NLP-informed CDS

James M. Walker, MD, FACP
Chief Health Information Officer, Geisinger

Jon Darer, MD
Unindicted Co-Conspirator
Chief Innovation Officer, Geisinger

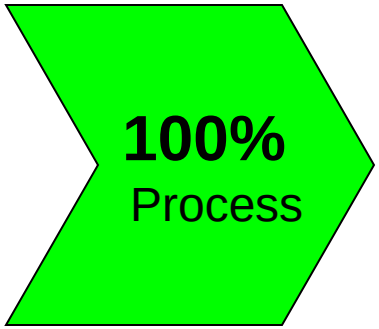
NLP-informed Care-Process Improvement (including CDS)

James M. Walker, MD, FACP
Chief Health Information Officer, Geisinger

Jon Darer, MD
Unindicted Co-Conspirator
Chief Innovation Officer, Geisinger

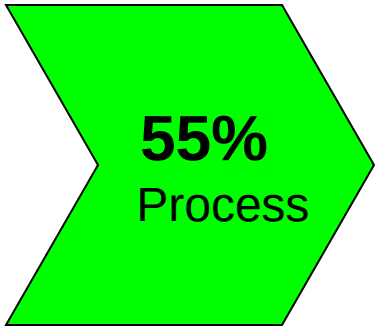
NLP-informed Care-Process Improvement

Goal



The Crisis of American Healthcare

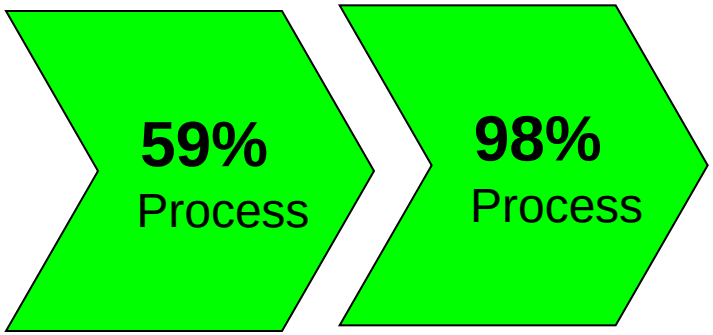
Reality



McGlynn (2003) The Quality of Healthcare Delivered to Adults

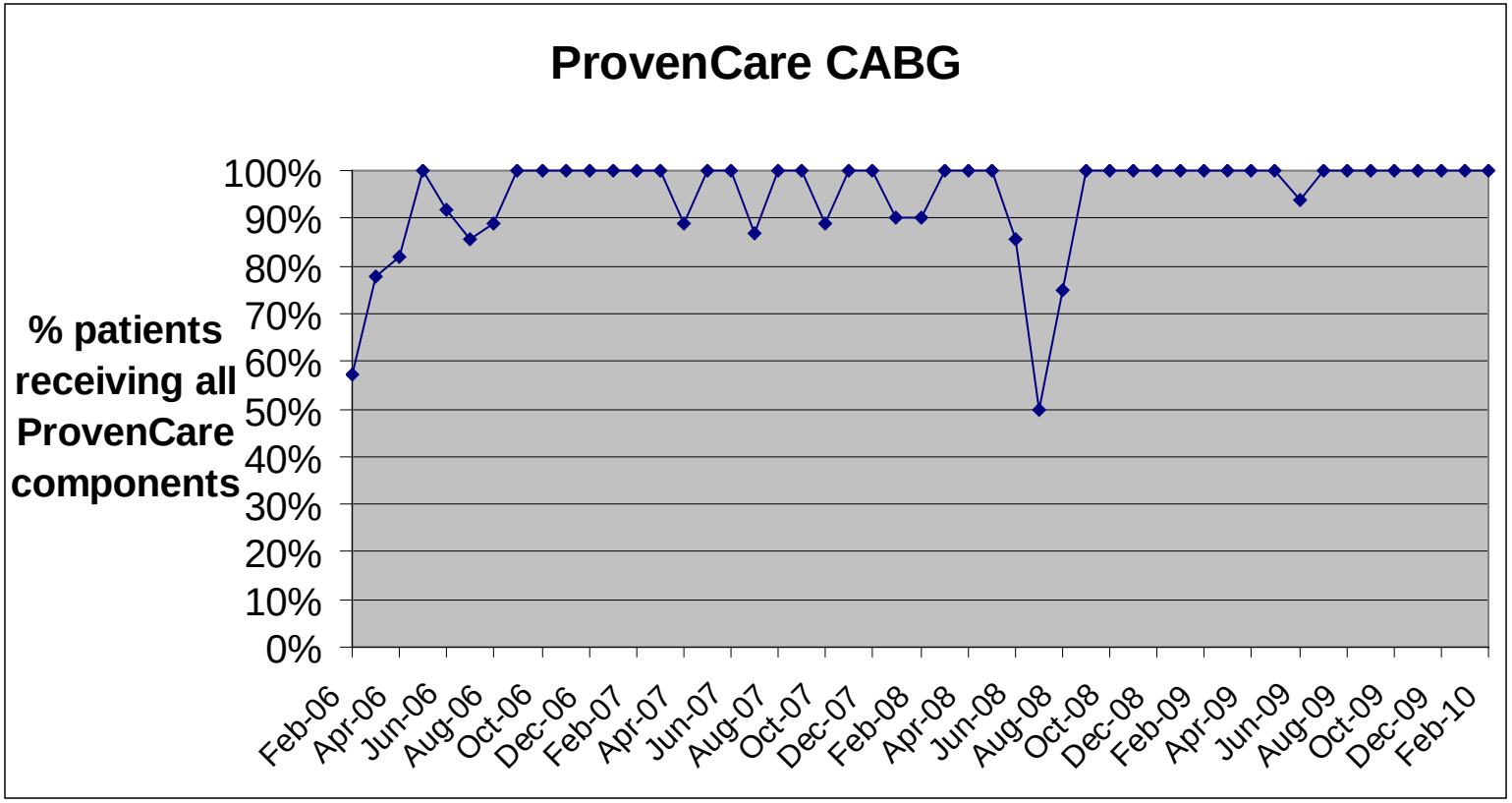
Proven Care Open-Heart Surgery

HIT-Supported
Process Re-Design



Casale (2007) Proven Care.

HIT-Supported Process Re-Design



Casale (2007) Proven Care.

Alert Fatigue - definition

Decision Support provided to people who are not committed to 100% processes.

Health IT in the Absence of Commitment to 100% Processes

- Expensive, burdensome mistake
- Unlikely to improve quality, efficiency, or satisfaction.

HIT in the Service of 100% Processes

- Indispensable infrastructure.

Care-Process Improvement & CDS

- Improve health.
  - *[Improve non-care determinants. 90%]*
  - Improve care processes.
    - Support shared patient & clinician sense making.
    - Support patient & clinician knowledge acquisition.
    - Support shared decision making.
    - Translate decisions into cost-effective processes.
      - Proactively embed decisions in care processes. **(CDS?)**
    - Improve care-process reliability.

Current Use of NLP for Care-Process Improvement

- Care-process reliability (in "process-real time"*)
  - "Reduce time from abnormal mammogram to biopsy and from positive biopsy to treatment."
  - Use NLP to find positives (in absence of "flag").
  - Analytics done; process re-design underway.
  - Next: AAAs, pulmonary nodules, ovarian cysts
- Not point-of-care yet.

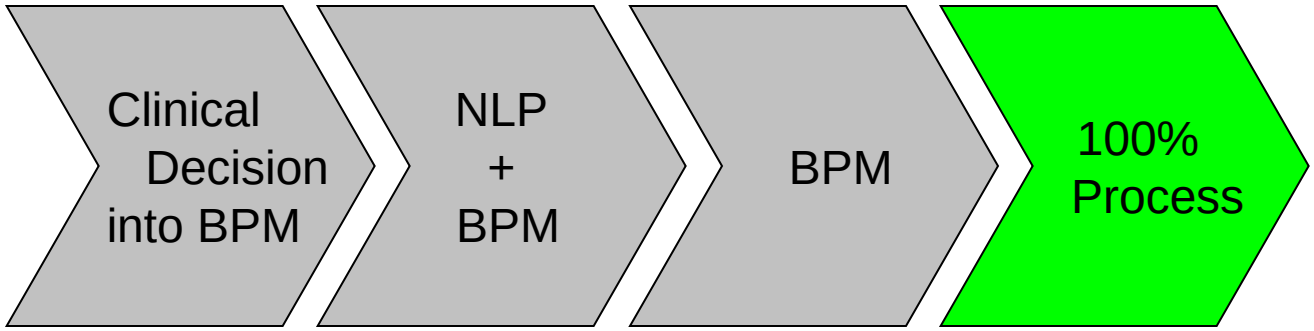
***Process-Real Time** – rapidly enough to optimize care processes and patient outcomes

Current Use of NLP
Possible Use Cases

- Every patient with any noted mammographic abnormality seen in Breast Clinic?
- Every mammogram with any noted abnormality reviewed by Breast Clinic?
- Only patients with clinically significant mammographic abnormality seen in Breast Clinic?

***Process-Real Time** – rapidly enough to optimize care processes and patient outcomes

Current NLP-informed Care-Process Improvement



Why Not Point-of-Care?

- Why point-of-care?
  - We are moving as much care as possible away from the traditional (expensive, inconvenient, rushed) POC.
  - Networked PHR makes non-POC usable and useful.
- Aggregation of complete information takes time.
- Robust analysis requires a decision engine outside the EHR.
- EHR users (rightly) demand sub-second screen flips.
- Suggestive NLP can be confirmed.

New, Acute Low-Back Pain (GIGO)

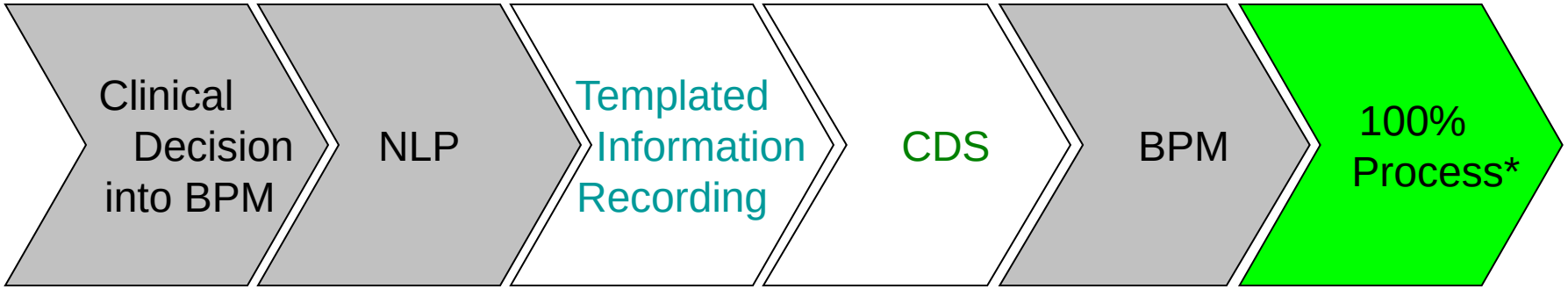
- Common, Painful, Morbid, Expensive
- Over-tested, over-treated (benign)
  - No imaging helpful.
  - Pain meds as needed
  - Bed rest: 14 days >> 7 >> 2 >> Activity as tolerated
  - 90% well in 4 weeks
- Under-tested, under-treated (malignant)
  - 96% chance of metastatic cancer >> bed-bound for life
  - Emergency MRI
  - Emergency X-Ray Therapy consult
- 16 criteria differentiate benign and malignant reliably.

  RA Deyo (1992) The Rational Clinical Examination. JAMA; 268, 760-65.
- NLP? The 16 never gets recorded.

(Future) NLP at the Point of Care

- Human or NLP identifies Low-Back Pain.
- NLP can find no prior LBP (or a human identifies it as new).
- NLP finds only 4 of the Deyo 16 in the EHR.
- BPM offers a template with 4 completed & 12 blank.
- Humans (e.g., patient, nurse and doctor) complete the 12.
- CDS calculates diagnosis, prognosis, and plan (order set).
- Doctor and patient negotiate the diagnosis and plan.
- BPM puts diagnosis, prognosis, and plan in the after-visit summary.
- BPM sends patient questionnaires at 2 and 21 days (symptoms; drug adverse effects and adherence; exercises).

NLP-informed Care-Process Improvement (CDS)



*Including documentation and reporting of assessment, decision, performance, and outcome

Questions

- To what extent can NLP mitigate the effects of sub-optimal
  - information-creation support?
  - information-documentation support?
- When information-creation and information-documentation support are optimized, what will the role of NLP be?
  - Exploration for new knowledge?

What Level of Automation Can NLP Support? Now, Soon?

- Full Automation
  - Criteria: highly specific AND negligible adverse effect of error
    - Specificity > 99%? > current criterion standard? > current actual practice?
  - Ex: Abnormal mammo with no record of patient notification
- Partial (Human-mediated) Automation
  - Criteria: lower specificity OR non-negligible risk
    - Sensitivity > ?
    - Specificity > ?
  - Ex: “Does this patient have new, acute low-back pain?”
    - Sensitivity > 95%, Specificity > 90%?

Levels of Automation

- The system activates a protocol
  - without notifying a human.
  - and notifies a human.
  - and allows a human limited time to veto it.
  - contingent on a human's approval.
- The system suggests one action among many options for human approval.
- The system narrows the options for action to a few.
- The system offers a full set of reasonable options.
- The system presents data clearly, but offers no other assistance.

Adapted from Parasuraman, R., T. B. Sheridan, et al. (2000). "A model for types and levels of human interaction with automation." IEEE Transactions on Systems, Man, and Cybernetics--Part A: Systems and humans 30(3): 286-297.

Structured Data Entry

The limited role of NLP and unstructured text in medical diagnosis:

it is unclear that accurate medical diagnosis/advice mandates front-end NLP technology: structured data entry with thesaurus/N-gram assisted pick-lists or word/phrase completion might suffice.

Nadkarni, P., L. Ohno-Machado, et al. (2011). "Natural language processing: an introduction." JAMIA 18(5): 544-551.