Overcoming Barriers in a Complex Adaptive System

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- Editor for Annals of Applied Statistics
- 60+ journal articles & 70+ presentations/seminars
- Collaborations: Children’s Healthcare of Atlanta, DCH, DPH, VA, CDC among others

My favorite quote, a well-worn slogan “in God we trust—all others bring data.”
Healthcare Complexity
System Fragmentation

Medicare  Medicaid

Federal level  State level

Health Plans

Employer-based  Exchange

Uninsured

Centralization  Shifting complexities
Policy: Who is in charge?

System-level policies (e.g. PPACA)
System-level oversight (e.g. FDA, CDC, HHS)

State-level policies (e.g. reimbursement, scope of practice, independence practice)
Health plan participation (e.g. marketplace)

Who? E.g. opt-in/out of health plans;
What? E.g. training requirements; services provided
Where? E.g. Clinic, home-based, school-based

Health education, health behaviors
Cost: Who is in charge?

Expenditure: federal programs, state-level programs

Cost: reimbursement levels, services to be reimbursed; deductibles; premiums

Cost: services submitted for reimbursement, services provided depending on cost levels, patient acceptance

Expenditure: deductible, premium, opportunity cost, lost productivity,
Data Challenges

- **Data sources and availability:** What data? Where to get data?
- **Data integration:** How standardized?
- **Data access:** Who to use the data? Who own them?
- **System transformation:** What is the evidence?
Overcoming Barriers
Opportunities for Change: Policy

- Aligning incentives with quality and efficiency
- Correcting price signals in the healthcare market
- Producing and using better information

- Emphasize health not healthcare
- Empower decision making
- Reduce complexity

- Partner in management, design and value generation

[Diagram showing the Healthcare System (Management), Patient (Health), Providers (Partnership), and Substructures (Partnership) with directional arrows between them.]
Opportunities for Change: Cost

- Align medical and technological advancement with value generation
- Apply system engineering

- Enable making value-based decisions
- Target prevention to high-risk population

- Promote transparency in costs
- Adopt new revenue models
- Develop data systems

Healthcare System (Management)

Patient (Health)

Providers (Partnership)

Substructures (Partnership)
Healthcare Engineering and Analytics

**INFORMATION**
- Patients and Claims
- Providers & Payers
- Census information
- Historical trends
- Other data sets
  - EHR, disease registries
  - National & state surveys
  - Etc.

**DATA**
- Diagnosed disease
- Prevalence
- Utilization of care
- Treatments given
- Costs
- Trends
- Variation

**KNOWLEDGE**
- Causations
- Predictions
- Gap analysis
- Opportunities for improvement

**DECISIONS**
- Engineer better systems
- Change behaviors
- Prevent disease
- Reduce gaps
- Decrease cost
- Improve outcomes

Architectures; Integration, sharing; Privacy; Wrangling; Extraction; Visualization;

Data mining; Machine learning; Statistical inference; Network analysis; Simulation & optimization; Visualization

Deriving & validating hypotheses; Designing, planning, and optimizing; Testing, ranking, & scoring; System dynamics
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