Why this topic

• Aperiodic reviews
  – Grand challenges perspective in 2008
  – Lobach et al, AHRQ study on evidence-based reviews of CDS effectiveness, 2011
  – Teich review of state of the art at AMIA meeting, Oct 2011

• What is new about current environment?
  – Convergence occurring in semantic interoperability work
  – Large players, with large aggregate databases becoming more robust
    • Potential for population-based CDS
  – PCMH and ACO focus on integrating care across episodes
  – Meaningful Use initiatives and quality focus
  – Ascendancy of an “app” culture with ubiquitous access
  – Emerging efforts at integrated view of patient record
Top 10 list of challenges

**Framework**
1. Scope of care process
2. Forms of CDS delivery
3. Patient-centered and shared decision making

**Knowledge sources**
4. Development, formalization, and incorporation of CDS knowledge
5. Dissemination of best practice knowledge
6. Knowledge management tools and resources
7. Population data

**Use**
8. Modes of integration to support interoperability and widespread use
9. Usability and effectiveness
10. Safety, quality, regulation, and liability
1. Scope of care process

- Consider whole care continuum
  - Including health and wellness

- Data model for longitudinal patient record
  - Everything is now focused on EHRs, CCDs, PHRs as separate entities
  - Need single integrated data view

- Need for single source of truth
  - Reconciliation for meds, problems, care plans, reliable timelines
  - Management of roles/responsibilities for data access, entry, update
2. Forms of CDS delivery

Research on forms of CDS and their effectiveness – new modes and refinement of old modes

Advice tools
• Rules – setting-specific adaptation, localization, embedding
• Guidelines, protocols, flow sheets – workflow tools
• Calculations, algorithms, etc.
• Prediction models, fuzzy models, machine learning models
• Population-based comparisons
• Incorporation of genomic data

Information tools
• Enhanced visualization, summarization – graphics, trends, dashboards
• Information retrieval – infobuttons, question-answering systems – refinement based on context
• Feedback, quality reporting
• Role of social networking?

Structured/ mnemonic resources
• Order sets
• Structured documentation/reporting
• Structured encounters/templates for data capture
• Extraction of findings from narrative reports
3. Patient-centered and shared decision making

- How to respond to drug risk ads, genetic questions, etc.
  - [http://youtu.be/HSqRBMjEWvY](http://youtu.be/HSqRBMjEWvY)
- Sites for cardiac, cancer, other risks, genome profiling sites
- Emergence of personal sensors, home healthcare
- Role of patient in entering and updating health information
- What kind of CDS and guidance can be automated for patients, what to escalate
4. Development, formalization, and incorporation of CDS knowledge

• Transition from EBM studies to guidelines (narrative) to formalized knowledge to implemented CDS
  – GEM/GLIDES
  – eRecommendations project
  – GLIF, Proforma
  – CDSC, SHARPC 2B projects

• Standards
  – Order sets
  – Infobutton manager
  – Data model – vMR
  – DSS SOA standard
  – Still no executable guideline standard
  – No healthcare workflow model
  – Need for context/setting model

• Need better understanding of where GLs fit in care process, when patients are on or fall off of them
  – SAGE project
  – Decomposition
  – A GPS analogy
A possible paradigm: Guidance a la GPS

GPS car navigation system

- Goal/target specified
  - based on setting, problem, care plan if they already exist
  - can be suggested by system
- Alternative approaches offered
- Tracking of data & actions
  - degree to which goal is being met
  - midcourse corrections
- Information resources offered
  - both along path & at destination
- Useful both off-line & on-line
5. Dissemination of best practice knowledge

- Authoritative knowledge base(s)
  - Governance/oversight/peer review
  - Who maintains and updates
  - How/when updated
  - How disseminated
  - Where should the knowledge live (or the shared data on which it can be derived)
  - Intellectual property and copyright
  - Role of knowledge vendors
6. Knowledge management tools and resources

- What KM tools should be available
- How provided
- How interface with local KM resources
- How local sites and vendors can best leverage/adapt general knowledge
- How support local processes by capturing and disseminating best practice usage experience
Setting-specific factors:
How, When, Who, Where … and Refinement of the What

- Triggering/identification modes
  - On chart open, on lab test result, on provider login, …
  - Registry, periodic panel search, patient list for day, …
- Inclusions, exclusions
  - To be more patient-specific
- Interaction modes, users, settings
- Timing considerations
  - Advance, late, due now, …
- Data availability/sources/entry requirements
- Thresholds, constraints
- Actions/notifications
  - Message, pop-up, to do list, order, schedule, notation in chart, requirement for acknowledgment, escalation, alternate. …
- Exceptions
  - Refusal, lost to follow up, …
7. Population management

• Temporal modeling of longitudinal databases
• Prediction models
• Direct retrieval of cohorts
• Using cohort to structure the encounter
• How to update population-based best practices recommendations when new evidence comes along
8. Modes of integration to support interoperability and widespread use

- Overcome platform dependence
- Share best practices
- Take advantage of mobile platforms, ubiquitous computing
- Approaches based on apps, services, integration with vendor platforms
  - Encourage innovation
Interoperable development and deployment initiatives

- **AppWorks**
  (ASU/Mayo-led cooperative project)

- **SMART** (Harvard SHARP) project
- **OpenCDS project** (Kawamoto, Utah)
- **VA/DoD integrated platform**
9. Usability

• Capture and representation of context
• Setting, interface, visualization, intended user, platform constraints, patient specificity
• Workflow, team cognition, handoff
• Abstraction of features of user experience in successful environments for sharing
Approaches to usability

Plaisant C et al, Twin List

Shneiderman B et al, LifeLines
Care continuity and coordination (CCC) – a key potential paradigm shift

• Need for CCC especially in:
  – patients with chronic disease
  – patients with multiple problems
  – multi-specialty care
  – critical care
    • or any team-based care situation
  – management across episodes and in/out of hospital
    • PCMH/ACO focus

• EHR poorly suited to this
  – reviewing results, writing notes, ordering tests and treatments, updating problem list are all separate tasks
  – need for new paradigm
    • back to the future: a problem-oriented medical record!
    • transaction/dashboard-focused
    • documentation as by-product of actions
State-based encounter

• “Clinical management states”
  – problems at various stages of evolution or treatment

• Frequently occurring states correspond to typical encounters
  • relevant data elements identified
  • guidelines used to suggest likely assessments, plans

• Provides framework for organizing clinical data & other pertinent info
Example: Diabetes

controlled by diet

poorly controlled

insulin-dependent

complicated by ...

complicated by heart disease
<table>
<thead>
<tr>
<th>Problems</th>
<th>Goals</th>
<th>Gaps/Needs</th>
<th>Care Plans</th>
<th>Status</th>
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- Problems
- Goals
- Gaps/Needs
- Care Plans
- Status
10. Safety, quality, regulation, and liability

• What kinds of CDS are safe for patient direct use?
• Role of advice directly from system to patient
• When is CDS a black box?
• What is standard of care?
• Use of quality reporting and feedback to drive care improvement
• Relation between quality measures and CDS
  – Reactive vs. proactive
  – But opportunity to synchronize to drive improvements
A goal: Make CDS invisible

• Guide care process
• Anticipate user needs
• Make right thing the easy thing to do
• Facilitate auto-documentation, auto-order, auto-schedule, auto problem list update
• Focus on usability
  – Apps, visualizations, analytics
Roles of NLP

• Question-answering systems, infobuttons
• Finding cases for interventions
  – Identifying problems
• Detecting adverse events
• Finding data needed for CDS
• Integrating diverse sources for CDS
  – e.g., Wagholikar K, et al.
    • Clinical decision support with automated text processing for cervical cancer screening. JAMIA, in press
    • similar paper on colorectal cancer screening, submitted
• The tradeoff issue
  – Documentation easier if notes less structured
  – But for chronic disease with CCC approach, more benefit from structure
• Potential role of voice for navigation and completion of structured templates
  – Selection of options, translation to standard concepts
Roles for probabilistic techniques

- Inference tools – prediction models, fuzzy logic, bayesian modeling, machine learning
- Cohort characterization – for population management
  - Identifying outliers, high-risk patients, those requiring individualized care, detecting adverse events
  - In conjunction with NLP methods
- Direct CDS use of cohorts for analyzing “patients like mine”
- Annotation of current state based on temporal modeling of sparse data in record
Conclusions

• CDS landscape has greatly changed
• We have new opportunities to rethink the care paradigm
  – Integrate diverse data and knowledge sources
  – Focus on usability, CCC
  – Design CDS to support these tasks
  – Develop interoperable apps to foster innovation
• Important roles for NLP and probabilistic techniques