

The Seventh Annual Predictive Modeling Summit

# Integrating EHR and Predictive Modeling: Opportunities and Challenges

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# About the ACG<sup>®</sup> System

**The Johns Hopkins ACG System offers a unique approach to measuring morbidity that improves accuracy and fairness in evaluating provider performance, identifying patients at high risk, forecasting healthcare utilization and setting equitable payment rates.**

# ACG Uses

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## Government Agency

- Risk-Adjusted Payments
- Comparative Effectiveness Research
- Disparities measurement
- Medical Homes Support
- Provider performance measurement

## Provider Organizations

- Population Stratification
- High Risk Case Identification
- Risk-based contract evaluation

## Health Plan

- Provider Performance Measurement
- Population Stratification
- High Risk Case Identification
- Medical Homes Support
- Actuarial / Underwriting/Bid rate
- Revenue Optimization

# The ACG System Team

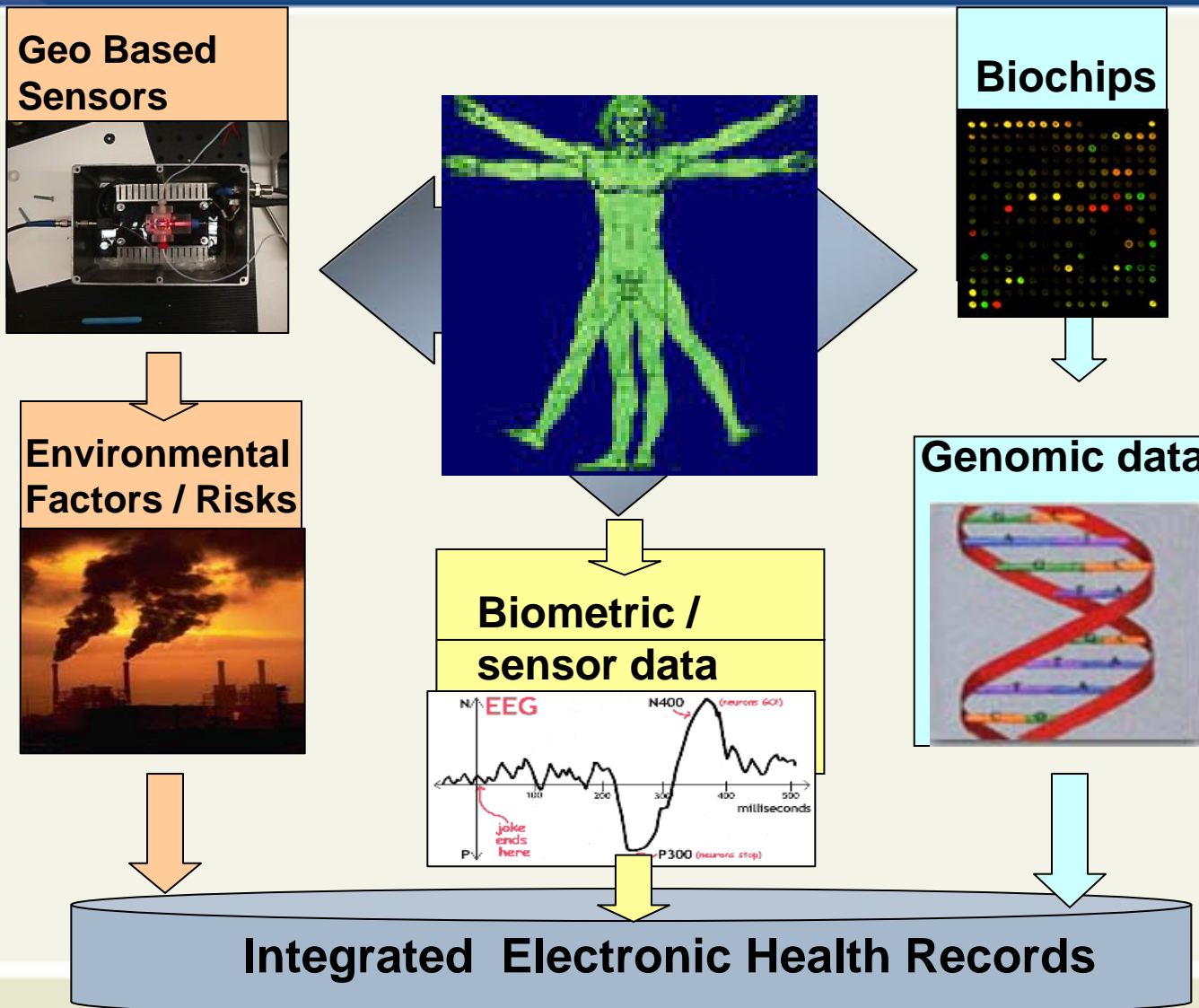
- The ACG System was first developed 30 years ago within the Department of Health Policy and Management at the JHBSPH
- Led by Professor Jonathan Weiner, DrPH
- The Global Team includes:
  - Epidemiologists
  - Statisticians
  - Economists
  - Physicians
  - Pharmacists
  - Researchers

# Presentation Goals

- A sense of the good, bad, and the ugly related to incorporating EHR data streams into predictive modeling
- Share some real world experience at JHU in using EHR data in PM
- Describe a new initiative at JHU to make more effective use of EHRs for managing health in populations

# The Challenge: The types of digital information soon to be available will go well beyond just medical care and organized public health systems

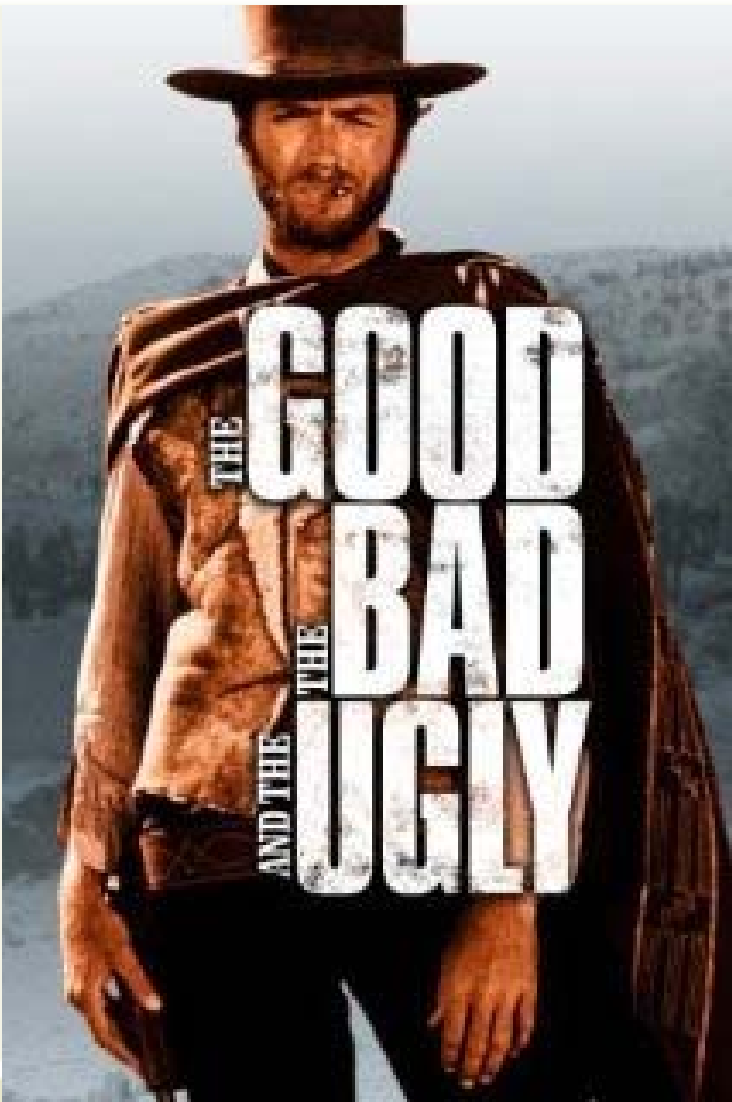
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Graphic Adapted From EU

# A Tale of ...

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- EHR data are now being use in PM, often in clinical contexts (disease outcomes, readmissions, mortality)
- EHRs are becoming much more widely adopted in the U.S.
- EHRs are a much richer data source than claims
- Opportunity to expand risk domains for modeling (e.g, clinical performance risk, outcomes)
- Potentially makes PM much more salient at the point of care (PM scores in real time)
- There are benefits beyond simply adding new variables

# Other Benefits and Uses of EHRs

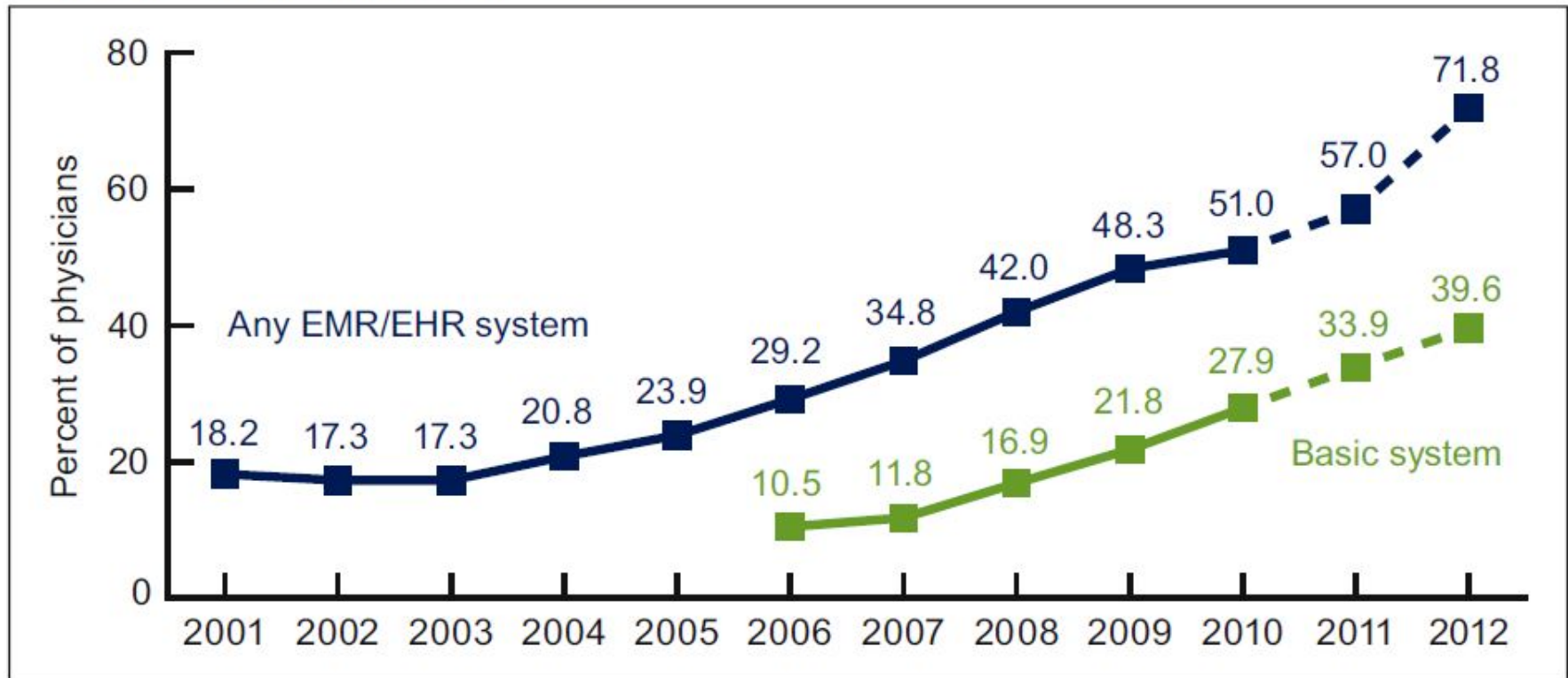
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- Confirmatory information on diagnoses and treatments
- Un-coded diagnoses (including those derivable from diagnostic tests)
- Potential for more complete data that cuts across settings
- Key attributes of the patient's medical history are retained (the data are inherently longitudinal)
- Data are often more accurate and complete than in administrative claims
- More amenable to outcomes research

# EHRs Are Being Widely Adopted

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Figure 1. Percentage of office-based physicians with EMR/EHR systems: United States, 2001–2010 and preliminary 2011–2012



Source: USDHHS, CDC-National Center for Health Statistics--2013



# EHR Data Have Much Broader Sweep <sup>12</sup> Than Administrative Data

Clinical Domain  
Symptoms/Physical Status  
Diagnostics  
Therapeutics  
Medical History  
Genomics

Patient Domain  
Socio-economic  
Behavioral/Lifestyle  
Family  
Preferences  
Insurance Status  
Knowledge/Attitudes  
Community Norms  
Access to Care  
Race/ethnicity



# Data That Might Be Needed to Fully Account for Variations in Cost

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- **MEDICAL**

- Use of services
- Morbidity
- Disease Staging
- Level of Frailty/Disability and Ability to Function Independently
- Biometrics/Vital Statistics/Physical Exam
- Lab and Other Structured Investigation Results (e.g., imaging, EKG)
- Medical treatments and procedures, including hospitalizations, prescribing, use of DMEs, and use of clinicians

- **HEALTH SYSTEM**

- Health System: Formularies, availability of diagnostic and procedural equipment, beds
- Care Provider Network and Practice Patterns
- Community Resources

- **PERSONAL**

- Demographics
- Socioeconomic: income and education
- Employment
- Lifestyle
- Social Supports/Living Arrangements
- Patient Health KABB
- Patient Preferences/Patient Reported Outcomes
- Insurance Enrollment and Coverage
- Access to Care
- Genomics/Family History
- Environment
- Social Norms, Including Use of Indigenous/Alternative Medicine and Customs About Disease and Its' Treatment



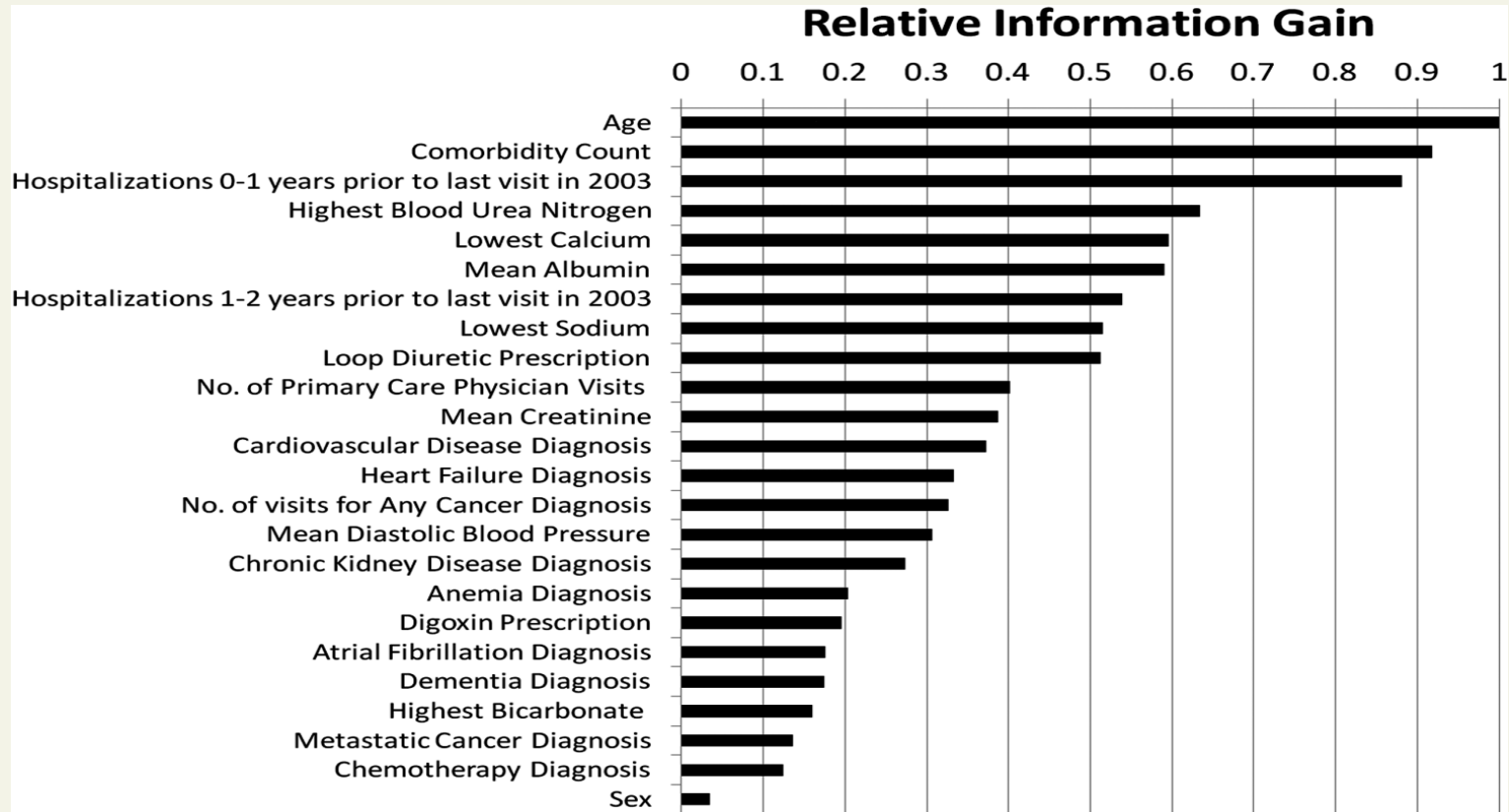
- Some of the EHR gems are buried in free text clinical notes which are difficult to extract and which may expose patient identifiers
- Irregular, unsystematic and nonstandard reporting
- Inaccuracies and errors and not uncommon
- The data have many dimensions but are sparse
- There are varied data sources with unknown provenance
- Complex interaction effects (e.g., certain lab values are important if patient has particular comorbidity profile)
- There needs to be a strong conceptual basis for selecting EHR variables for inclusion or model instabilities will result

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# The Predictive "Yield" From EHRs is Variable and Will Likely Depend on the Modeled Outcome

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## Modeling 5 Year Life Expectancy in Older Adults: Relative Information Gain



From Mathias, JS; et al. Development of a 5 year life expectancy index in older adults using predictive mining of electronic health record data. *J Am Med Inform Assoc* 2013;20:e118–e124.



# The Ugly



**There is still limited interoperability between systems: every system ends up being highly customized so even one from a single vendor may not be interoperable with implementations in other systems**





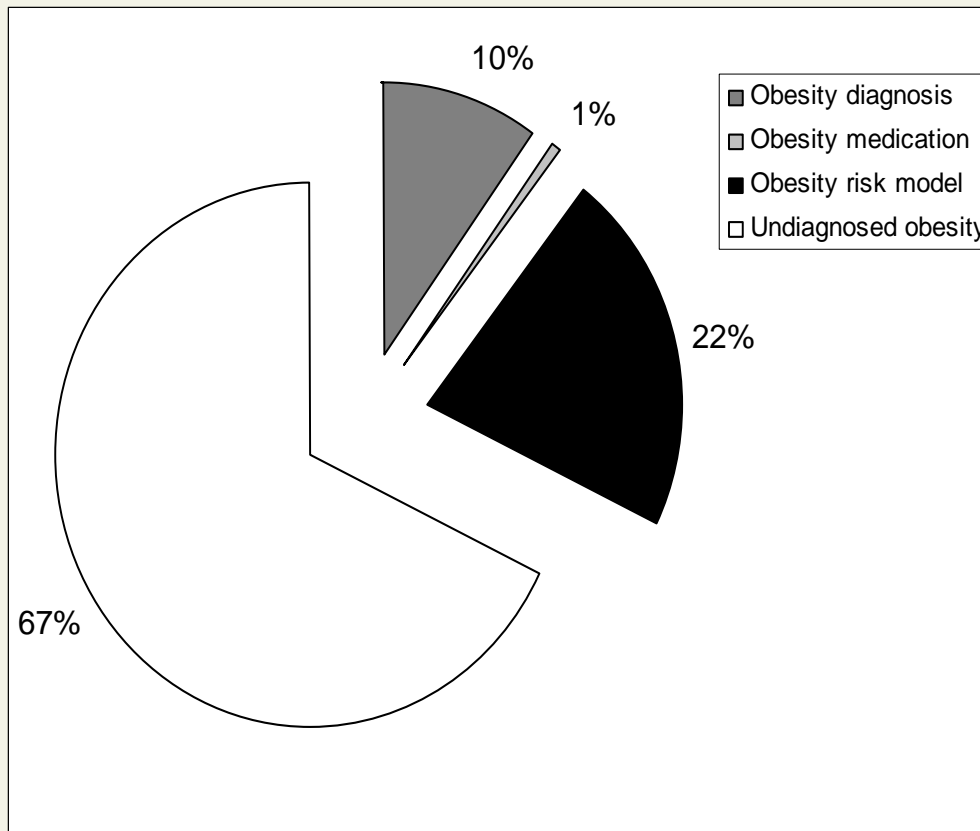
# Case Studies in EHR Predictive Potential: Obesity I

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- Obesity is widely appreciated as a factor that influences the use of health resources
- Administrative claims tend to under-estimate the true prevalence of obesity, reducing its' value as a predictor of future costs
- In 2010, Weiner and colleagues attempted to model the risk of obesity from administrative claims (Popul Health Manag 13:201-207)
- They had access to BMI from HRAs of 7 BCBS plans
- Findings are instructive in how poorly obesity is captured with administrative claims

# Case Studies in EHR Predictive Potential: Obesity II

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Only 11% of obesity can be picked up with medical and pharmacy claims

# The Value of Using EHR Data for Obesity Assessment

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- Obesity is highly under-diagnosed
- The high data quality observed in the EHR dataset may in part reflect the selection of anthropometric and demographic data, which are semantically unambiguous and directly measured as a matter of routine.
- In the EHR data, the potential effects of individual measurement error are damped by the size of the sample and repeated measurement, resulting in highly stable population estimates of BMI and obesity prevalence

From Bailey, LC; et al. Multi-Institutional Sharing of Electronic Health Record Data to Assess Childhood Obesity. PLOS ONE. June 2013 | Volume 8 | Issue 6 | e66192.



# Case Studies in EHR Predictive Potential: Lab Data I

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- In 2012, IMS Health delivered an enhanced LifeLink™ database extract that included outpatient laboratory data to the Johns Hopkins ACG® System team
- Our primary goal was to do groundwork and explore how clinical test results could inform patient care management.
- Explored use of lab data for establishing levels of control for a number of chronic conditions: Diabetes mellitus, Chronic kidney disease, Dyslipidemia, Hypothyroidism, Hepatitis B, Microcytic anemia

# Case Studies in EHR Predictive Potential: Lab Data II

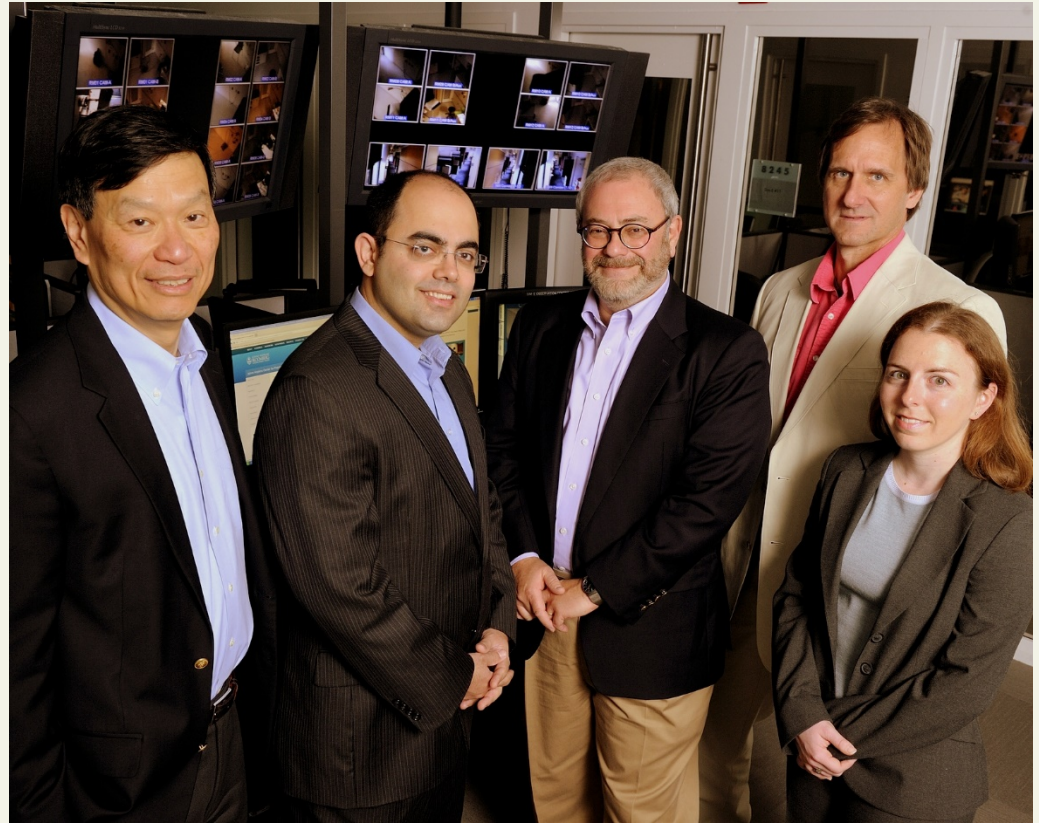
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Results so far have been mixed but suggest usefulness ...

<b>Model</b>	<b>Concurrent Year 1: 2010</b>	<b>Prospective Year 2: 2011</b>
<b>A: ACG DxRx</b>	.4865	.3306
<b>B: ACG DxRx + Renal Stage</b>	.5172	.3972

# JHU Launches New Initiative to Harness IT for Improving Population Health 22

## The Center for Population Health IT (CPHIT)



# The Johns Hopkins Center for Population Health IT (CPHIT) -- Mission and Focus

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The **mission** of CPHIT (“see-fit”) is to improve the health and well-being of populations by advancing the state-of-the-art of Health Information Technology (HIT) and e-health tools used by private health care organizations and public health agencies.

CPHIT’s **focus** will be on the application of electronic health records (EHRs), e-health and other digitally-supported health improvement interventions targeted at communities, special need populations and groups of consumers cared for by integrated delivery systems (IDSs).

# Scope of CPHIT's Activities

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- Establish a leadership role in the development of a national/global research agenda for population HIT.
- Undertake breakthrough and translational R&D and associated technology transfer.
- Establish a comprehensive R&D infrastructure with access to EHR data and a large cadre of multi-disciplinary Johns Hopkins University (JHU) faculty.
- Initiate and maintain an ongoing active dialogue with public sector and industry stakeholders.
- Support the JHU informatics educational mission.



# Initial CPHIT R&D priorities- 1

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1. Development and testing of *health status and quality measures* created from EHRs and other HIT systems.
2. Use and advancement of computing methodologies – including *natural language processing* (NLP) and *pattern recognition* tools.
3. Initiation of effective approaches for *linking provider*-centric EHR systems with *consumer*-centric internet and mobile-based e-health applications.
4. Development of EHR-based tools and decision support applications to help *manage high risk populations*.\*
5. Lead technical and strategic approaches for creating and demonstrating *interoperability* of EHR networks for public and private sectors.

\* Note - the JHU ACG risk adjustment / predictive modeling tool, in use in 18 countries and applied to 80 million people, is now based in CPHIT



6. Creation of *legal / ethical and policy frameworks* around the secondary use of EHR data for public health goals.
7. Development of innovative EHR-based tools and decision support for next generation *quality / safety improvement*.
8. Strategic *integration of data from multiple sectors*--health plans, health systems, physicians, agencies, etc.-- with EHR data to enhance population-based interventions and research.
9. Development of *standardized tools and frameworks* to support future *R&D and evaluation* in the fields of population health IT and informatics.

# Some current Johns Hopkins CPHIT projects

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- Integrating HIE “exchange” data from all hospitals in state to develop real-time readmission risk scores for MDs.
- Natural language / text mining across provider EHRs to identify high risk pregnancies in need of intervention.
- Innovative electronic “population decision support” systems for IDSs and public health agencies.
- State-of-the-art EHR based predictive modeling tools.
- New “e-measures” of performance from digital sources for managing and monitoring care in IDS/ACOs.
- Frameworks & standards for secondary use of EHR and e-health data for application to population & public health.

# Concluding Remarks

- Only part of the important factors that affect patient health arise in medical settings ... we need a means for integrating patient data across multiple sources
- EHRs may be crucial for effectively tackling risk adjusted outcomes assessment
- Johns Hopkins has formed a Center for Population Health Information Technology (CPHIT) that specifically intends to tackle issues related with squeezing information out of EHRs.
- We are currently in the process of building the next generation e-ACGs with the help of CPHIT

# Future Predictive Models Will (or Should) ...

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- Become part of the electronic health care workflow
- Will support decision making at the point of care
- Be more finely tuned to specific individuals and populations
- Predict health outcomes beyond cost
- Target broader timeframes
- Be more accurate
- Involve more complex modeling
- Become more transparent and less hyped
- Keep us busy for the rest of our careers!!

# In closing

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**“ Predictions are hard,  
especially about the future.”**

**Niels Bohr**

**Nobel Laureate in Physics**

# For More Information:

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- Visit the ACG web site at: [www.acg.jhsph.org](http://www.acg.jhsph.org)
- Visit CPHIT web site at: [www.jhsph.edu/cphit](http://www.jhsph.edu/cphit)
- Contact Johns Hopkins at: [askacg@jhsph.edu](mailto:askacg@jhsph.edu)
- Contact me at: [dbodycom@jhsph.edu](mailto:dbodycom@jhsph.edu)
- Attend the April 2014 ACG User Conference in Seattle

