



INCOSE 2003 Panel:

Systems Engineering & Hospitals of the Future: Challenging the Status Quo

**July 2nd 2003
2:35 pm – 4:20 pm**

**John R. Zaleski, Ph.D.
(Moderator)**

C. William Hanson, M.D.

Orlando Illi

LTC Ralph Franco



Healthcare providers around the country and the world are beginning to realize that maintaining and improving

Quality of care

While meeting the needs of an increasing **Quantity** of patients

And assuring **Affordability** for those patients

...requires a change in the status quo—a revolution in healthcare



Why a revolution?

- **Basic tenets...**

- **Motivate improvements in quality of care**
 - **New methods, technologies, provide incentive to change**
 - **Foster best practices that demonstrate measurable benefits and efficiency**
- **Promote systems thinking**
 - **Workflow/Scenario-based streamlining of procedures**
 - **Minimize redundancy**
 - **Measure and feedback to facilitate continuing improvement**
- **Establish standards**
 - **“Once-and-done” solutions are expensive to maintain, are not portable, and may not support the necessary rigor to ensure repeatability across the enterprise**

- **Many factors drive this...**

- **reduce occurrence of medical errors, costs**
- **loss of staff**
- **increase in number, age of patients**
- **increase in frequency of patients with chronic ailments**



Some facts...



Medical Errors: A Systems Problem

- **Medical Errors are estimated to cost ~\$37.6B each year**

Source: Agency for Healthcare Research & Quality and the Institute for Medicine (IOM), November 1999

- **As many as 98,000 patients die as the result of medical errors in hospitals each year**
 - **Wrong medication, Med interaction, Complications, Diagnostic error, Equipment failure, Infection, Blood transfusion, Misinterpretation of orders**
- **Joint Commission on Accreditation of Healthcare Organizations (JCAHO)**
 - Established a “Sentinel Event Policy” in 1996
 - Commission reviewed 2,034 cases between 1995 and 2002
 - Top Causes of Medication Errors, in order, include Orientation/Training, Communication, Info Availability, Standardization, Storage/Access, Competency/credentialing, Supervision, Staffing, Labeling, Distraction

Source: <http://www.jcaho.org/accredited+organizations/ambulatory+care/sentinel+events/sentinel+event+statistics.htm>



The State of U.S. Population, Health Costs

- **Population projected to increase to ~400 million by 2050[‡]**
 - **> 50 percent increase over 1999 population**
 - **Median male life expectancy projected to increase from 74 in 1999 to 81 in 2050**
 - **Median female life expectancy projected to increase from 80 in 1999 to 87 in 2050**
 - **Expenses per inpatient day[†]: \$1,149 billion**
 - **Expenses per inpatient stay[†]: \$6,649 billion**

Increase in senior population translates into increased demand on system, including chronic ailments, more frequent hospital stays

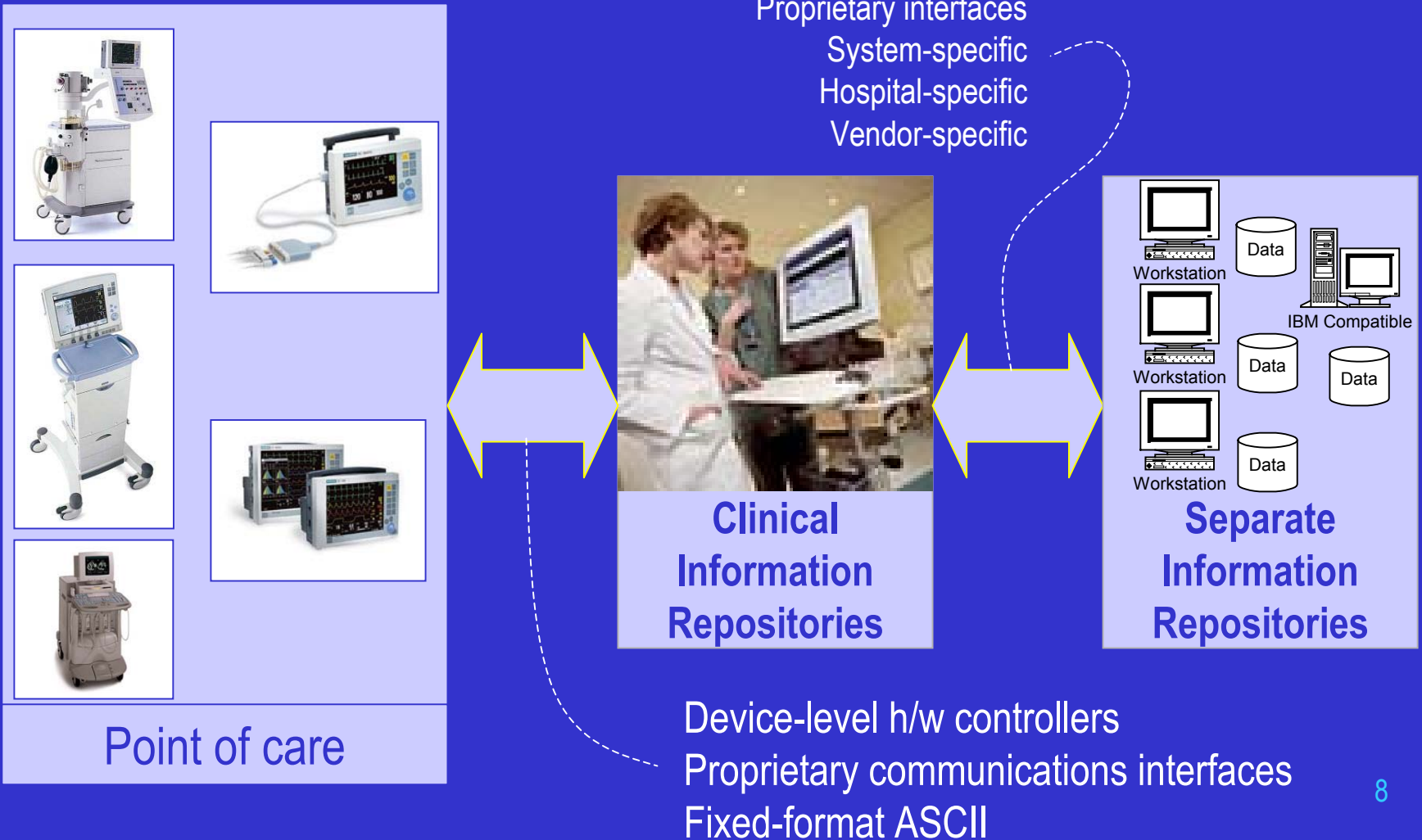
[‡] Hollman, Mulder, Kallan, "Methodology and Assumptions for the Population Projections of the United States: 1999 to 2100." Population Projections Branch, Population Division, US Census Bureau, January 13 2000

[†] American Hospital Association: Hospital Statistics, 2002 Edition.



Where we are today...

Hospital Integration: *The past*





The ramifications...

- **Disjointed, Disparate Systems**
 - **“Sneaker Net”**
 - **Inefficiency**
 - **Prone to error**
 - **Maintenance/support concerns**
 - **Few, consistently implemented standards**
 - **Varying interface requirements**



Where we're going...



Standards

- **Health Level 7 (HL7; <http://www.hl7.org>), *Digital Imaging and Communications in Medicine (DICOM; <http://medical.nema.org/>)...*
 - **Standard methods for communicating information (both ASCII<GO>, imagery<GO>) ensure that various systems can share information reliably, rapidly, w/o loss of context, patient information****

Header

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ID

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Data

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OBX||SN|FIO2^^local^3150-0^^LOINC||72|%^^ISO+||||R|||200211141214
OBX||SN|TVe^^local^20116-0^^LOINC||547|m|^ISO+||||R|||200211141214
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An HL7 Patient Vital Result Transaction



Technology

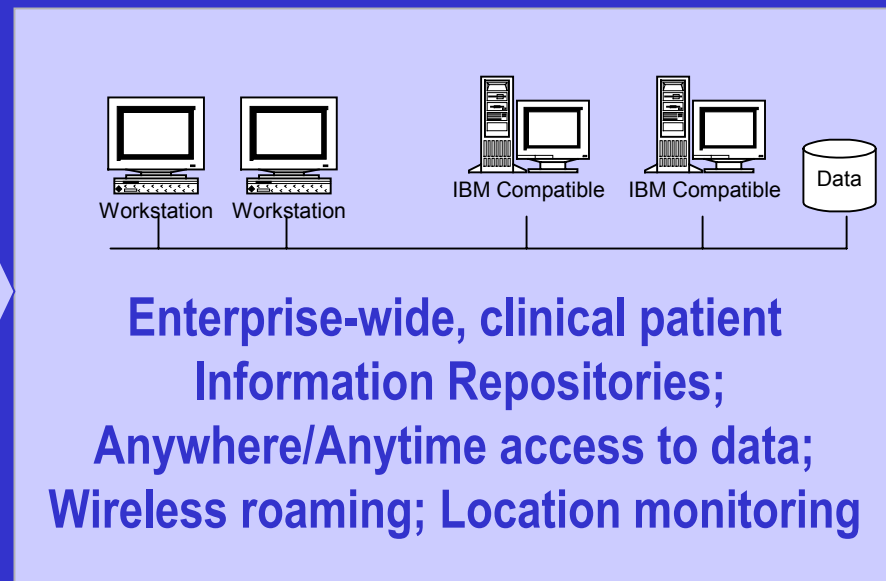
- **Wi-Fi**
 - **801.11a,b, and (now) g**
 - **DHCP-based**
- **Enterprise information technology**
- **Common identifiers**
- **Smart systems**
- **Workflow-based operations**
- **Training of clinical staff**
- **Sophisticated security systems**
 - **Single sign-on**
 - **Multi-tiered**
 - **Biometrics, smart-cards**
 - **Dynamic WEP-keys (wireless)**



Process

- **ISO**
- **SE/SW-CMM**
 - **Requirements & Scenario-driven designs**
 - **Standards-based**
 - **Measurable**
 - **Repeatable and component-based architectures**

Hospital Integration: *The future*



HL7 & Standards-based
Plug and play
Common User interfaces



The panel focus

- **To bring together individuals who are working towards these goals in real-life**
 - **Share the experience base**
 - **The triumphs and the challenges**
 - **Provide insight into application and understanding of the problems and how these impact us as stakeholders**
 - **Illustrate the role of systems thinking**



The Panelists...



C. William Hanson, MD

“Data management in an intensive care environment”

- **Professor of Anesthesia, Surgery and Internal Medicine, University of Pennsylvania, Philadelphia, Pennsylvania**
- **Visiting Professor, Princeton University, Princeton, New Jersey**
- **Chair Medical Board, Hospital of the University of Pennsylvania**
- **Many peer-reviewed papers (>30), book chapters, Letters; Editor of The Intensive Care Manual; and holder of 7 US patents**



“Data management in an intensive care environment” –*Dr. Hanson*

- Increasing demands for efficiency in delivery of health care to critically ill patients, new patient and data management paradigms are essential.
- Patients are moved throughout the hospital, back and forth from diagnostic and procedural sites and the data acquired in each location is typically managed and recorded in disparate fashions.
 - Clinicians are unable to form a coherent picture of the patient’s status over time and in response to different interventions.
 - Patient data are typically transcribed manually from bedside devices into the medical record, typically by highly skilled professionals who have substantial demands on their time – automated transcription of this data and wireless delivery to a database would be both desirable and cost-effective.
- Two competing wireless technologies, WiFi and Bluetooth, have different strengths
 - can provide robust, redundant data management environment in the ICU with both baseline data acquisition and the creation of ad-hoc, specialized personal area networks.



LTC Ralph Franco

“Information Exchange Requirements for Hospital Informatics”

- **Chief, Medical Information Systems Division, Directorate of Combat and Doctrine Development, U.S. Army Medical Department Center and School**
- **Diplomate of the American College of Healthcare Executives and a Certified Professional in Healthcare Information and Management Systems (CPHIMS) of the Healthcare Information and Management Systems Society**



“Data management in an intensive care environment” -LTC Franco

- The Army Medical Department Center and School (AMEDDC&S) has proposed a process for establishing inter- and intra-nodal Information Exchange Requirements (IER).
 - Information exchange across components can only be achieved effectively through standards in information exchange.
 - Drawing upon concept of interface requirements specifications, basis for IERs is a common method for communicating among modalities and information systems.
 - While much has been done in area of health care standards for data (health level 7—HL7, for instance) not all situations or medical modalities are designed to support this standard.



LTC (Ret.) Orlando Illi

“Information Exchange Requirements for Hospital Informatics”

- **Retired from Army, Rank of Lieutenant Colonel (LTC) on 1 April 1997**
- **Currently serving as Deputy Product Manager for Communications for Combat Casualty Care (MC4) at Ft Detrick, MD.**
- **1987 graduate of Florida Institute of Technology with a Master of Science in Systems Management (MSSM).**
- **Graduate of USMC and U.S. Army Command and General Staff Colleges as well as USMC Amphibious Warfare School and US Army Armor and Ordnance Officer Advanced Courses.**
- **Military decorations include Defense Meritorious Service Medal, Army Meritorious Service Medal (w/3 OLC), Army Commendation Medal (w/3 OLC), Army Achievement Medal and Humanitarian Service Medal.**



John Zaleski, Ph.D.

“Information & Technology Integration Standards”

- **Advisory Analyst with Siemens Medical Solutions Health Services in Malvern, PA.**
- **Presently directs the Modality Integration Laboratory**
 - **Focused on integration of medical modalities with hospital enterprise-based electronic patient records.**
- **Graduate work in systems engineering at the University of Pennsylvania**
 - **Specialized in post-operative respiratory recovery research at Hospital of University of Pennsylvania and University of Pennsylvania Medical Center.**
 - **Scholarly research includes over a dozen articles and more than a dozen patents.**