Emerging Computational Approaches to Interoperability – the Key to Long Term Preservation of EHR Data

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Disclosures: I am a co-inventor of two patient medical record products — one licensed to McKesson HBOC, 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.

Challenges to Long Term Preservation of EHR Data

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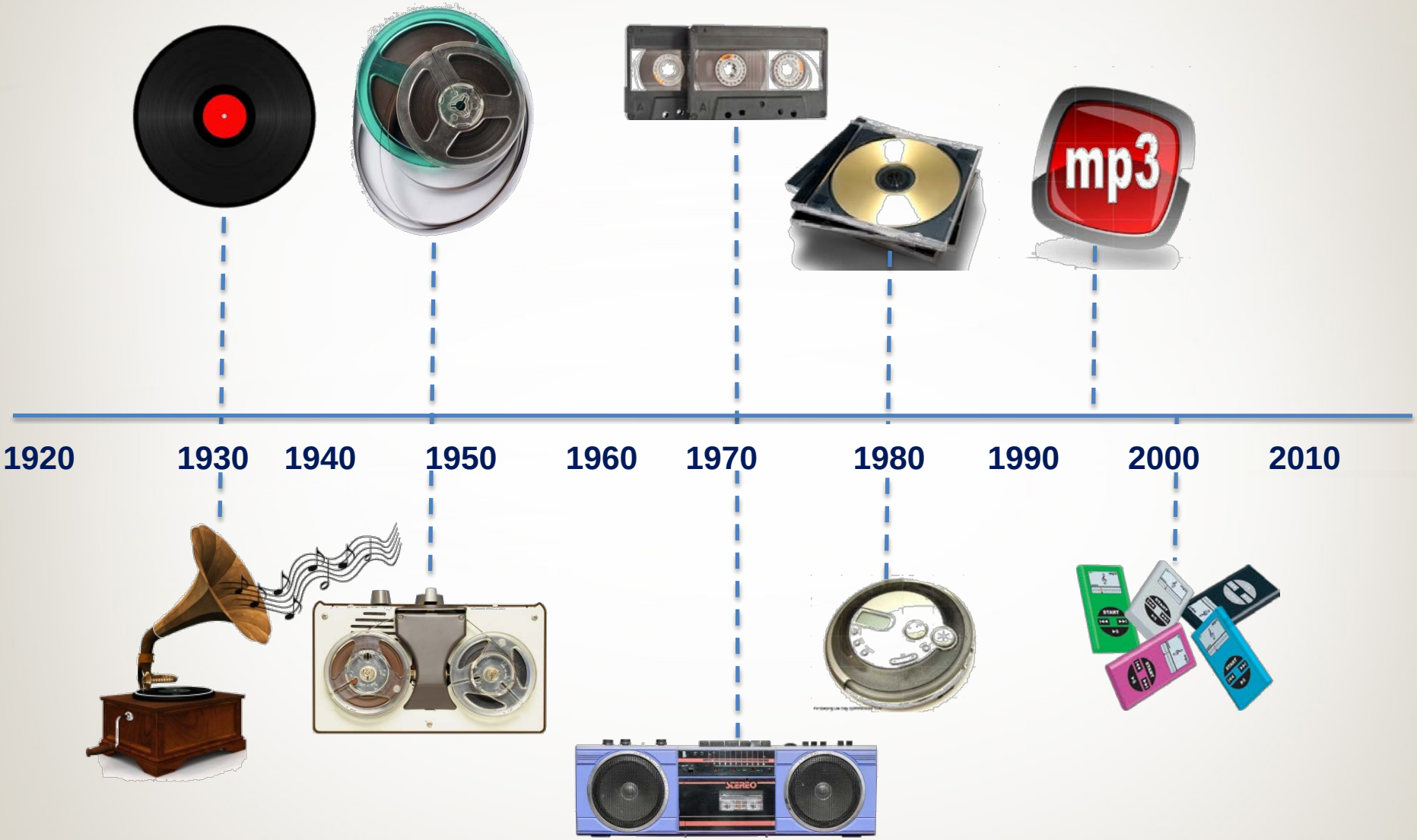
- Retention
- Retrieval
- Degradation of media

- Technological obsolescence
- Permeable membrane
- Complexity

Technological Obsolescence



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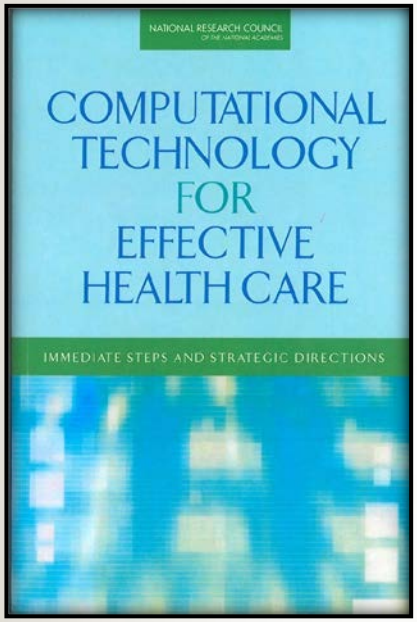
Central Conclusions

- 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).



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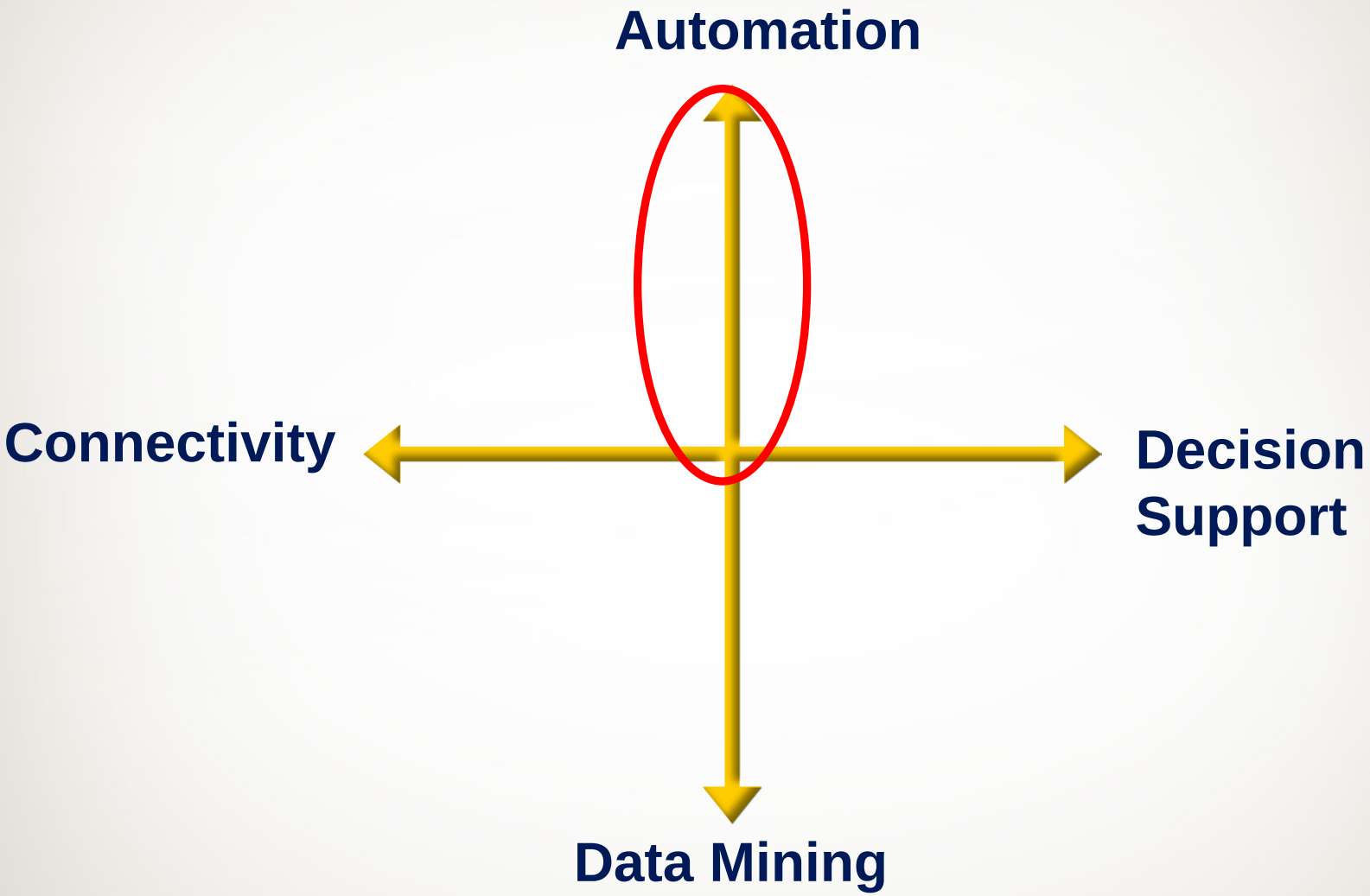
Principles to Support Change

- 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

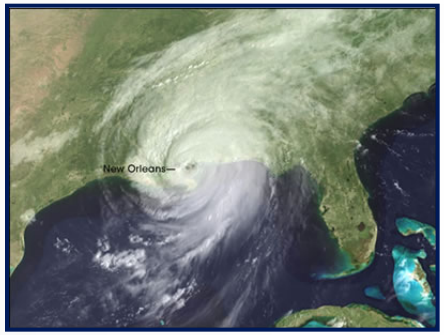


Stead WW. Electronic Health Records. In: Rouse WB, Cortese DA, eds. Engineering the system of healthcare delivery. Tennenbaum Institute Series on Enterprise Systems, Vol. 3. Amsterdam: IOS Press; 2010.

Decouple Data from Interpretation

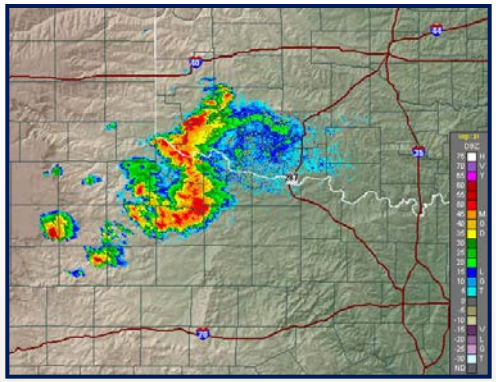
- Work at multiple scales
- Triangulate multiple signals for robustness

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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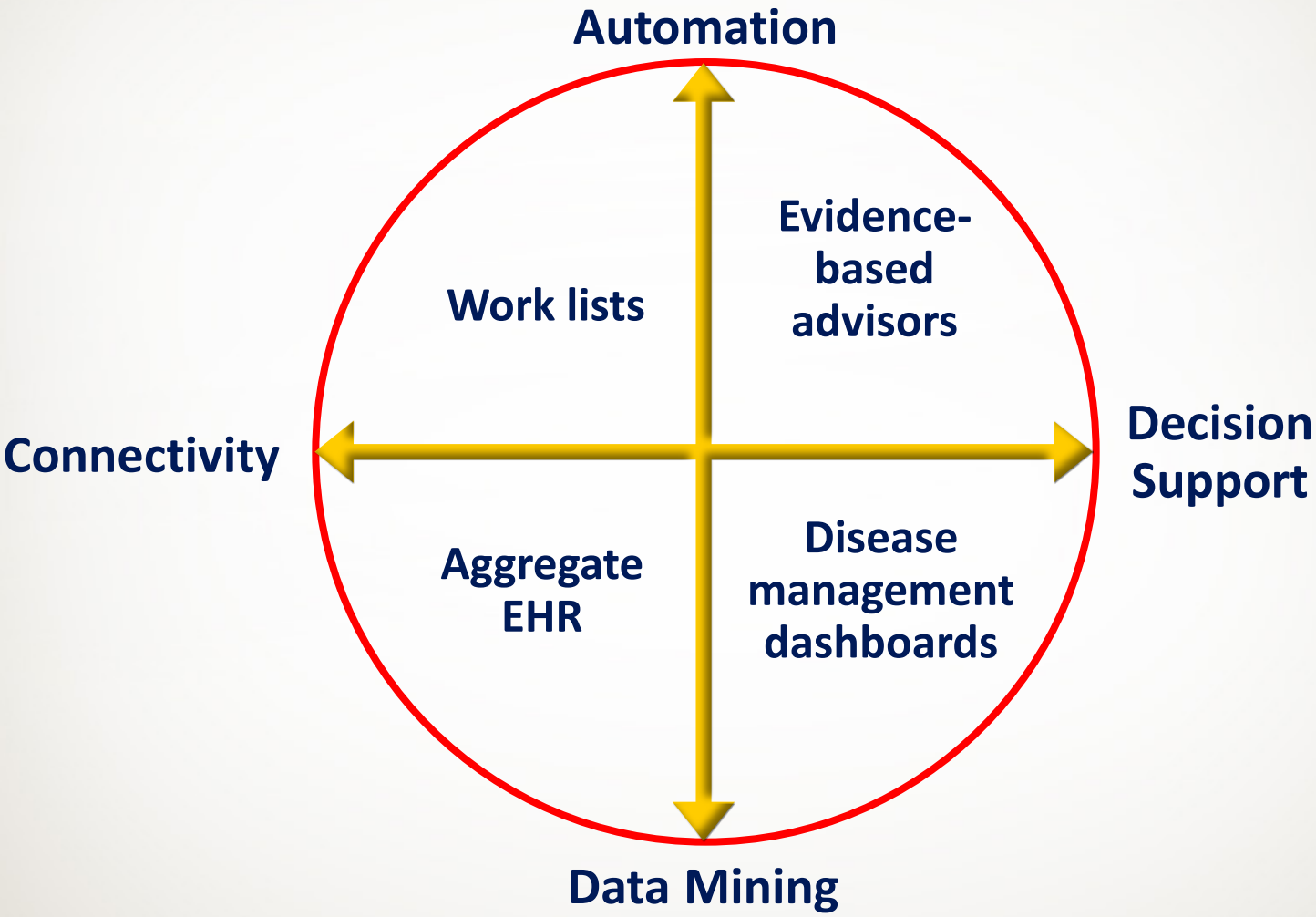
Match Computational Approach to Complexity of Data



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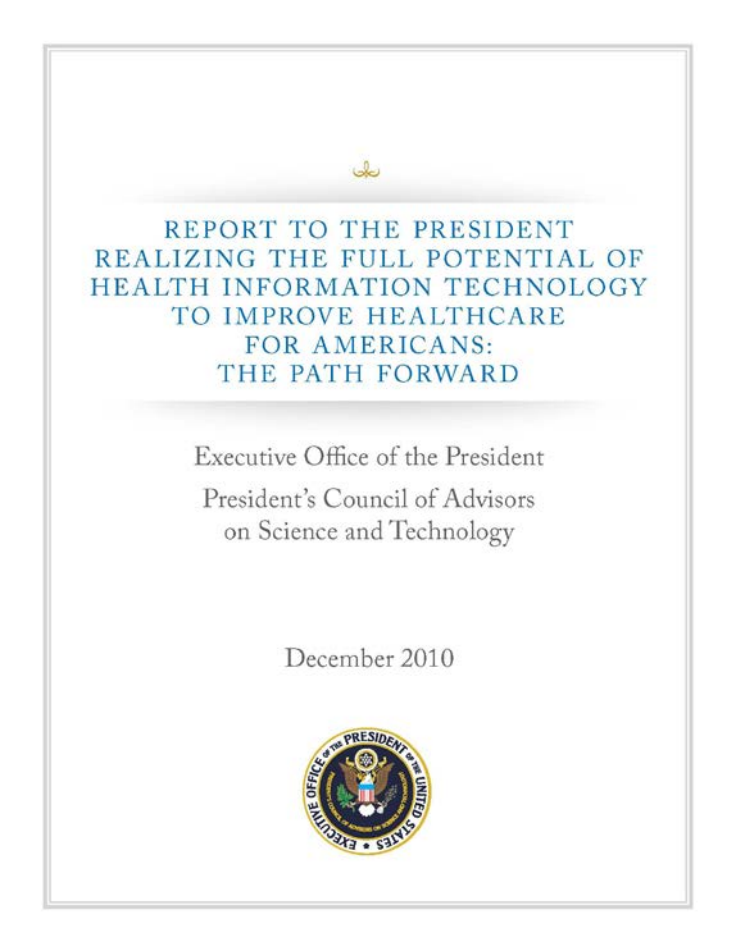
Use Structures & Models to Extract & Visualize

Abstraction	Generalization
Model	"formal relationship"
Feature Set	"package of related attributes"
Attribute	"structured information"
Data	"raw signal"
Observation	One Instance



REPORT TO THE PRESIDENT
REALIZING THE FULL POTENTIAL OF
HEALTH INFORMATION TECHNOLOGY
TO IMPROVE HEALTHCARE
FOR AMERICANS:
THE PATH FORWARD

Executive Office of the President
President's Council of Advisors
on Science and Technology

December 2010

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- Accelerate progress toward robust exchange
- Two levers
  - universal exchange language
  - interlinked search
- Key Concepts
  - extensible language
  - decouple syntax and semantics
  - atomic approach to exchange using tagged elements
  - persistent privacy tags that travel with data
  - record locator/data element access functionality
  - decouple key management, data, indexing & aggregation

Universal Exchange Language

Identity Metadata

Provenance Metadata

Privacy Metadata

Clinical Payload

To Be Identified

- Syntax
- Semantics for metadata
- Naming authority to manage names & versions of syntax & semantics
- Binding of coded elements to terminologies, names, spaces & versions

A Path Toward Long Term Preservation

- Capture data from any source in any form & archive as “raw signal”
- Keep data from different scales of biology or levels of abstraction separate
- Aggregate, interpret & annotate data purpose by purpose
- Establish an authority to manage naming & versioning for syntax, semantics, algorithms, structures & models
- Use pseudocode to exchange & archive algorithms, structures & models