

# Getting Optimal Benefits from the EHR via Standardizing Its Data Content

**EPD Congress**

**Amsterdam, Netherlands**

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**Stanley M. Huff, MD**



**Intermountain  
Healthcare**

*Healing for life*<sup>SM</sup>

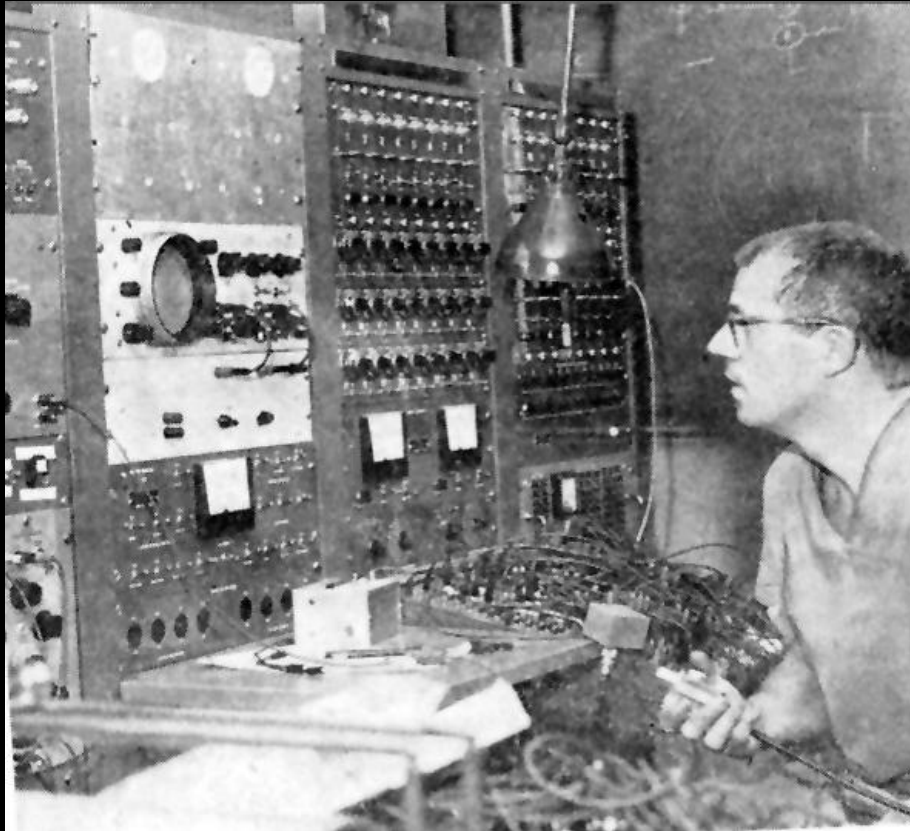
# Introduction

- Chief Medical Informatics Officer at Intermountain Healthcare in Salt Lake City Utah
- Professor (Clinical) University of Utah Department of Biomedical Informatics
- Current Board Member and Past Chair of Health Level Seven
- Member of the US National Health Information Standards Committee
- Co-chair of the LOINC Committee

# Intermountain Healthcare

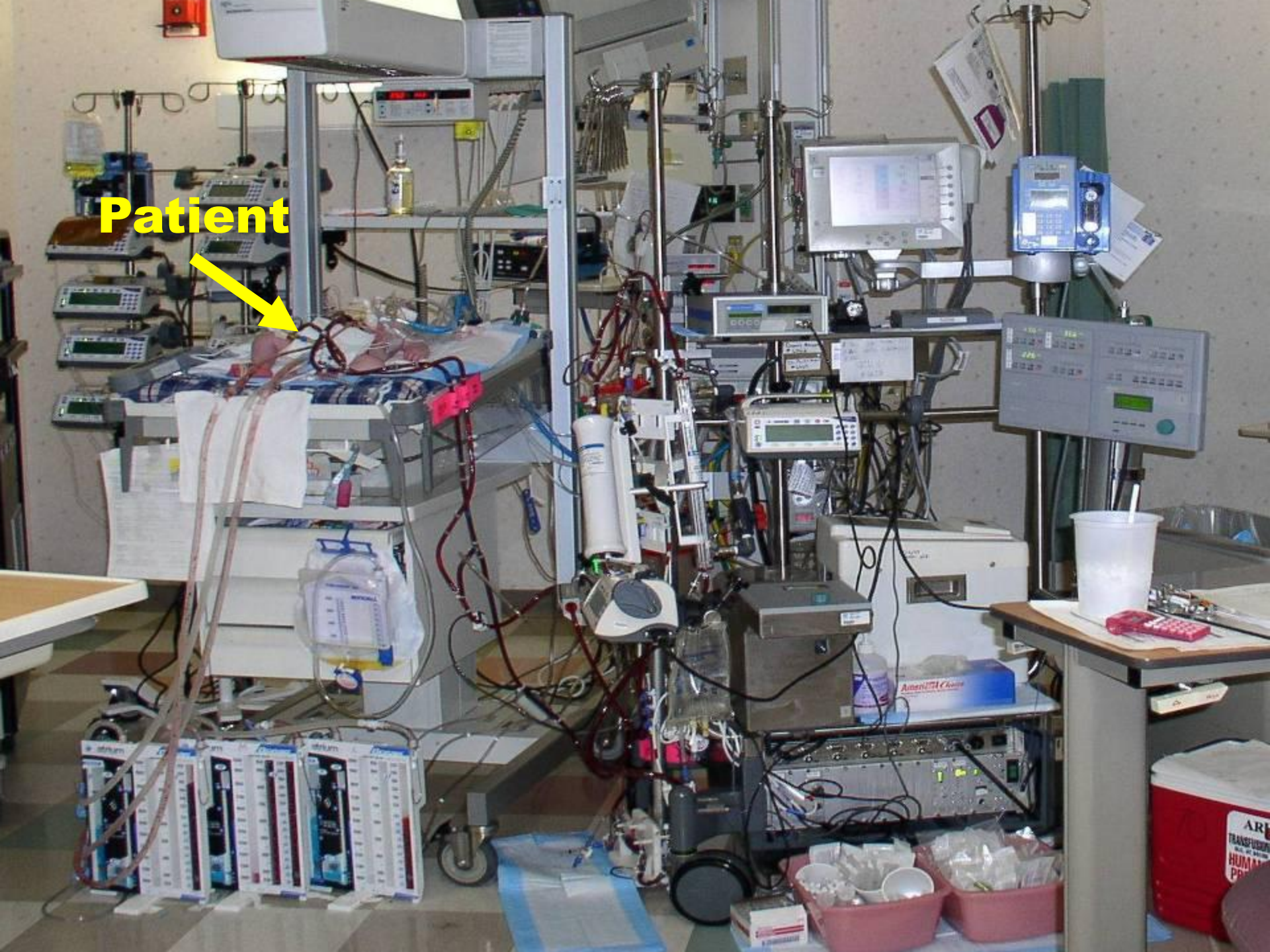
- Not-for-profit health care provider in Utah and Southern Idaho
- 24 Hospitals/ 2105 beds/150 Clinics
- Clinical data on ~2 million people
- Medical Group of ~750 employed physicians
- Insurance plan of 500,000 covered lives
- \$85M/year charitable care exclusive of bad debt
- 27,000 employees
- Partner in the Utah Health Information Network

# Homer Warner and HELP



- The first version of the HELP (Health Evaluation through Logical Processing) system was built in 1967
  - From its inception, the HELP system was built primarily to provide advanced decision support
-

**Patient**



# Core assumptions

‘The complexity of modern medicine exceeds the inherent limitations of the unaided human mind.’

~ David M. Eddy, MD, Ph.D.

‘... man is not perfectible. There are limits to man’s capabilities as an information processor that assure the occurrence of random errors in his activities.’

~ Clement J. McDonald, MD

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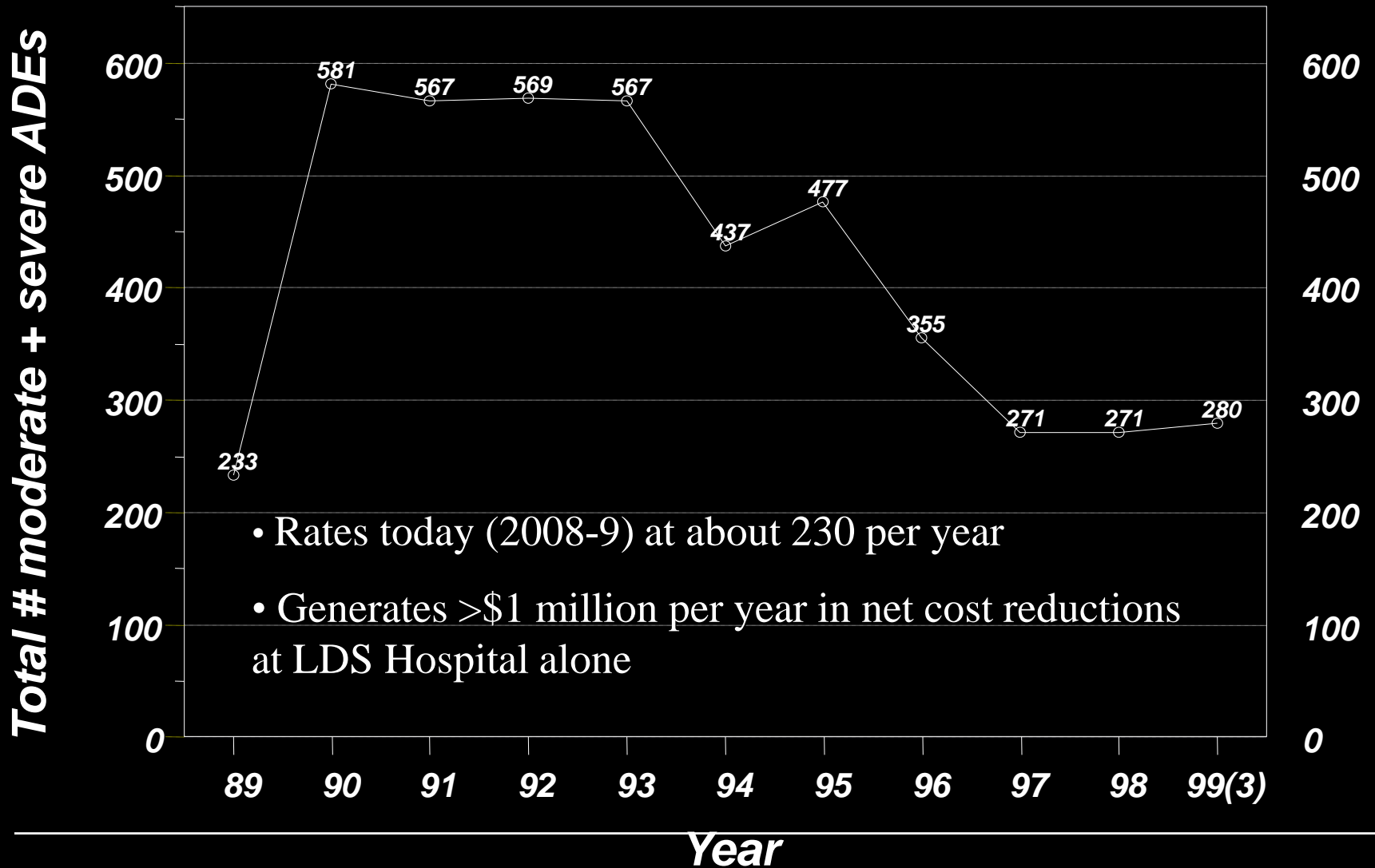
# Clinical System Approach

- Intermountain can only provide the highest quality, lowest cost health care with the use of advanced decision support systems
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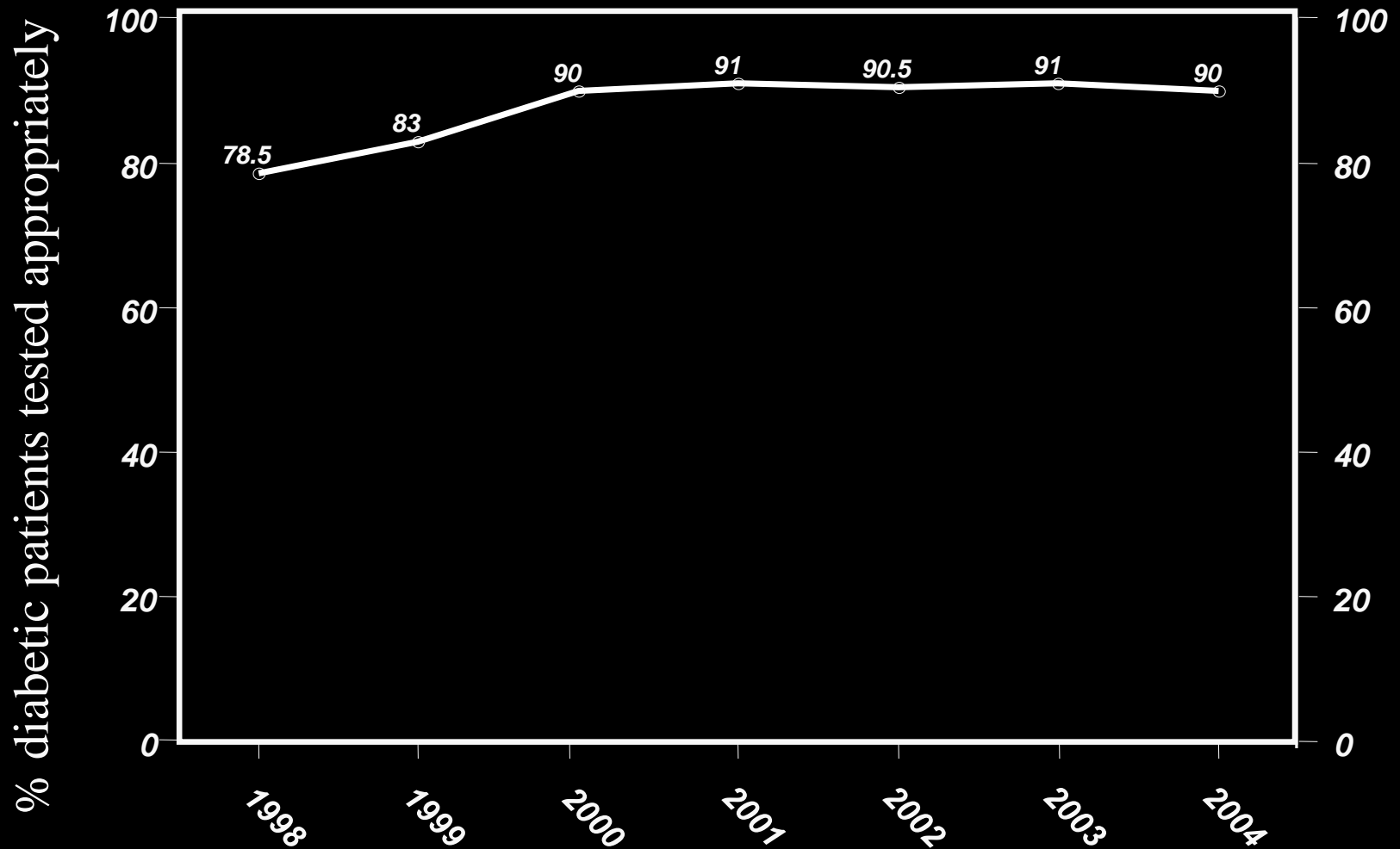
# Real time, patient specific, decision support

- Alerts
  - Potassium and digoxin
  - Coagulation clinic
- Reminders
  - Mammography
  - Immunizations
- Protocols
  - Ventilator weaning
  - ARDS protocol
  - Prophylactic use of antibiotics in surgery
- Advising
  - Antibiotic assistant
- Critiquing
  - Blood ordering
- Interpretation
  - Blood gas interpretation
- Management – purpose specific aggregation and presentation of data
  - DVT management
  - Diabetic report

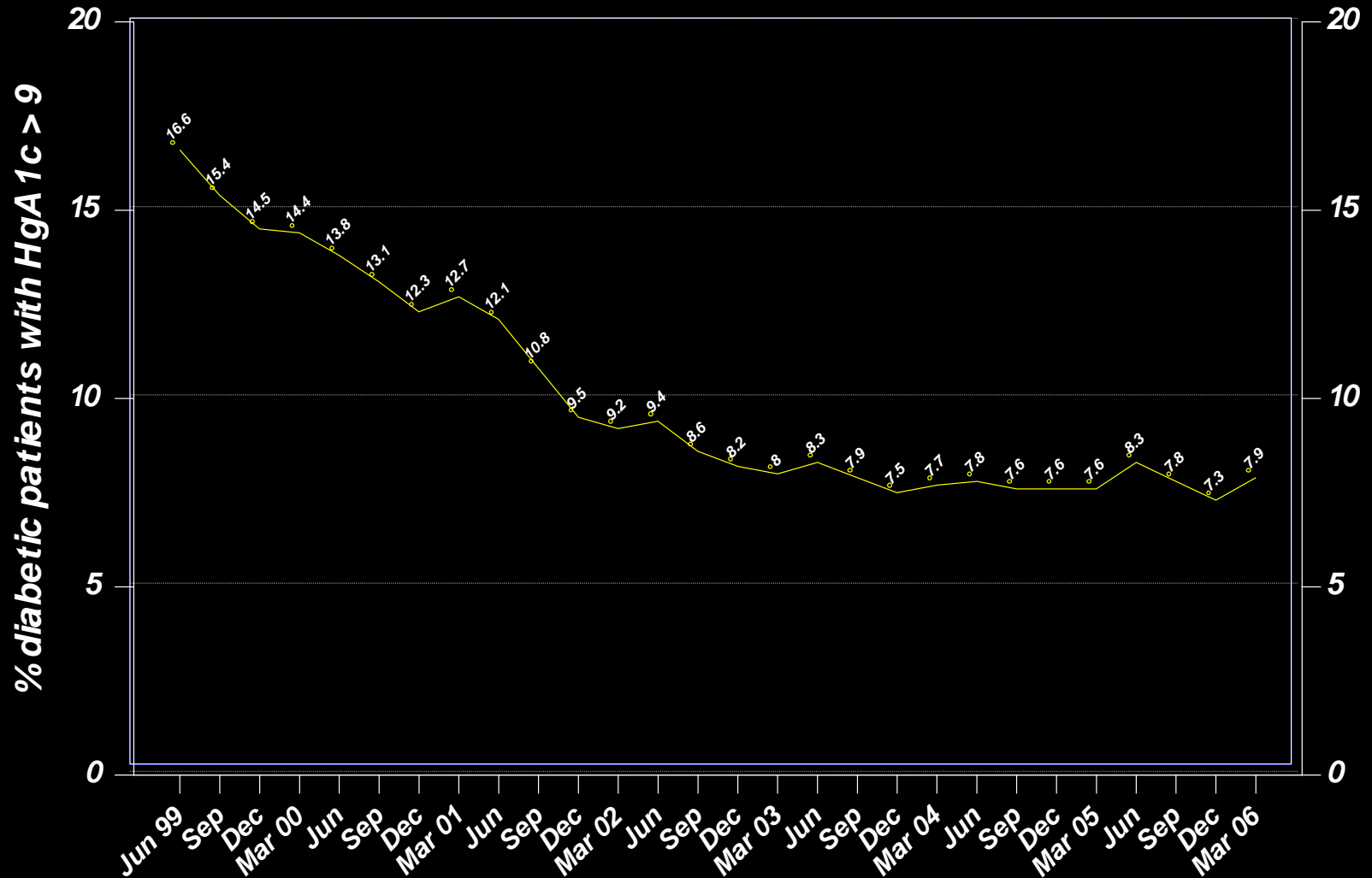
# Adverse Drug Events



# HbA1c Testing

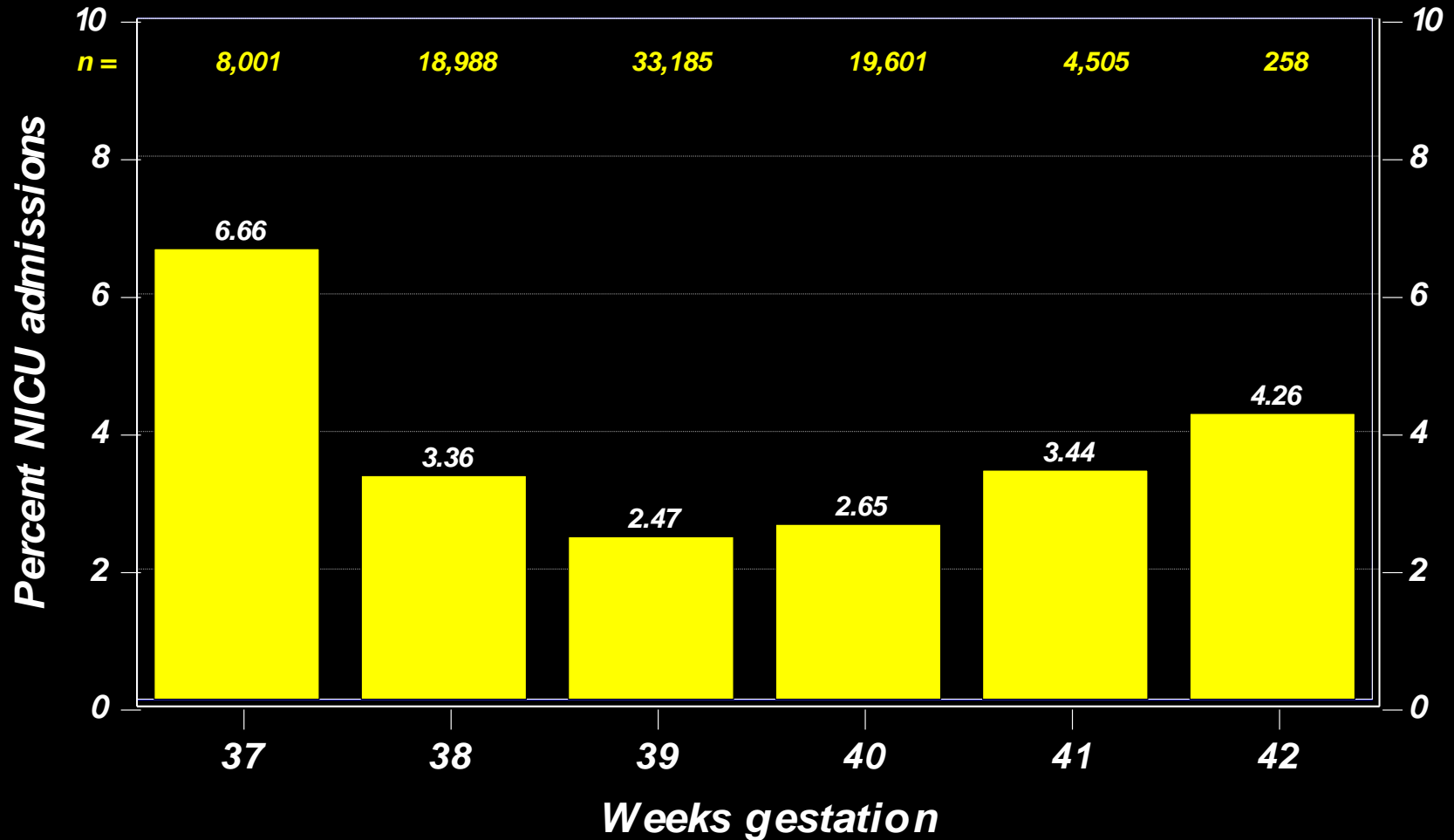


# Poor HbA1c control

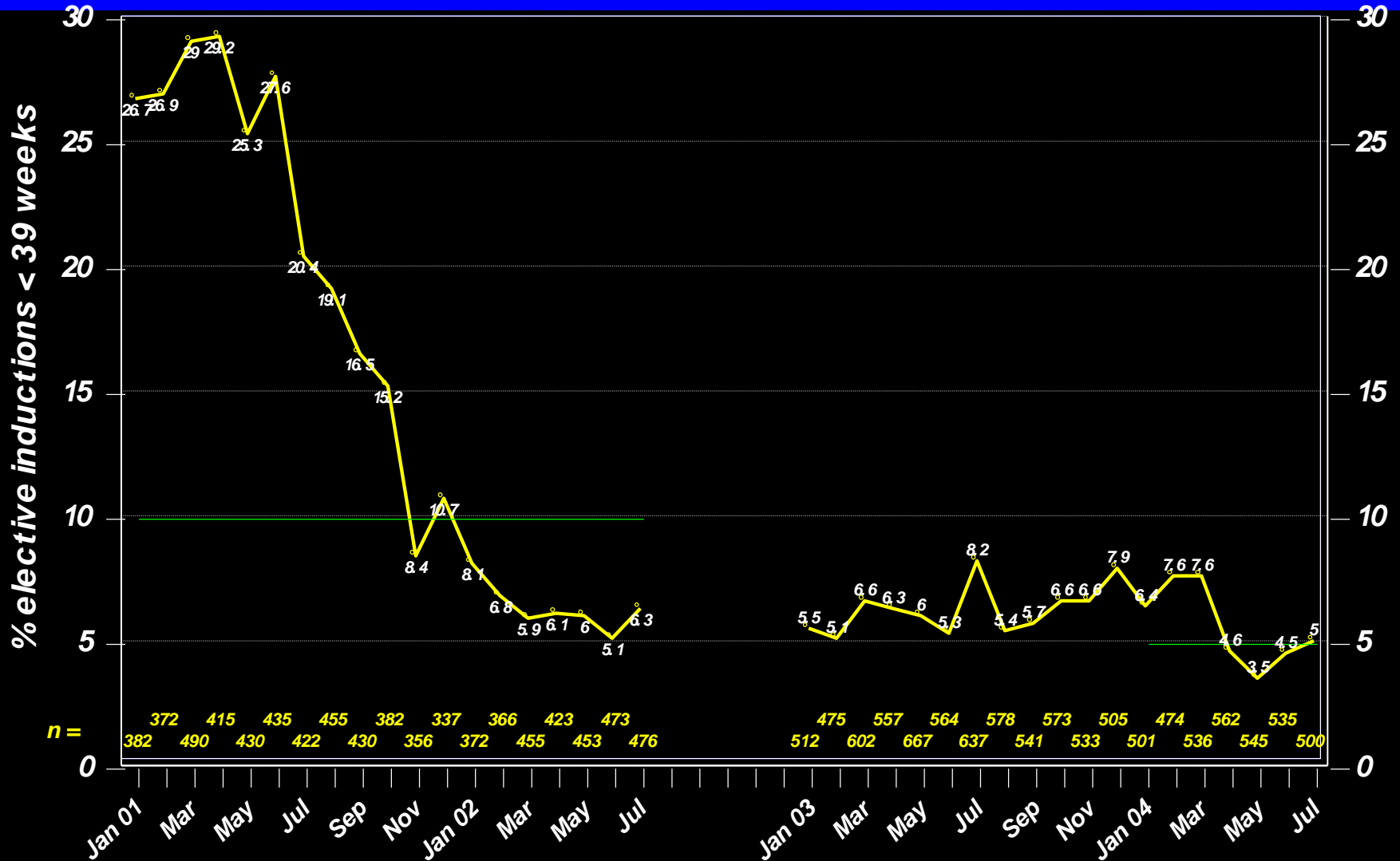


# Neo-natal intensive care unit (NICU) admits by weeks gestation

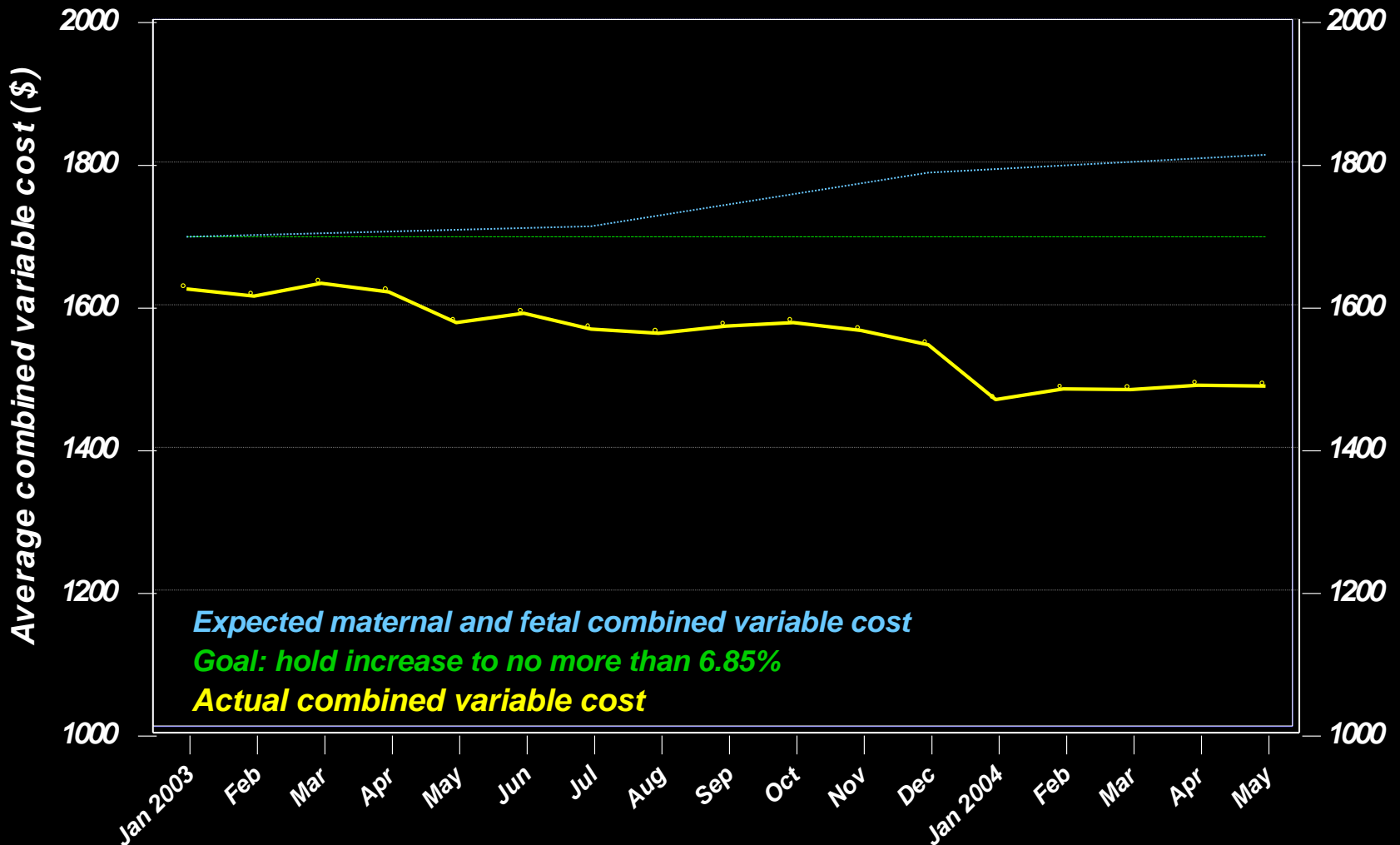
*Deliveries w/o Complications, 2002 - 2003*



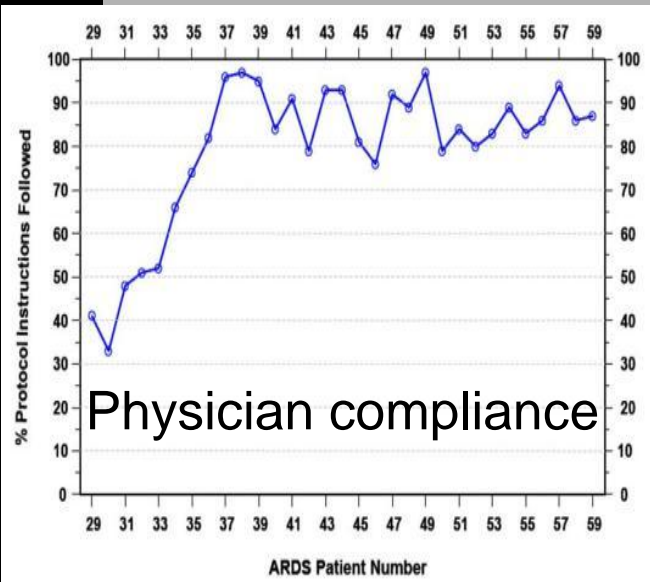
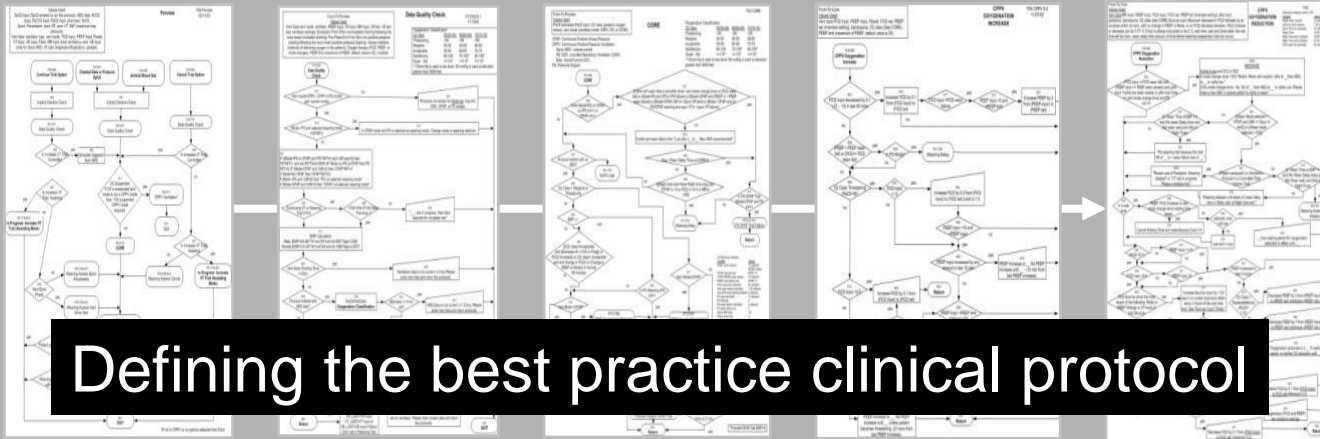
# Elective inductions < 39 weeks



# Labor & delivery variable cost



# ARDS ... Evidence in Action

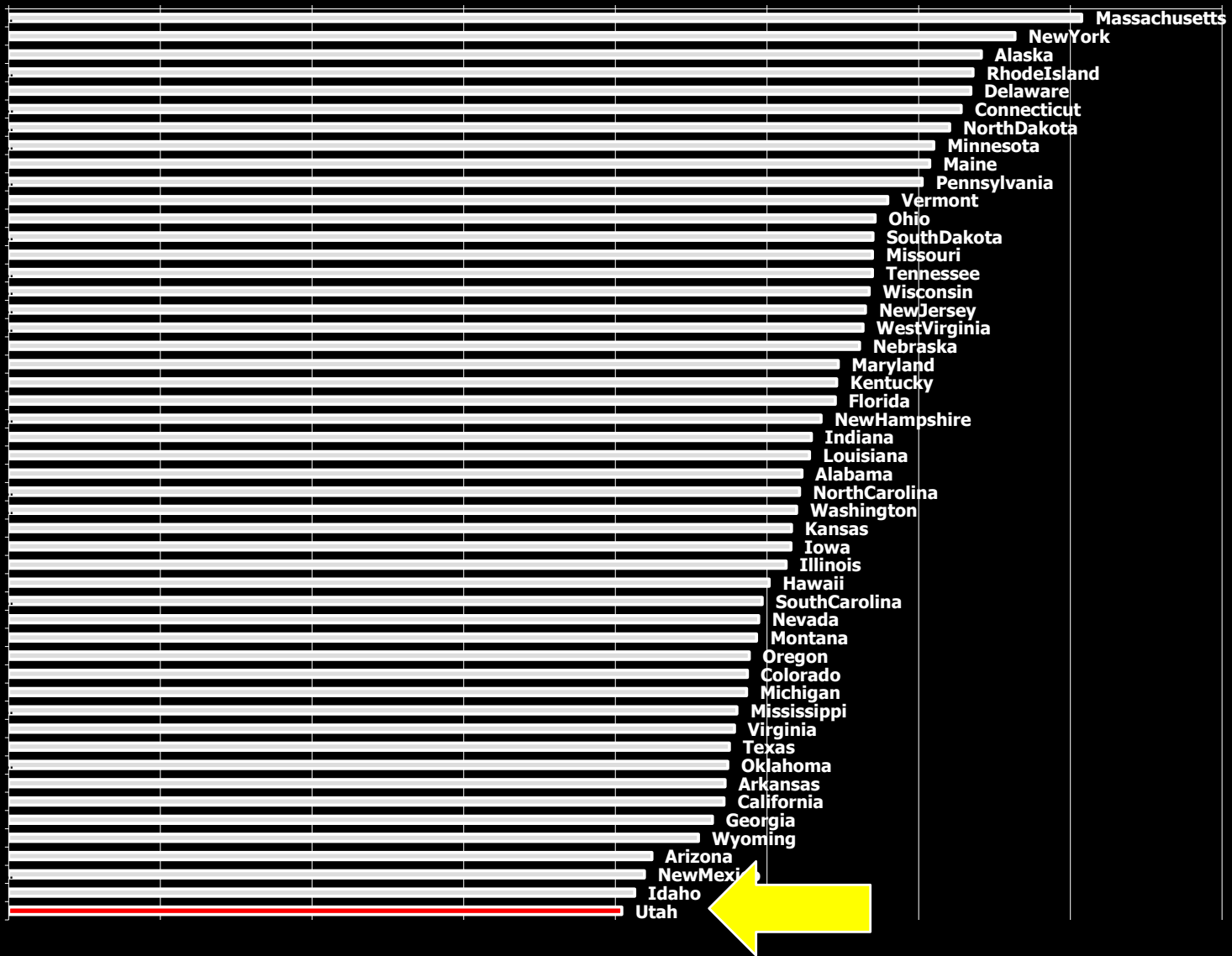


- ARDS ventilator management:
- Survival 9.5% → 44%
  - ~\$120,000 less cost per case!

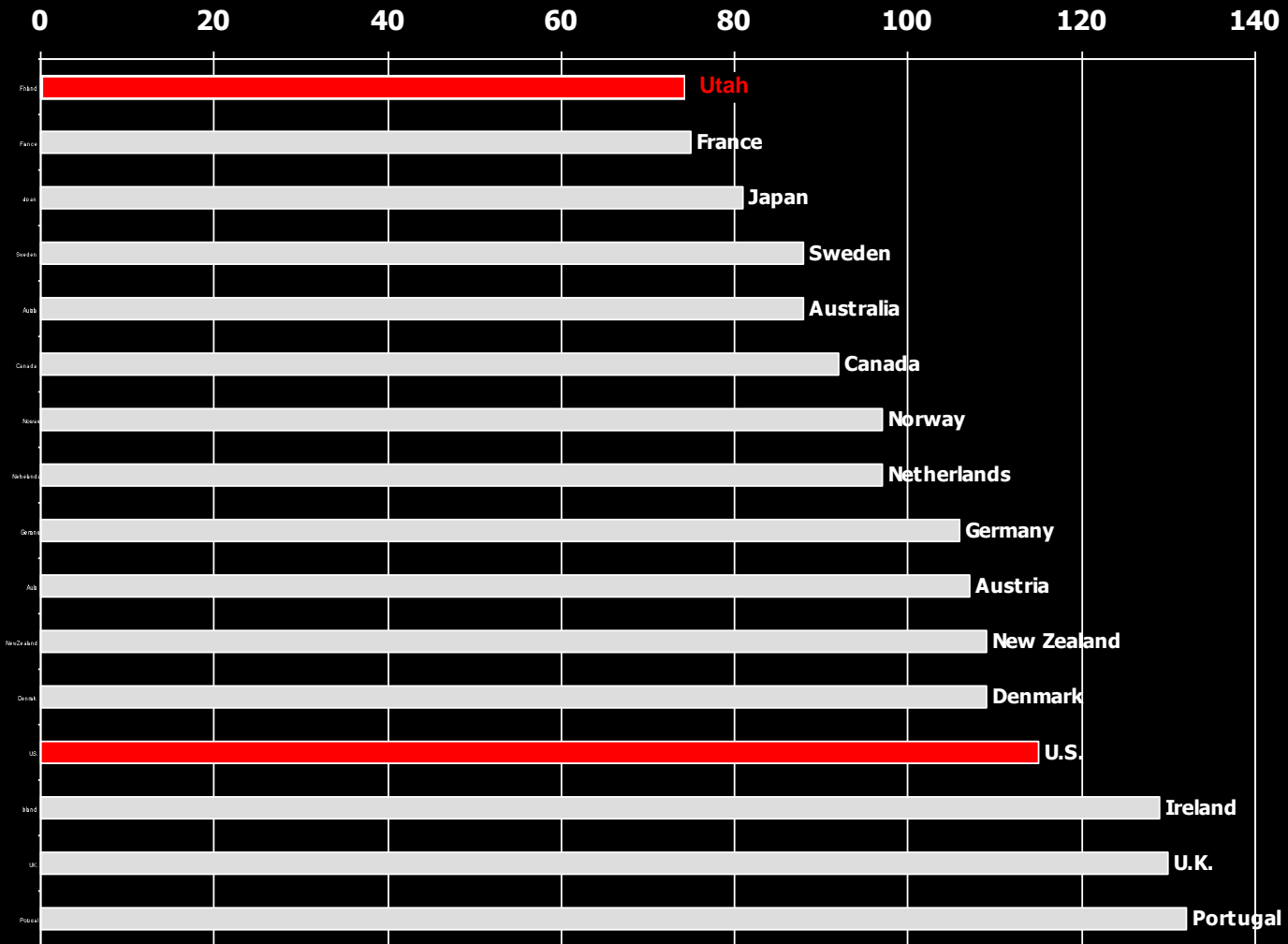
# Other Decision Support Modules

- Antibiotic Assistant
  - Ventilator weaning
  - ARDS protocols
  - Nosocomial infection monitoring
  - MRSA monitoring and control
  - Prevention of Deep Venous Thrombosis
  - Infectious disease reporting to public health
  - Diabetic care
  - Pre-op antibiotics
  - ICU glucose protocols
  - Ventilator disconnect
  - Infusion pump errors
  - Lab alerts
  - Blood ordering
  - Order sets
  - Patient worksheets
  - Post MI discharge meds
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# Outcomes — *Total Health Cost per Capita*

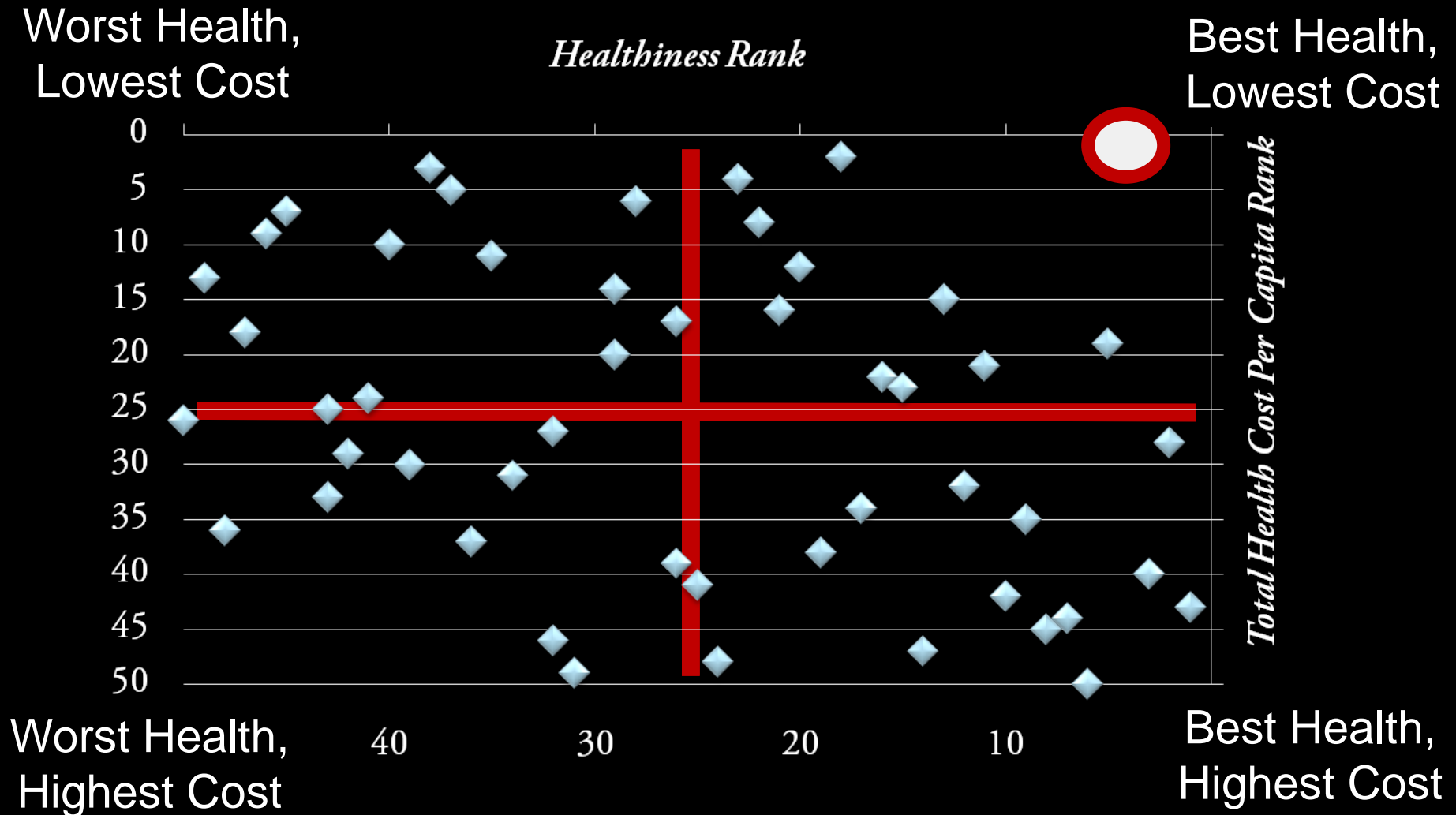


# Outcomes — *Mortality Amenable to Healthcare* (Deaths per 100,000 Population)



Source: World Health Organization, Nolte and McKee,  
Rutgers Center for State Health Policy Standardized for age (1998)  
Utah from 2003, normalized for general US change from 1998

# Outcomes – State Rankings of Healthiness Compared to Total Health Cost Per Capita Rank



Source: Healthiness – United Health Foundation  
Total Health Cost – Kaiser Family Foundation

# Information Systems Investment

- ~4.2 % of gross annual revenue for IS
- 800+ IS employees
- ~\$40 M annual expenditure for clinical systems

# Resources for Structured, Coded Data

- Roughly 12% of the total IS budget
  - Medical Informaticists – 12 FTEs
  - Modeling and terminology – 12 FTEs
  - Interface team (HL7, X12, DICOM) – 32 FTEs
  - Enterprise Data Warehouse – 35 FTEs

# Lessons Learned

- Advanced decision support is effective in improving quality and decreasing costs
- Developing, testing, and deploying decision support takes time and money
- Many health care providers will not have the resources to implement decision support

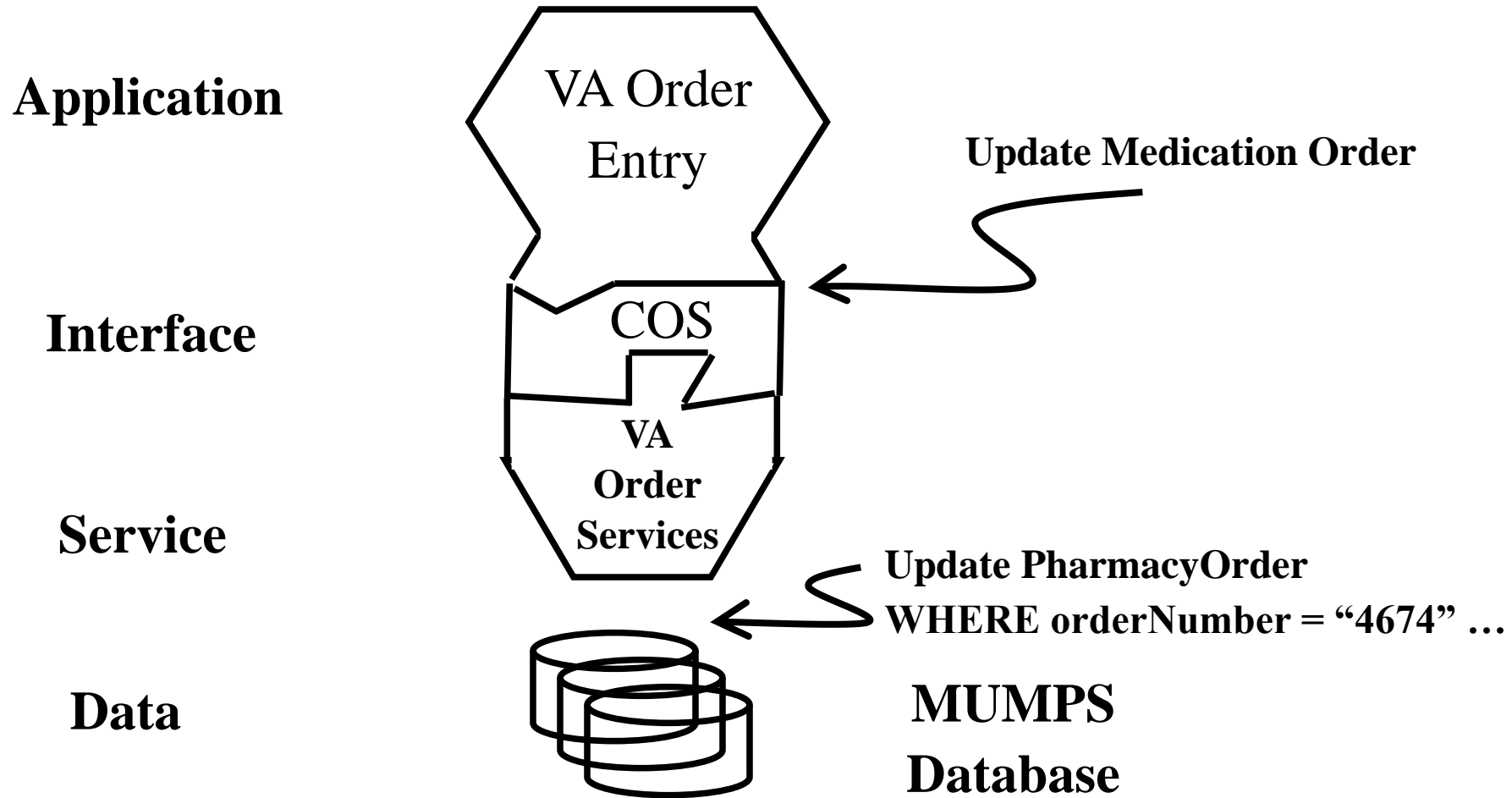
# Creating a Next Generation EHR with GE

- Comprehensive of all categories of clinical data
    - History, physical, pharmacy, laboratory, ...
  - All types of data
    - Text, numeric, coded, images, sounds, ...
  - Retained for 100+ years
  - The legal record for all or part of the patient's data
  - The data will outlive any particular application, service, programming language, database, or message format
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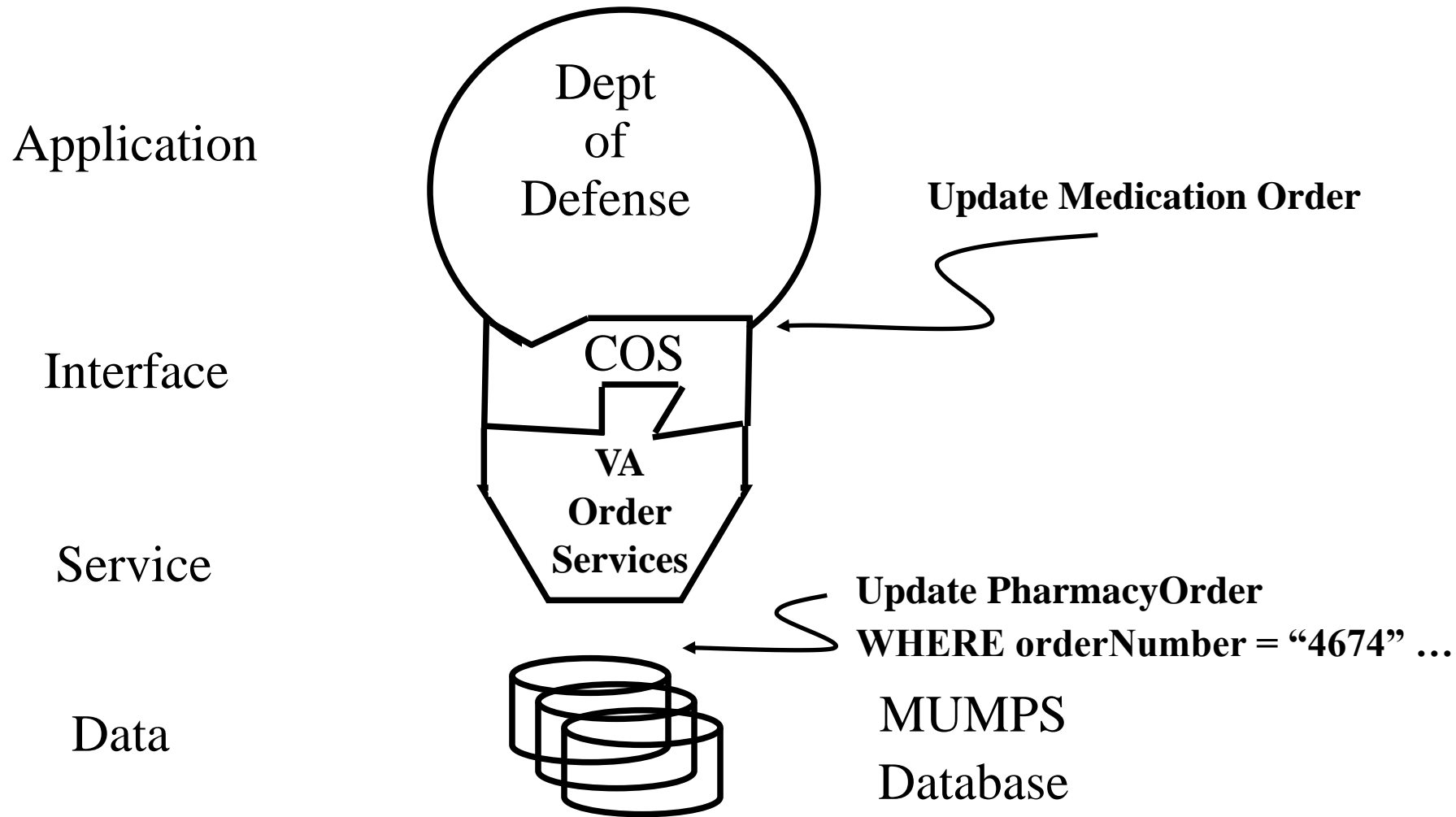
# Strategic Goals

- Minimum goal: Be able to share applications, reports, alerts, protocols, and decision support with ALL GE customers
  - Maximum goal: Be able to share applications, reports, alerts, protocols, and decision support with anyone in the WORLD
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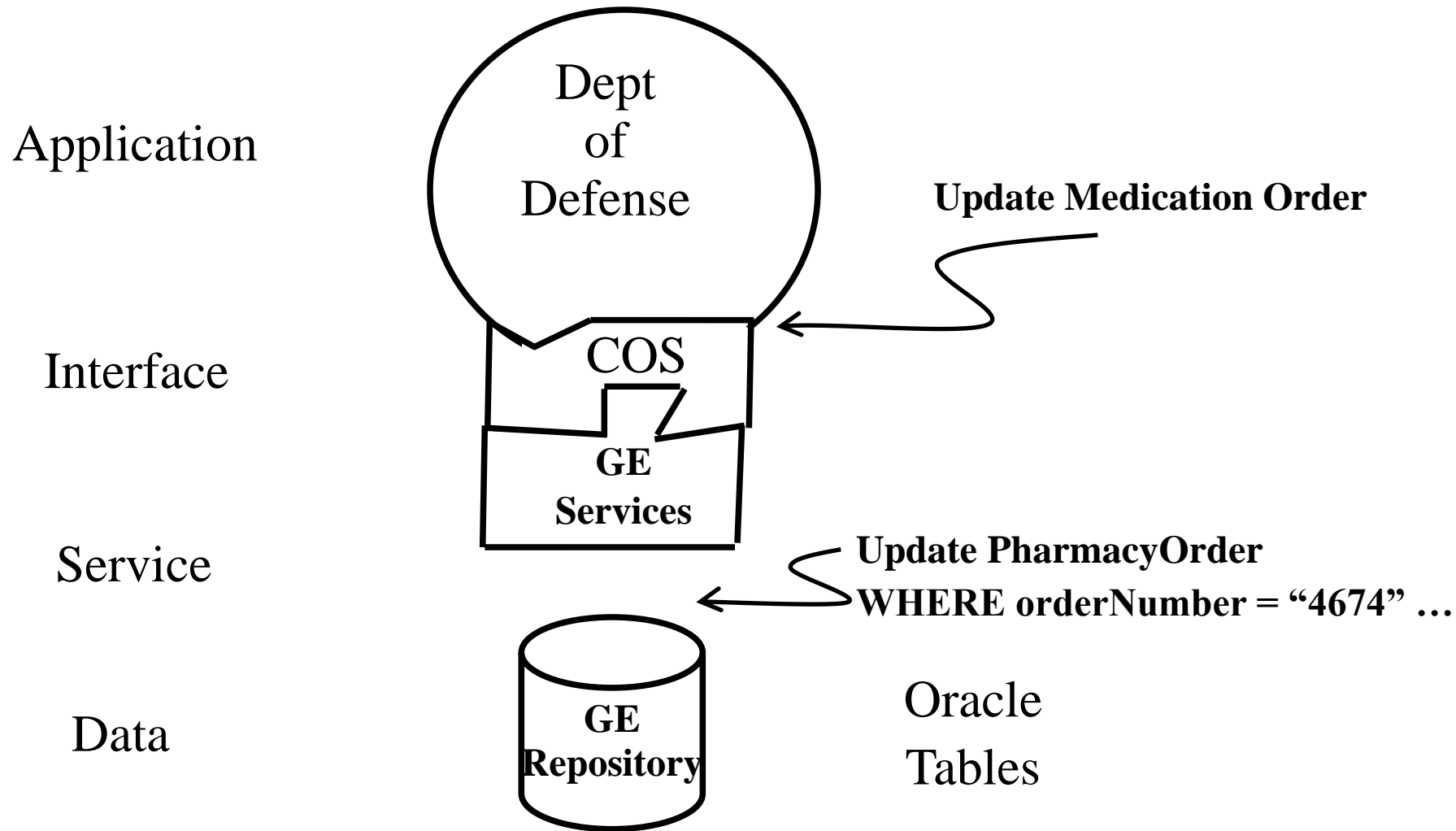
# Order Entry API (adapted from Harold Solbrig)



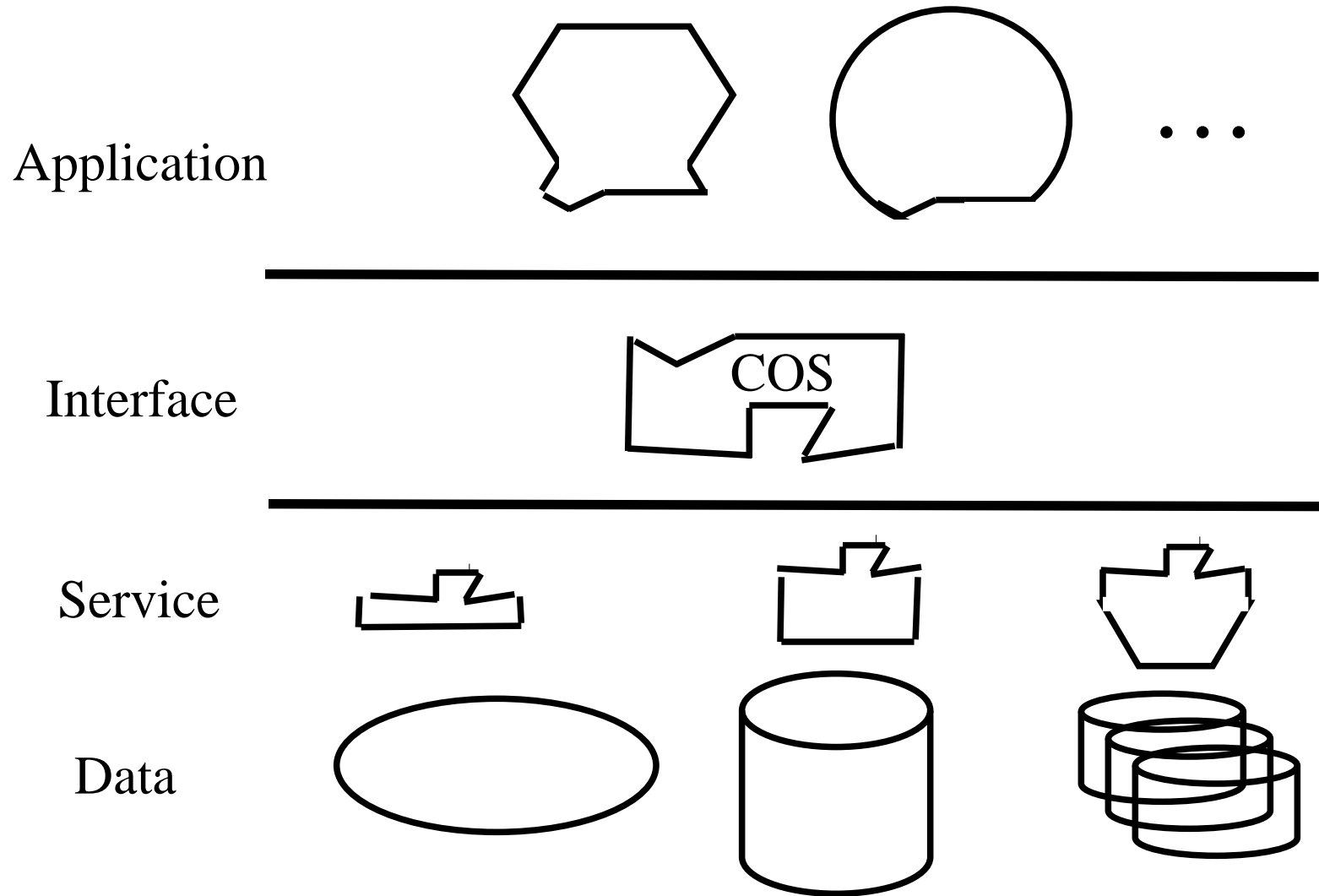
# Order Entry API – Different Client, Same Service (adapted from Harold Solbrig)



# Order Entry API – Different Server, Same Client (adapted from Harold Solbrig)



# Order Entry API (adapted from Harold Solbrig)



# What Is Needed to Create a New Paradigm?

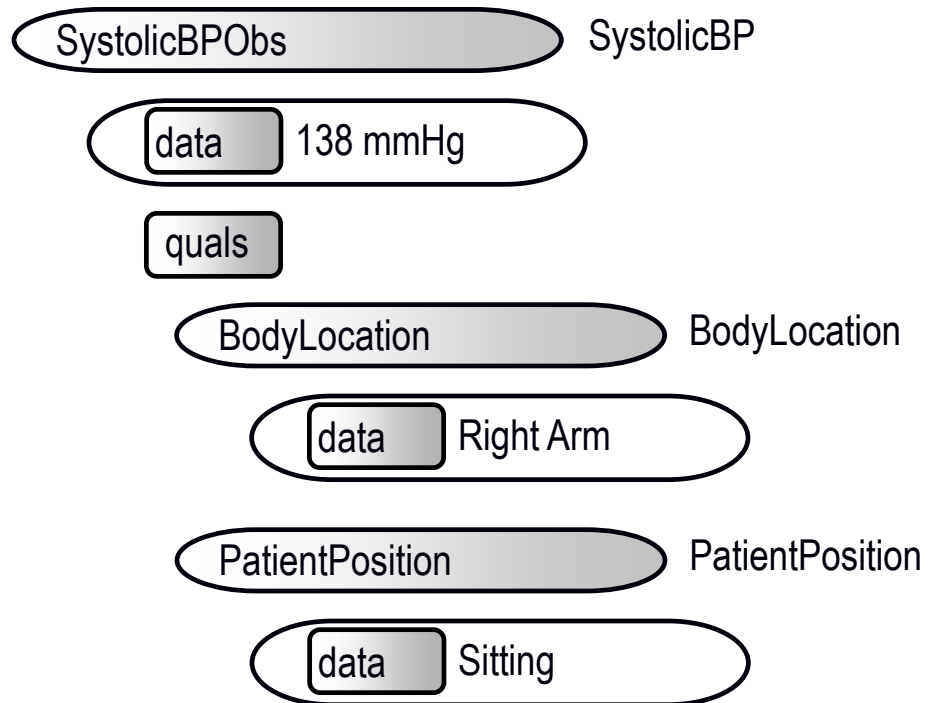
- Standard set of detailed clinical data models coupled with...
- Standard coded terminology
- Standard API's (Application Programmer Interfaces) for healthcare related services
- Open sharing of models, coded terms, and API's

# The Situation Today

- Typical approach
  - Each site makes its own codes and data models
  - There is no ability to share data, applications, or logic
- Data is not consistent between different specialties or domains
- Data is not consistent over time
  - T. Alan Pryor, “Programmers always leave for more money.”

# Example Model

## Blood Pressure Measurement Model (Storage Model)



# Model Driven System Stack

**Applications**

**Templates**

How an app uses content

**Form Elements**

Constraints on/additions  
to CEMs for apps

**Domain  
Services**

**Rules  
Definition**

**Detailed Clinical Models**

detailed info. models bound to terminology

**Coded, Controlled Terminology**

concepts, relationships, designations, contexts

# What if there is no model?

Site #1

Dry Weight: **70** **kg**

Site #2

Weight: **70** **kg**

- Dry
  - Wet
  - Ideal
-

# Relational database implications

Patient Identifier	Date and Time	Observation Type	Observation Value	Units
123456789	7/4/2005	Dry Weight	70	kg
123456789	7/19/2005	Current Weight	73	kg

Patient Identifier	Date and Time	Observation Type	Weight type	Observation Value	Units
123456789	7/4/2005	Weight	Dry	70	kg
123456789	7/19/2005	Weight	Current	73	kg

How would you calculate the desired weight loss during the hospital stay?

# What do we model?

- All data in the patient's EMR, including:
    - Allergies
    - Problem lists
    - Laboratory results
    - Medication and diagnostic orders
    - Medication administration
    - Physical exam and clinical measurements
    - Signs, symptoms, diagnoses
    - Clinical documents
    - Procedures
    - Family history, medical history and review of symptoms
-

# How are the models used?

- Data entry screens, flow sheets, reports, ad hoc queries
    - Basis for application access to clinical data
  - Computer-to-Computer Interfaces
    - Creation of maps from departmental/foreign system models to the standard database model
  - Core data storage services
    - Validation of data as it is stored in the database
  - Decision logic
    - Basis for referencing data in decision support logic
  - Does **NOT** dictate physical storage strategy
-

# Summary

- The reason for creating detailed clinical models is to support the capabilities we want the system to have
    - Longitudinal conception to grave EHR
    - Real-time patient specific decision support
    - Sharing of data within and outside of the enterprise
    - Clinical and administrative research and analysis
    - Sharing of decision support logic and protocols
    - Standard, open, modular, application development environment
  - The only feasible way to meet these goals is to create and share detailed clinical models that are based on standard coded terminology
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# Questions?