	v	0	0		v	v	
3011F	N, E Y	55y	3 d		flowsheet	MAR				v	v	-1	0	30	v	v	
3012A	S, J D	56y	14 d		flowsheet	MAR	v	F		v	v	0	0	30			
3012B	R, M	63y	10 d		flowsheet	MAR	v	F		v	v	-2	-2	30			
3013A	N, B D	60y	8 d		flowsheet	MAR	v	F		v	v	-3	-2	30			
3013B	H, S M	66y	16 d		flowsheet	MAR				v	v	0	-1	30	v	v	



Intermediate Outcomes





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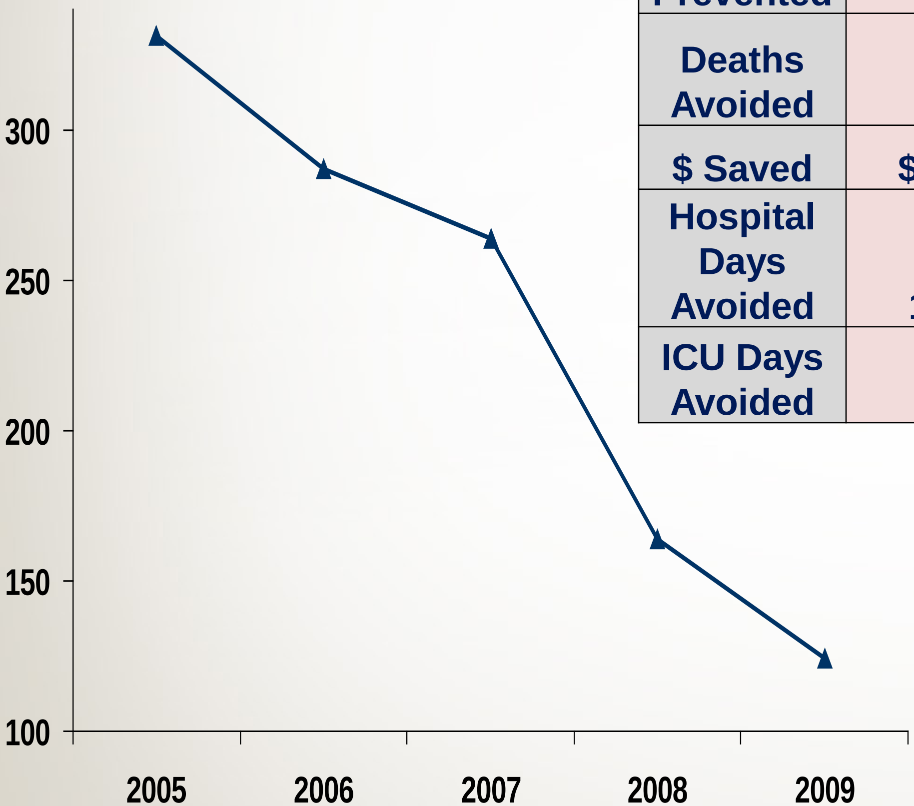
Summative Outcomes

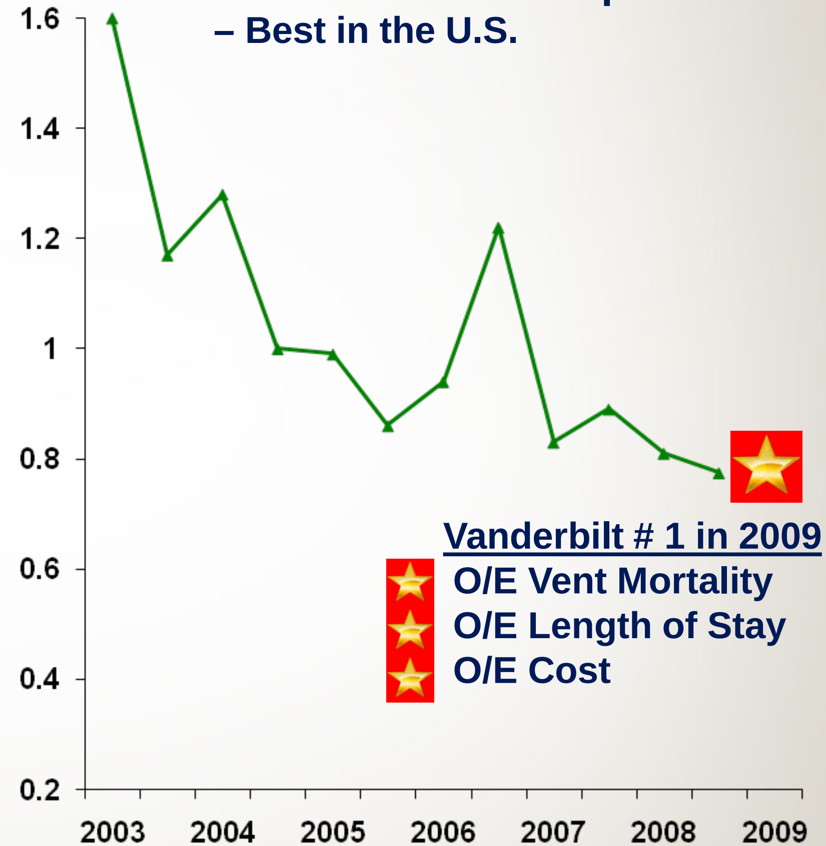
2. Impact on Results

	Fiscal Year 2009 Results c/w 2008
VAPs Prevented	108
Deaths Avoided	16
$ Saved	$4.3M
Hospital Days Avoided	1055
ICU Days Avoided	431

1. Number of Ventilator Acquired Pneumonia (VAP) Cases/Year at Vanderbilt



3. Mortality for Vanderbilt Ventilator Patients Compare to all the other Hospitals
– Best in the U.S.



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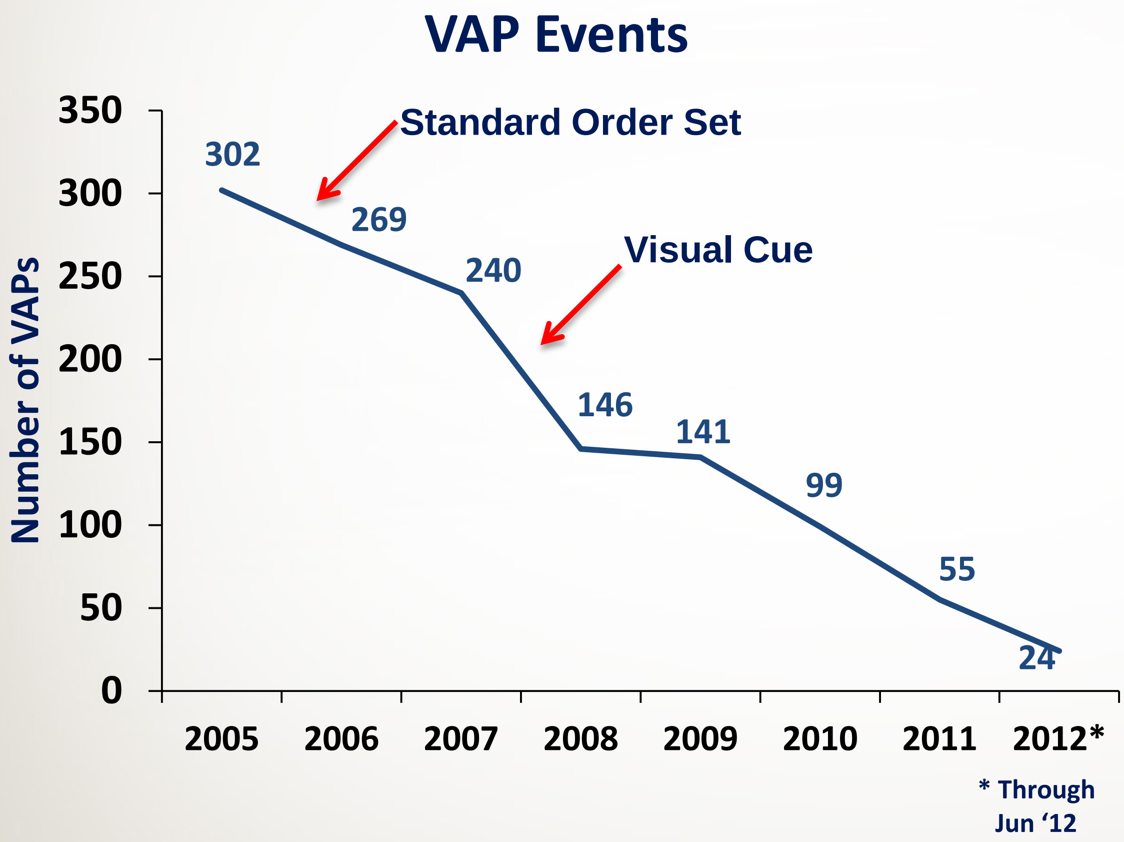
Continuous Improvement

Number of Ventilator-Associated Pneumonia (VAP) Cases/Year at Vanderbilt University Hospital



Mortality compared to all other University Hospitals – Best in the U.S.

	Jan 2008 – June 2012
VAPs Prevented	580
Deaths Avoided	87
Hospital Days Avoided	5,675
ICU Days Avoided	2,317

Estimated VU Savings: $23,000,000

Source: UHC and Vanderbilt Data

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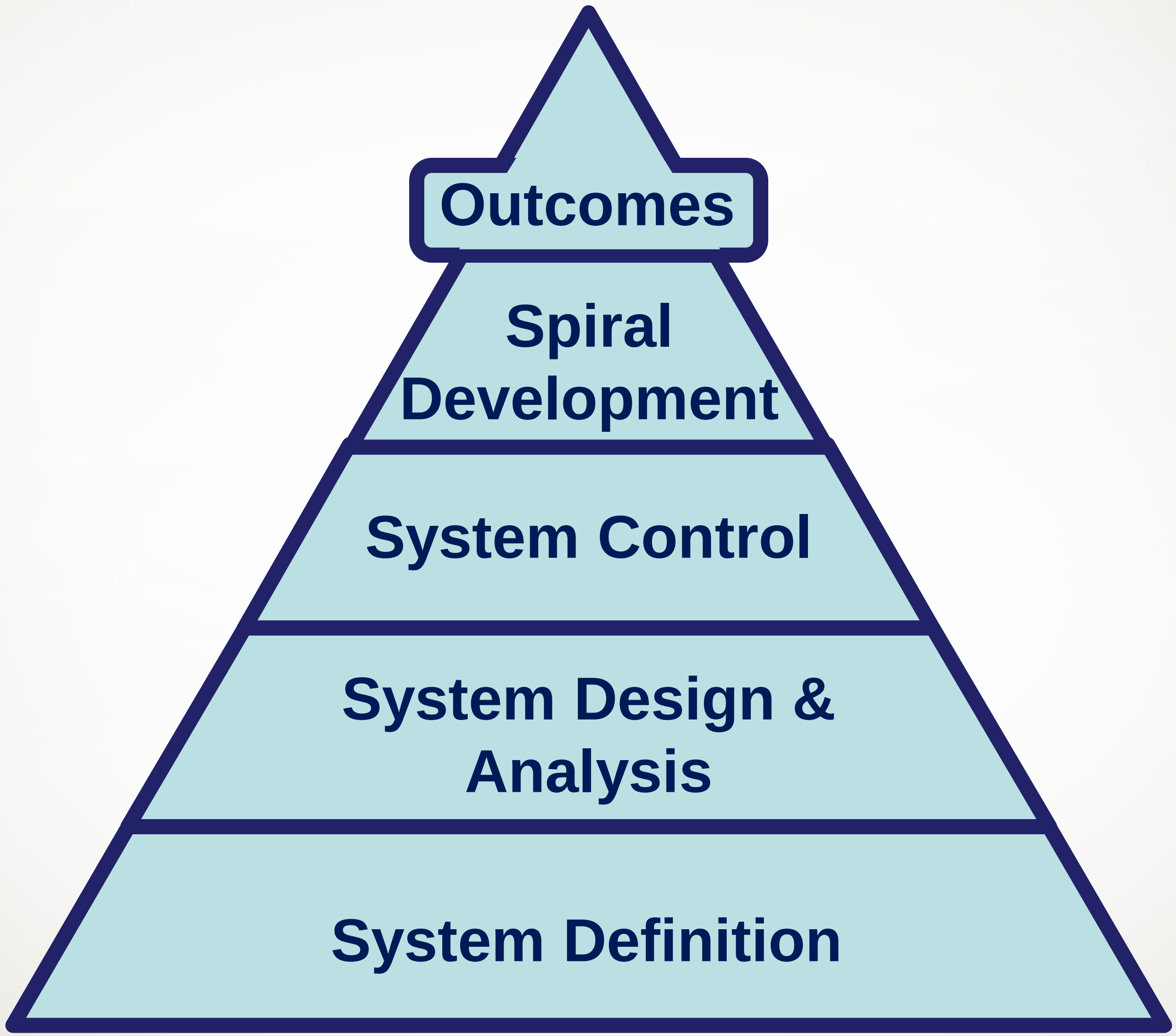
Systems Engineering Methods



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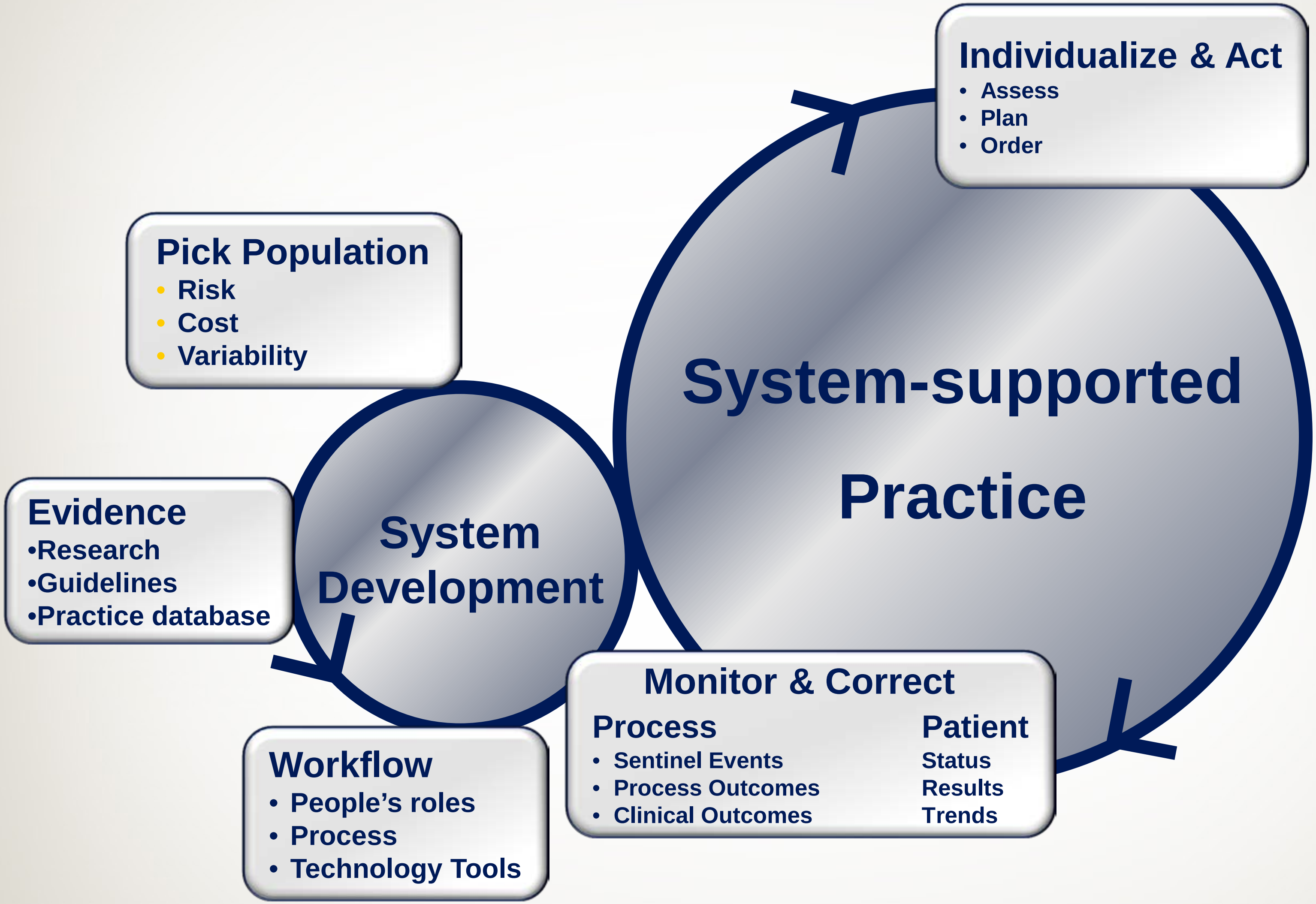
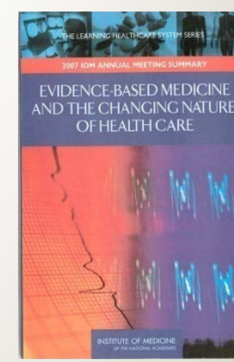
Systems Approaches to Care





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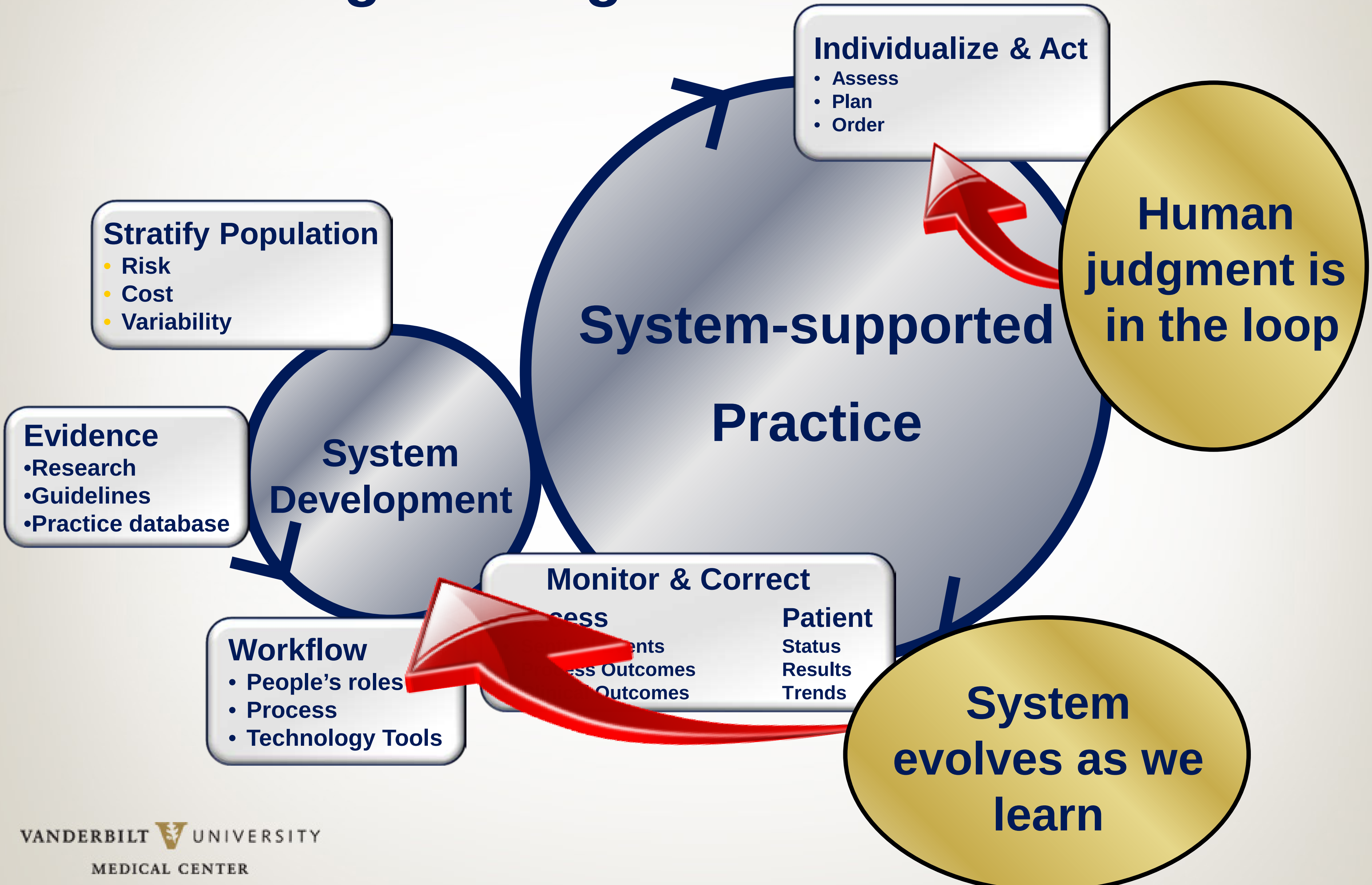
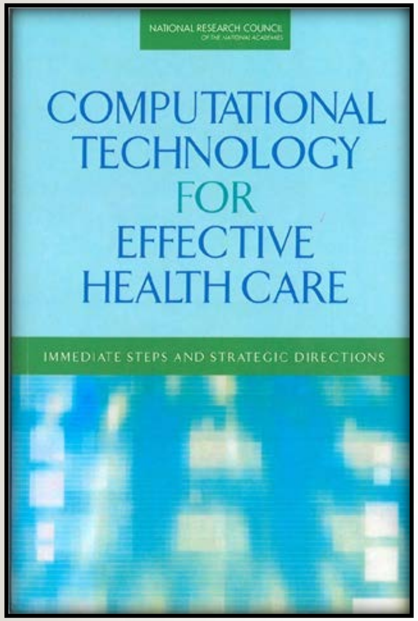
Stead WW. Beyond expert-based practice. IOM (Institute of Medicine). Evidence-based medicine and the changing nature of health care: 2007 IOM annual meeting summary, p. 96. Washington, DC: The National Academies Press 2008.

Challenges to applying systems engineering to healthcare



HCIT Expectation Gap



1/2009

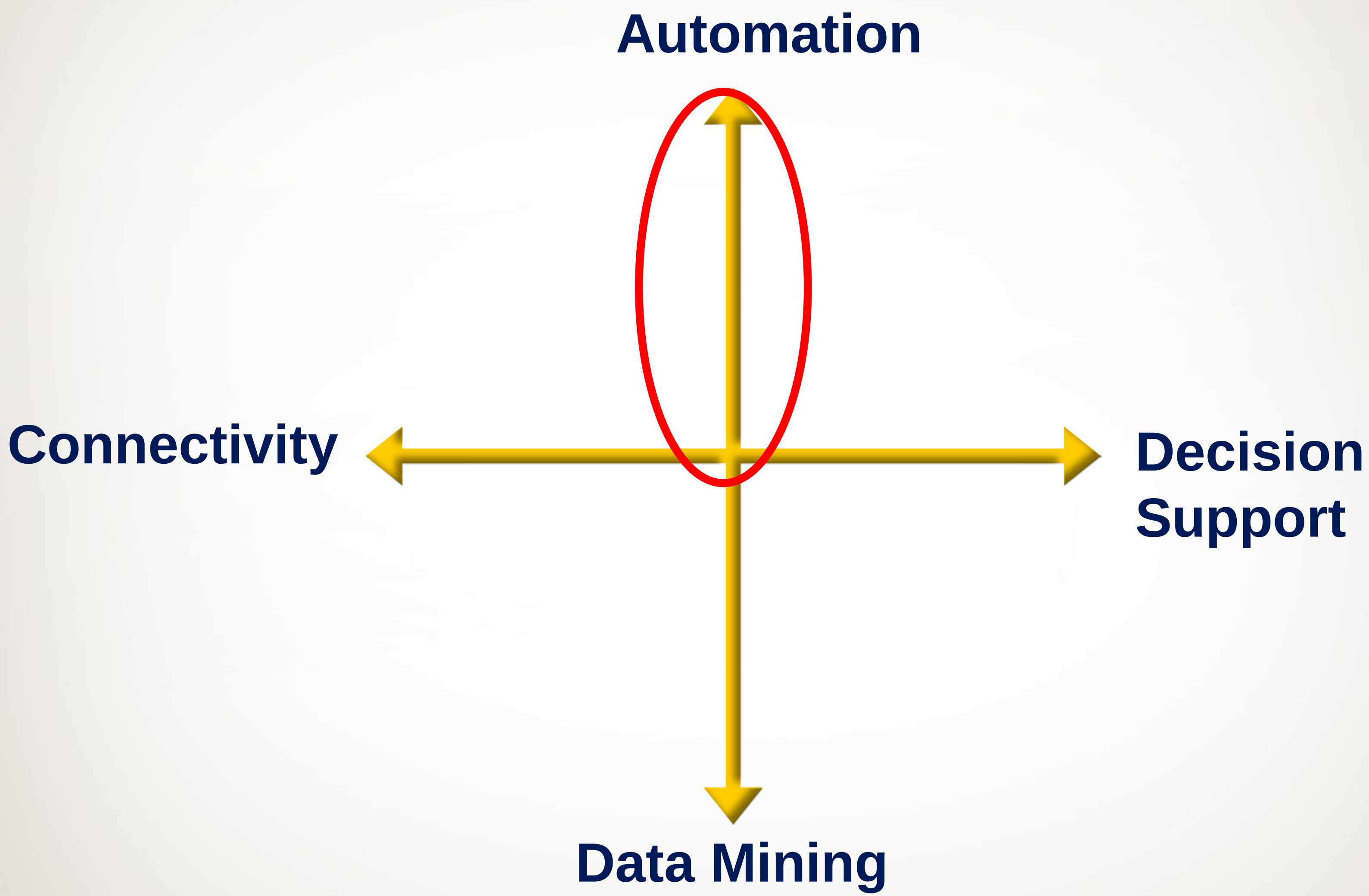
Central Conclusions

- Current efforts aimed at nationwide deployment of HCIT will not be sufficient to achieve the vision of 21st century health care, and may even set back the cause…
- Success will require emphasis on providing cognitive support (assistance for thinking about and solving problems).
- In the near term, embrace measureable health care quality improvement as the driving rationale for HCIT adoption efforts.

Principles to Support Change

- Record all available data to drive care, process improvement, and research
- Architect information and workflow systems to accommodate disruptive change
- Archive data for subsequent re-interpretation
- Seek and develop technologies that clarify the context of data

Root cause: Mismatch between Computational Technique & Scale of Problem



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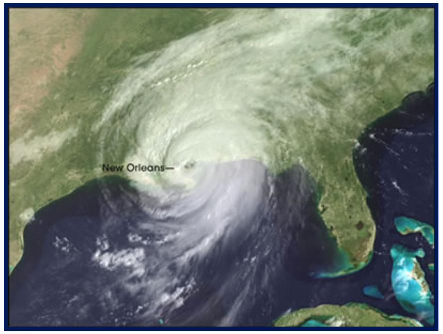
Stead WW. Electronic Health Records. In: Rouse WB, Cortese DA, eds. Engineering the system of healthcare delivery. Tennenbaum Institute Series on Enterprise Systems, Vol. 3. Amsterdam: IOS Press; 2010.

Decouple Data from Interpretation

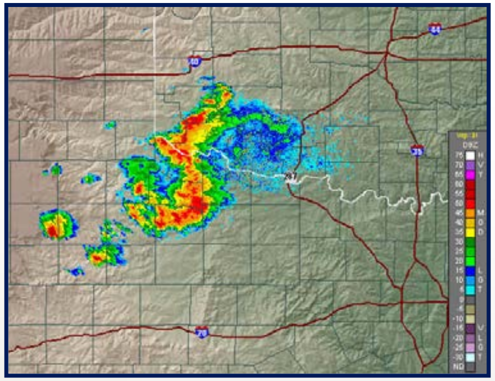
- Work at multiple scales
- Triangulate multiple signals for robustness

Satellite



Rain Gauge

Doppler Radar



Shift EHR Computational Paradigm

OLD	NEW
One integrated set of data	Sets of data from multiple sources
Capture data in standardized terminology	Capture raw signal and annotate with standard terminology.
Single source of truth	Current interpretation of multiple related signals
Seamless transfer among systems	Visualization of the collective output of relevant systems
Clinician uses the computer to update the record during the patient visit.	Clinician & patient work together with shared records and information.
The system provides transaction-level data.	The system provides cognitive support.
Work processes are programmed and adapt through non-systematic work around.	People, process and technology work together as a system.

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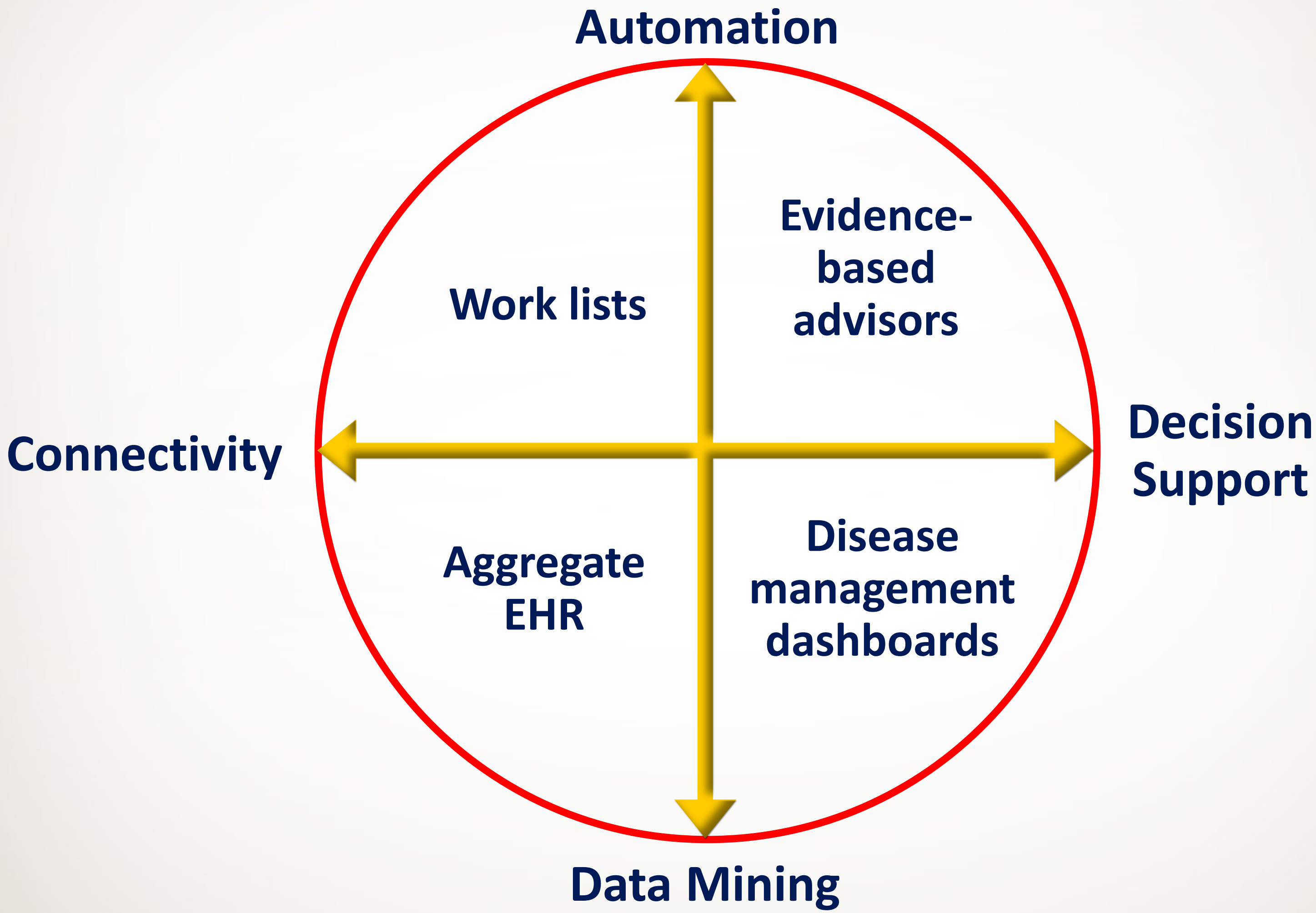
Match Computational Approach to Complexity of Data



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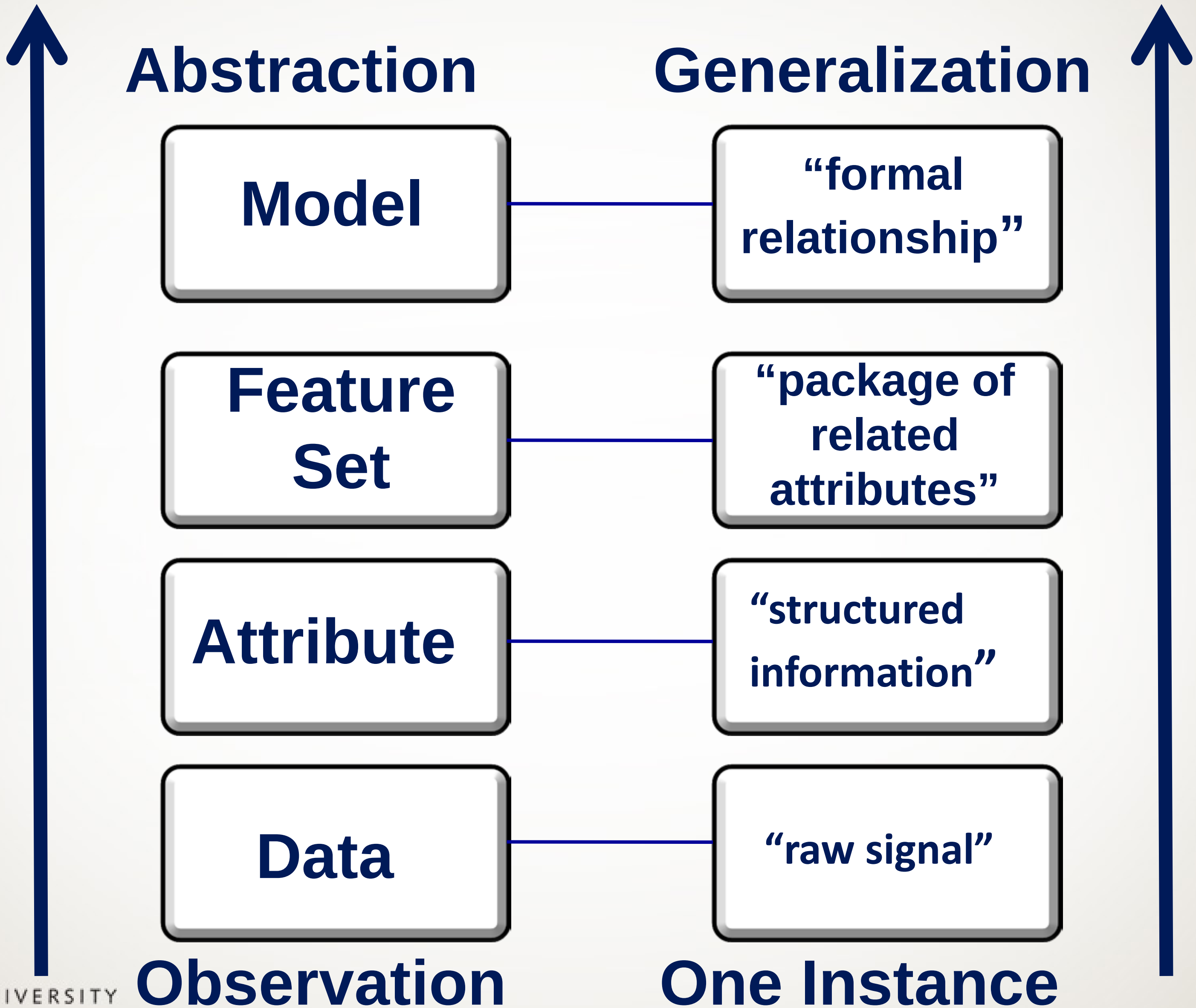
Use Structures & Models to Extract & Visualize



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Use Improvement Science to Adapt EHRs

- Ease of Learning
  - Set of functions a role needs to do, training time, time to peak efficiency
- Ease of Use
  - Time to complete & error rate for standard tasks, sensitivity & specificity for standard information-seeking tasks
- Cognitive Support
  - % of users handling new information correctly for a set of standard patients
- Adaptation to Change
  - Time from issuance of an urgent drug interaction update to its deployment in 80% of operational systems
- Effectiveness
  - % of alerts overridden by role, % of ADEs following an alert override, % of ADEs in absence of an alert

Take Home Messages

- Focus on what you need to improve, not external measures
- Use measurement driven, iterative cycles to create self correcting sustained improvement
- Use a common fact base to drive agreement
- Target 100% performance across the set of practices appropriate to a patient
- Combine people, process and technology to get the desired result