Human Factors and Ergonomics in Health Care and Patient Safety

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What's the problem?

- US – health care expenditures = 13% GNP

- Institute of Medicine – 1999 – Report on medical errors and patient safety:
  - 44,000 to 98,000 Americans die in hospitals each year as a result of medical errors.

- Canada:
  - about 185,000 of the 2.5 million annual hospital admissions associated with an adverse event

Mexico?

Patients Pledge to Fight Medical Error

Patient safety advocates from throughout the Americas concluded a hemispheric workshop in May pledging to raise awareness about the deadly toll of medical errors and to work to improve patient safety in their home countries.

Evangelina Vásquez, of Mexico, told how her son, Uriel, suffered neonatal jaundice shortly after birth, and how her pleas for medical attention were dismissed by health care providers. The untreated jaundice produced a type of irreversible brain damage known as kernicterus. Vásquez took her case to Mexico's National Commission on Human Rights and won a favorable decision.

Alicia Herrera, another participant from Mexico, told how she had suffered extreme pain and permanent disfigurement and disabilityas a result of faulty administration of anesthesia prior to a tooth extraction. Herrera wrote a book about her ordeal, *The Face of Medical Negligence: Do You Want to See My Face?*

WHO World Alliance for Patient Safety

Second Global Patient Safety Challenge

Safe Surgery Saves Lives

The World Alliance for Patient Safety is initiating work on the second Global Patient Safety Challenge in January 2007. The programme, "Safe Surgery Saves Lives", aims to improve the safety of surgical care around the world. By focusing attention on surgery as a public health issue, WHO is recognizing its growing importance ... safety of health ... ... ates.

http://www.who.int/patientsafety/en/
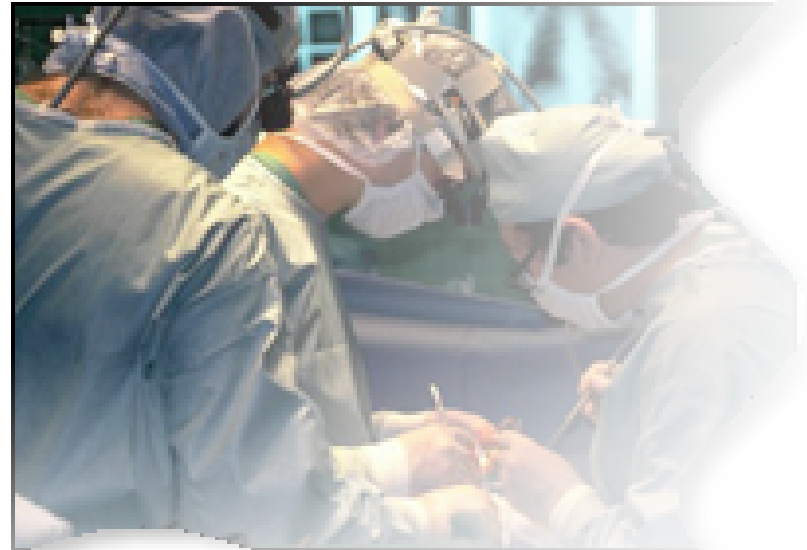
Institute of Medicine-2001 Crossing the Quality Chasm

- *"Health care has safety and quality problems because it relies on outmoded systems of work. If we want safer, higher-quality care, we will need to have redesigned systems of care, including the use of information technology to support clinical and administrative processes."* (p. 4)

Progress toward understanding patient safety

- IOM'2000 Report – *To Err is Human*
- IOM'2001 Report – *Crossing the Quality Chasm*
- IOM'2003 Report – *Patient Safety – Achieving a New Standard for Care*
- IOM'2003 Report – *Keeping Patients Safe*
- IOM'2006 Report – *Preventing Medication Errors*
  - Human error / System approaches
  - Design of information technology
  - Importance of human factors

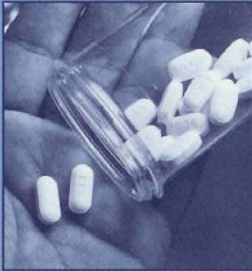# HFE expertise in healthcare organizations

Employee health: occupational safety & health, ergonomics

Purchasing of equipment: usability

Quality improvement: process analysis

Risk management: incident reporting, event analysis

OR and critical care: teamwork, communication

HANDBOOK OF HUMAN
FACTORS AND ERGONOMICS
IN HEALTH CARE
AND PATIENT SAFETY

EDITED BY
PASCALE CARAYON

Human
Factors
and
Ergonomics

51 chapters:
- Human error
- Sociotechnical systems and macroergonomics
- Technology, medical devices
- Physical ergonomics
- Methods and tools
- Various care settings
- …

Take-home messages

1. A human factors perspective can provide useful, important information on *systemic factors* that contribute *to patient safety.*

2. Need to *integrate* human factors in the *design* of healthcare technologies, systems and processes.
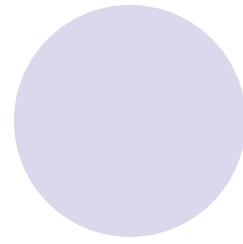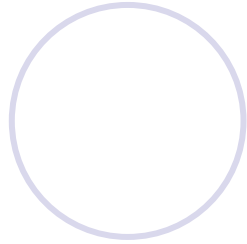
Based on research on human factors in…

… health care and patient safety

Funding from the Agency for Healthcare Research and Quality

http://www2.fpm.wisc.edu/seips/
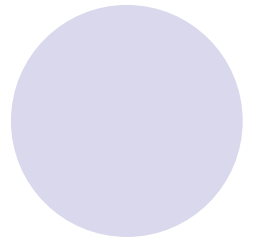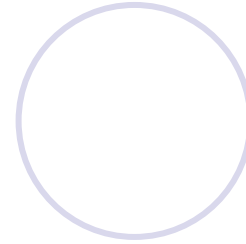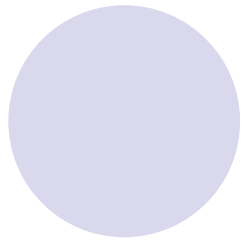
Medication Errors

Leape et al. (1995) "Systems analysis of adverse drug events" JAMA

Table 2.—Errors by Type of Adverse Drug Event (ADE) and Stage of Drug Ordering and Delivery*

	Physician Ordering, No. (%)	Transcription and Verification, No. (%)	Pharmacy Dispensing, No. (%)	Nurse Administration, No. (%)	All, No. (%)
Preventable ADEs	41 (32)	2 (5)	4 (11)	40 (32)	87 (26)
Potential ADEs, nonintercepted	26 (20)	25 (63)	21 (55)	84 (67)	156 (47)
Potential ADEs, intercepted	63 (48)	13 (33)	13 (34)	2 (2)	91 (27)
Totals	130 (100)	40 (100)	38 (100)	126 (100)	334 (100)
% by stage	39	12	11	38	100

*Percentages may not add to 100% due to rounding.

Causes of medication errors:
- lack of knowledge of drug
- faulty dose checking
- setting up of infusion pump

Medication administration technologies

IV Pump Technology

Bar Code Medication Administration (BCMA) Technology

Safe Medication Administration through Technologies and Human Factors – SMArT^{HF}
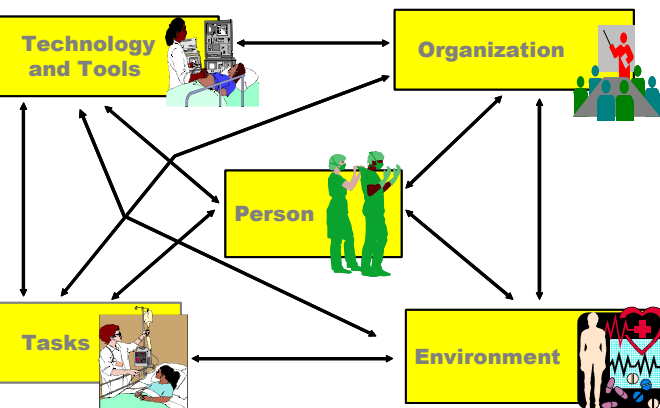
Aims of the project:

1. To determine the effect of Smart IV Pump technology implementation and integration with BCMA technology on medication errors.

2. To determine the impact of Smart IV pumps and the integration with BCMA technology on end users.

3. To describe a human factors prospective error analysis and to qualitatively evaluate its effectiveness on the implementation success of technology in an acute care hospital setting.

http://cqpi2.engr.wisc.edu/smarthf/index.html

Multidisciplinary research team

- Pascale Carayon (PI)
- Tosha Wetterneck (co-PI)
- Roger Brown
- *Joshua De Silvey*
- *Myra Enloe*
- Ann Schoofs Hundt
- *Qian Li*
- Mark Linzer
- *Tracy Love*

- Brad Ludwig
- Susan Kleppin
- *Mustafa Ozkaynak*
- *Prashant Ram*
- Steve Rough
- *Tanita Roberts*
- Mark Schroeder
- *Sade Sobande*

BCMA = Bar Coding Medication Administration

Work system factors observed in BCMA medication administration

- Tasks:
  - Potentially unsafe med. admin.
- Person:
  - Patient in isolation
- Environment:
  - Messy, insufficient light
- Technology:
  - Automation surprises, malfunctions
- Organization:
  - interruptions

# *Leape et al. (1995) "Systems analysis of adverse drug events" JAMA*

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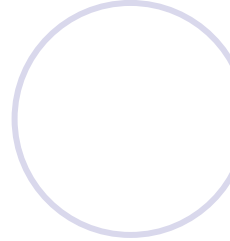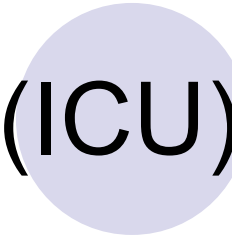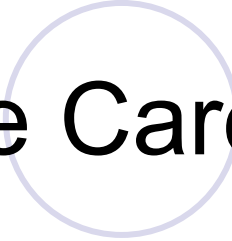*Percentages may not add to 100% due to rounding.

Technological solution?
CPOE = Computerized Provider Order Entry
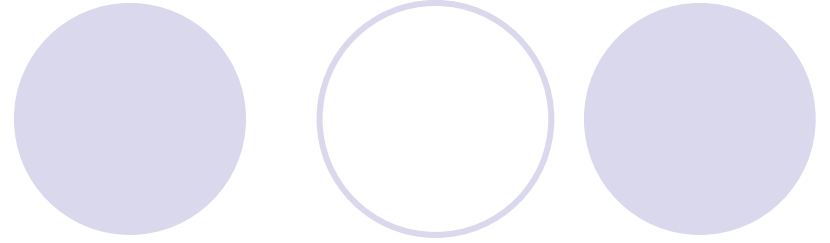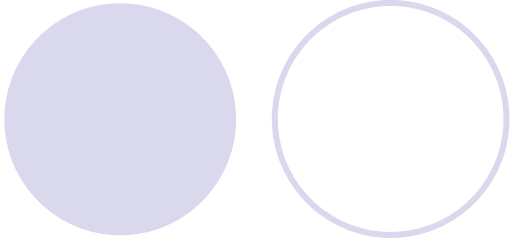
CPOE Implementation in ICUs
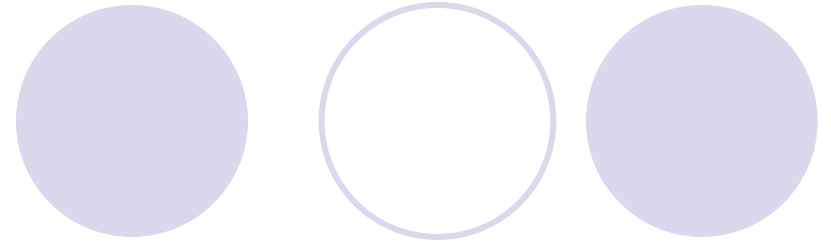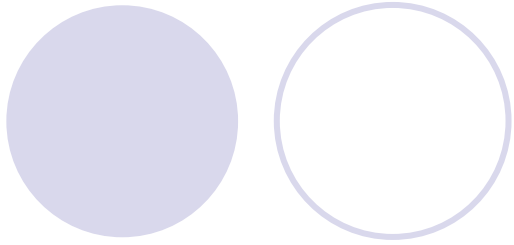
Intensive Care Unit

Intensive Care Unit (ICU)
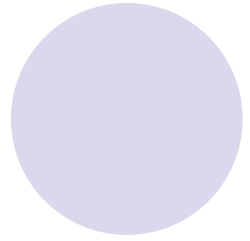
How does a medication order look like?

CPOE Implementation in ICUs

Aims of the project:

1. To determine the effect of CPOE on safety and quality of care in ICUs.

2. To determine the impact of CPOE on end users (physicians, pharmacists, nurses, respiratory therapists) in ICUs.

3. To determine the financial value of CPOE implementation.

4. To examine the impact of prospective human factors error analysis in CPOE implementation.

http://cqpi2.engr.wisc.edu/cpoe/index.htm
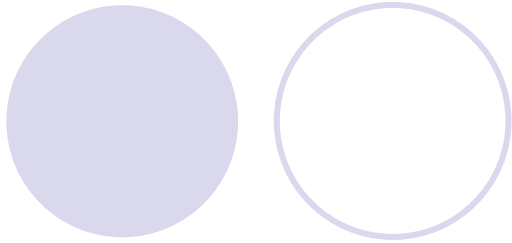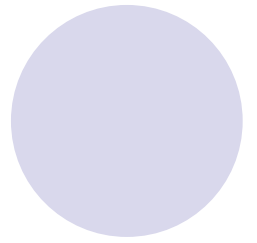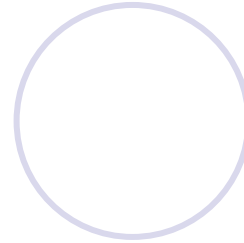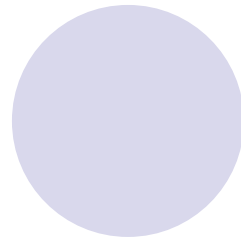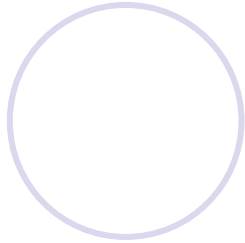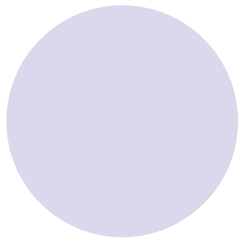
In conclusion...

178 medication incidents in 7 months

	TYPE OF INCIDENT	NO. REPORTED
1.	The *wrong patient* received or almost received a medication	36
2.	A patient received or almost received a *wrong dose* of medication	36
3.	A patient received or almost received an *extra (unordered) dose* of medication	36
4.	A patient's medicine was *omitted* or almost omitted	31
5.	A patient received or almost received the *wrong drug*	23
6.	A patient received or almost received medication at the *wrong time*	14
7.	A patient received or almost received the medicine through an *improper route*	2

Probably the first (modern) study on medication errors…

… was conducted by Alphonse Chapanis (1960).

## A CRITICAL INCIDENT STUDY OF HOSPITAL MEDICATION ERRORS
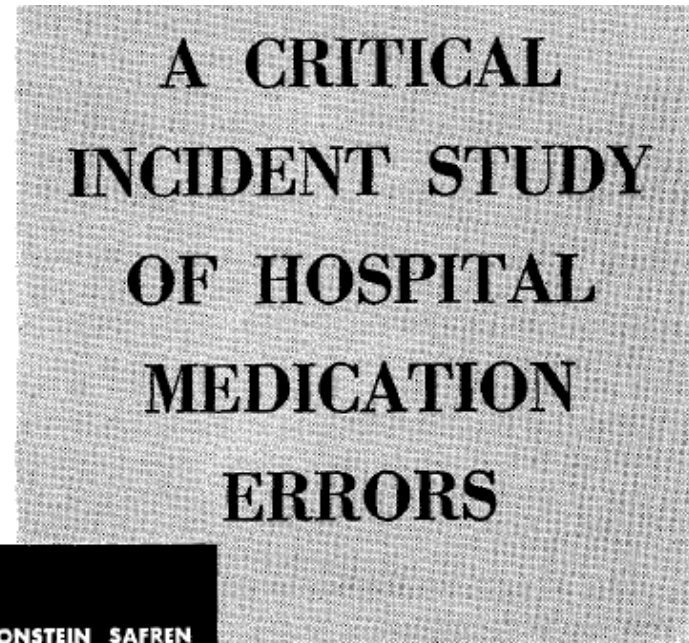
by MIRIAM ARONSTEIN SAFREN and ALPHONSE CHAPANIS, Ph.D.

In Part I of a two-part article, the authors report their study of 178 medication errors and near errors occurring in an 1100-bed hospital during a seven-month period. They discuss the critical incident technique as a method of studying the problem, previous research and its shortcomings and the major causes of errors unearthed by the study.

In Part II, which will appear in the next issue of this Journal, the authors will outline their recommendations, based on the study findings, to reduce medication errors and near errors in hospitals.

What can we do today so that 40 years from now human factors concepts and methods will have made a difference in the safety of patient care?
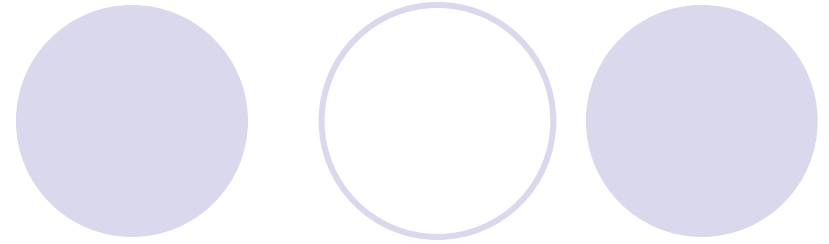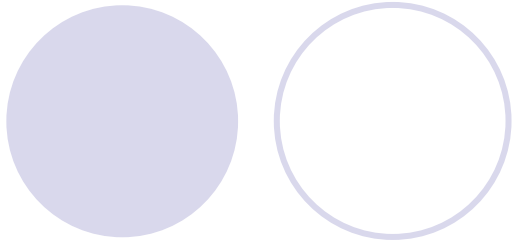
- Understanding the characteristics of health care:
  - Complexity
  - 'People' industry
  - Technology
  - Criticality
  - Variety of care settings: hospital, outpatient, home,…
- Partnership with health care
- Systemic effects or 'unintended consequences'
- Impact

Need for HFE (intervention) research…

…that will contribute to care that is:

- safe
- effective
- patient-centered
- timely
- efficient
- equitable

HFE in Healthcare Delivery
Research needs

- Major issues facing health care and patient safety:
  - Workload of healthcare providers
  - Medical errors and adverse events: identification, management, review, recovery
  - Reliability of systems, processes and technologies
  - Patient safety in a variety of settings
  - Transitions of care
  - Medical devices and healthcare information technology

Take-home messages

1. A human factors perspective can provide useful, important information on *systemic factors* that contribute *to patient safety.*

2. Need to *integrate* human factors in the *design* of healthcare technologies, systems and processes.

Lucian Leape in *Ergonomics in Design* – Summer'2004

- "Given the complexity of health care and the formidable obstacles it presents to change, to overcome those barriers and create a safe culture does indeed seem to be the ultimate challenge for those who specialize in human factors."

Muchas Gracias...

Merci...

Thank you...