IMPROVING UNDERSTANDING AND EDUCATION ABOUT TECHNOLOGY-INDUCED ERRORS AND E-SAFETY: THE UNIVERSITY OF VICTORIA PERSPECTIVE

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HEALTH INFORMATION SYSTEMS CAN REDUCE MEDICAL ERROR RATES

- In the 1990’s studies were published highlighting the number of medical errors that occur during the provision of healthcare
  - (Leape et al., 1998)

- Health information systems were identified as a possible solution

- Health information systems research found that technology could be used to reduce the number of medical errors made by health professionals
  - Physician order entry systems
  - Decision support systems
  - Pharmacy systems
  - Clinical documentation
    - (Bates et al., 1998; Kaushal et al., 2003; Smith et al., 2005; Poon et al., 2006)
HEALTH INFORMATION SYSTEMS CAN REDUCE MEDICAL ERROR RATES

- In North America policy recommendations were made to implement health information systems in physician and office settings to reduce medical error rates
  - (Institute of Medicine, 2000)
Health Information Systems Introduce New Types of Errors

In 2004 research emerged suggesting technology could facilitate medical errors

(Kushniruk et al., 2005; Koppel et al., 2005;)

Research suggested technology has the ability to:
• reduce medical errors

AND
• introduce new types of errors

Main finding: Errors can have their origins in health information systems

(Kushniruk et al., 2005; Koppel et al., 2005)
Health Information Systems Introduce New Types of Errors

Health Informatics Research documented the emergence of technology-induced errors involving health information systems...
Canadian Definition for Technology-Induced Errors?

- Technology-induced errors are those sources of error that “arise from the:
  
  (a) design and development of a technology
  (b) implementation and customization of a technology
  (c) interactions between the operation of a new technology and the new work processes that arise from a technology’s use”

  (Borycki & Kushniruk, 2008, p. 154; Borycki et al., 2012)
EFFECTS OF HEALTHCARE CONTEXT

- Healthcare is unique and therefore the technology-induced errors that arise in healthcare are unique to the healthcare setting.

  - Severity and immediacy of technology-induced errors differs from banking, aviation and nuclear power because of this **uniqueness**
  
  - *Complex context has a significant influence upon types of errors*  
    - (Borycki & Kushniruk, 2010)
NEED FOR HEALTH INFORMATION SYSTEMS SAFETY RESEARCH

- 90% of errors are system related (i.e. Blunt end errors) and 10% are human errors (i.e. Sharp end)
  - (Cavenaugh et al., 2006)
- Case has been made in the automotive, aviation and health care
- The case for technology-induced errors is present in health care
Rise in Technology-induced Errors

- As the number of health information technologies (HIT) that are used to support consumers and health professionals continues to grow so does the problem of technology-induced errors
  - (Borycki et al., 2013)
Why are Technology-induced Errors Important?

We are only beginning to explore the tip of the iceberg

(Borycki et al, 2013)
WHAT DO WE KNOW ABOUT TECHNOLOGY-INDUCED ERRORS?

- We are only just beginning to document the range of technology-induced errors that are occurring.
- Many technology-induced errors are still unknown.
- We know they have their origins in:
  - Software Design and Development
  - Human factors
  - Workflow
  - Implementation
  - Training
  - Software Maintenance

(Borycki & Kushniruk, 2008)
WHAT DO WE KNOW ABOUT TECHNOLOGY-INDUCED ERRORS?

- Future errors will involve new technologies introduced into healthcare.

- Health professionals are only just beginning to report on them – learning curve.

- Many governments are only beginning to embark on the process of developing strategy to address these types of errors.
CURRENT FOCUS: NATIONAL EFFORTS TO IMPROVE HEALTH INFORMATION SYSTEM SAFETY IN CANADA, THE UNITED STATES OF AMERICA AND ENGLAND

- For information about modern approaches from this page see the following published article for more detail:


  (Kushniruk et al., 2013)
**Why is Education Important?**

- Technology-induced errors are important as we need to:
  - understand how these errors occur within a:
    - Complex healthcare system context
    - Situational context
    - Patient context

(Borycki et al., 2013)
WHAT IS THE FOCUS OF EDUCATION?

For information about educational content from this page see the following published articles for more detail:


IDENTIFYING TECHNOLOGY-INDUCED ERRORS: SOME EXAMPLES FROM OUR WORK

- **Default** – e.g. health professional enters the correct dose, but the default auto populates the field (Kushniruk et al., 2005)

- **Display visibility problem** – e.g. cannot see that need to scroll down a menu to get right dose (result -> wrong dose entered) (Kushniruk et al., 2005)

- **Navigation problem** – e.g. cannot backtrack to screen with critical patient information (Kushniruk et al., 2004)

- **Consistency problem** - e.g. interface seems to indicate can enter data when cursor blinking, in other cases can’t (result -> data not entered in some cases) (Kushniruk et al., 1996)

- **Meaning of labels problem** – cannot access function needed due to not understanding label (result -> best practice advisory (BPA) ignored) (current work) (Li et al., 2014)
IDENTIFYING TECHNOLOGY-INDUCED ERRORS: IMPLICATIONS FOR COGNITION

- **Layout and organization** of information (on the screen) can have a profound impact upon work activities and decision making (Patel et al, 2001; Kushniruk et al., 2005)

- Health professionals could become “screen driven” (Kushniruk et. al., 1996)

- Could lead to **suboptimal diagnostic performance and error** (Kushniruk et. al., 1996)

- Influences **how information is recorded** in physician-patient interactions (Patel et. al., 2000), including **leaving out patient information**

- Some **features and functions** of user interfaces are highly associated with error (Kushniruk et. al, 2005)
Risk Management
CONTINUUM OF METHODS FOR DIAGNOSING TECHNOLOGY-INDUCED ERRORS

For information from this page see the following published articles for more detail:


Evidence-based Heuristics For Health Information Systems Safety

- For information from this page see the following published article for more detail:

(Carvalho, Borycki et al., 2009)
USABILITY ENGINEERING TO PREVENT TECHNOLOGY-INDUCED ERROR

For information about this topic, see the following published articles:


For information about the use of clinical simulations to study technology induced error see the following published papers:


CLINICAL PLUS COMPUTER BASED SIMULATION TO SUPPORT DECISION-MAKING ABOUT TECHNOLOGY-INDUCED ERROR

- Extension of computer based simulations
- Clinical simulations are used as input parameters to a computer-based simulation model

For information about this methodology see the following published article:

Reducing Technology-induced Error Before During and After Implementation

For information from this slide about how to reduce the incidence of technology-induced error see:

APPLICATION OF MULTIPLE APPROACHES TO REDUCE TECHNOLOGY-INDUCED ERRORS

- Safe Design
- Improved Procurement of Safer Health IT
- Testing and Evaluation
  - Safety Heuristics
  - Cognitive Walkthrough
  - Usability Testing
  - Clinical Simulations
  - Computer-based Simulations
  - Case Studies
- Root Cause Analysis
- Monitoring
- Management Decision Making

Using multiple approaches improves the overall safety of technology by identifying features and functions of technology that lead to errors

(Borycki & Keay, 2010)
Institute of Medicine in 2011

“To achieve better health care, a robust structure that supports learning and improving the safety of health information technology is essential. Proactive steps must be taken to ensure that health information technology is developed and implemented with safety as a primary focus”

(Institute of Medicine, 2011)
Complexity of health care has increased with the introduction of health IT
Technology is affecting diagnosis and decision-making of health professionals
Technology-induced errors need to be mitigated

(Institute of Medicine, 2015)
TRAINING AND TRAINING PROGRAMS

- Limited

- Health professionals and health information technology professionals

  - Recognition of a technology-induced error
  - Where to report
  - Participate in investigations
    - (Borycki & Keay, 2010; Borycki, 2015)
TRAINING AND TRAINING PROGRAMS

- Health Information Technology Professional
  - Safe Design and Development
  - Models to Understand Errors
  - Risk Management
    - Prevention
    - Conduct investigations
    - Training
  - Culture of Safety
  - Best Practices
    - Developed in Canada and other countries
    - International issue

(Borycki, 2015; Borycki & Keay, 2010)
TRAINING AT THE SCHOOL OF HEALTH INFORMATION SCIENCE ABOUT E-SAFETY

- School of Health Information Science
  - One of the largest and oldest health informatics schools in Canada
    - 35 years old
    - Over 900 alumni

- Programs
  - Undergraduate and Graduate courses in all aspects of health informatics to prevent and mitigate technology-induced error

- Classroom and Hands-on-training
  - Models
  - Methods
    - Coding errors
    - Usability testing, Clinical Simulations and Error Reporting Approaches
  - Risk Management
  - Managing Health Information Technology

- 2 Week Course in Health Information Technology Quality and Safety
  - May 2016
CURRENT STATE

For information about how technology is becoming safer:


(Borycki et al., 2012)
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REFERENCES


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