Misuse of Information Technology in Clinical Diagnosis and Treatment: How Many Die from Medical Mistakes?

Celik Y*

*PhD, Prof. Dr. Biruni University, Medical Faculty, Department of Biostatistics, Editor-in-Chief of the ijbcs journal, ycelik@biruni.edu.tr, GSM: +905325906032

Abstract

"**First do no harm**" is a popular saying that derives from the Latin phrase, "**primum non nocere**." The term is particularly popular amongst those involved in the field of healthcare, medicine or bioethics since it is a basic principle taught in health care providing classes. In order to provide the highest level of patient care, doctors, nurses, and other healthcare providers will rely on the professional health information technology.

According to Food and Drug Administration (FDA) data, 1.3 million patients are injured per year from medication errors.

The way to prevent mistakes is to educate students while they are in medical school, to teach non-memorizing, logic thinking, and to learn how to use both technology and technology equipment's. To learn the power of diagnostic marker needs to learn Biostatistical understanding.

Key words: Misuse, Information Technology, Clinical Diagnosis, Medical Mistakes

Introduction

"**First do no harm**" is a popular saying that derives from the Latin phrase, "**primum non nocere**." The term is particularly popular amongst those involved in the field of healthcare, medicine or bioethics since it is a basic principle taught in health care providing classes.

There are two tremendous industries that are huge and still growing: healthcare and information technology. In order to provide the highest level of patient care, doctors, nurses, and other healthcare providers will rely on the professional health information technology. The roots of modern health systems were established 7000 years ago.

The role of error can be complex. While many errors are non-OMPİLED, an error can end the life of someone with a long life expectancy or accelerate an imminent death. We have estimated that medical error is the third biggest cause of death in the US and therefore

requires greater attention. Medical error leading to patient death is under-recognized in many other countries, including the UK and Canada.

The annual list of the most common causes of death in the United States, compiled by the Centers for Disease Control and Prevention (CDC), informs public awareness and national research priorities each year. It has been reported that medical error is the third most common cause of death in the US (Fig.1) (1-3).
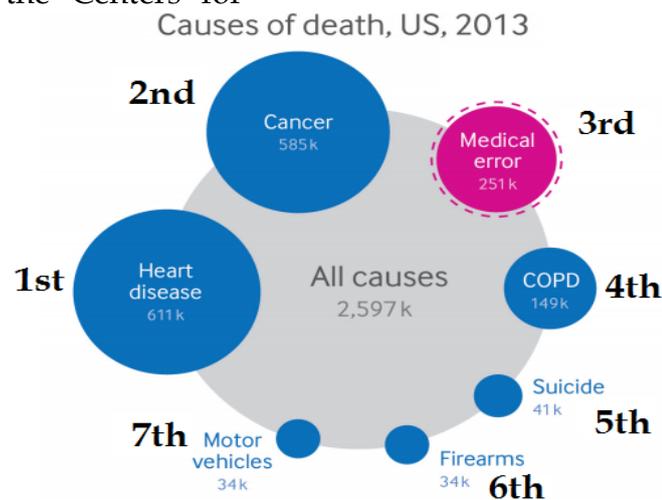

Fig 1. Most common causes of death in the United States, 2013 (2).

Human error is inevitable. Although we cannot eliminate human error, we can better measure the problem to design safer systems mitigating its frequency, visibility, and consequences. Strategies to reduce death from medical care should include three steps (4):

A) Making errors more visible when they occur so their effects can be intercepted;

B) Having remedies at hand to rescue patients and

C) Making errors less frequent by following principles that take human limitations into account (Fig. 2).
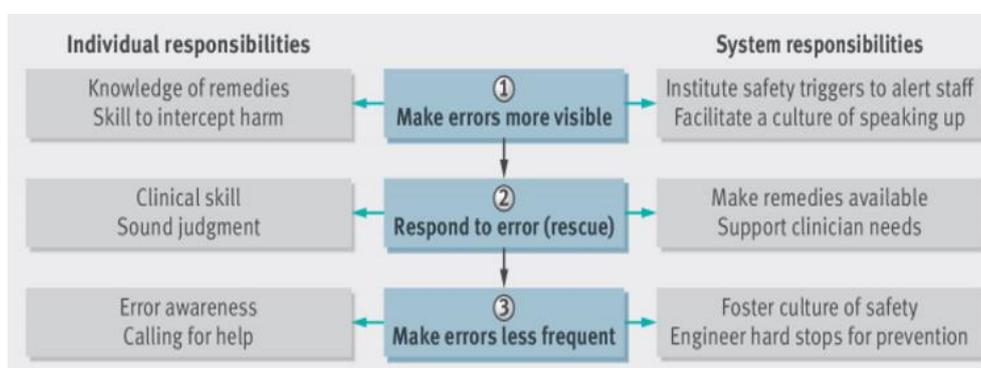
Fig 2. Model for reducing patient harm from individual and system errors in healthcare

The Epidemic of Preventable Errors Deaths was compiled from various literatures as follows (5):

• According to Food and Drug Administration (FDA) data, 1.3 million patients are injured per year from medication errors.

• One in five Americans (22%) report that they or their family member experienced a medical error.
• In Canada, reports show between 9,000 and 24,000 deaths per year because of medical errors.

• It is also reported in Canada that 1 in 13 patients admitted to an acute hospital suffered an adverse effect.

• In a report to Parliament in 2008, Britain reported 11,000 deaths per year because of medical errors.

• Fifteen thousand Medicare patients die each month in part because of hospital care including such events as bedsores, excessive bleeding from blood thinners, infections, and mis medications.

• Of the 1 million Medicare patients discharged each year, 134,000 were harmed by medical care.

• A North Carolina study in 2008 shows 25.1 per 100 patients are injured because of medical errors.

• A University of Toronto study shows 2 million adverse drug effects with 100,000 deaths per year.

• A study shows 2,000 deaths per year due to unnecessary surgery, 7,000 deaths due to medical errors, 20,000 deaths due to other medical errors, 80,000 deaths due to infections, and 106,000 deaths due to adverse effects

from medications; or 225,000 deaths per year because of hospitals; or the number 3 killer in the United States. (Note: This study is 10 years old, and now the data shows higher exposures.)

• A study by the Society of Actuaries in 2008 showed the cost of medical errors to be almost $20 billion per year, $17 billion of which went to pay for treatment of those harmed. This study estimated 7% of patients admitted will be exposed to a medical error.

• One-third of all patient admissions result in some form of medical error.

• Forty wrong-site surgeries occur every week in the United States.

• In 1999–2001, the sixth leading cause of hospital deaths in the United States was by methicillin-resistant *Staphylococcus aureus* (MRSA), costing $50 billion.

• United Kingdom a study found that 12% of all primary care patients may be affected by a prescribing or monitoring error over the course of a year, increasing to 38% in those 75 years and older and 30% in patients receiving five or more drugs during a 12-month period. Overall, 5% of prescriptions had prescribing errors (6).

• A Swedish study found a medication error rate of 42%. However, two-thirds were related to a failure to state the purpose of the treatment on prescriptions and only 1% of errors resulted in an incorrect dose (7).

• A study from Saudi Arabia reported that just under one-fifth of primary care prescriptions contained errors, but only a small minority were considered serious (8).

• Another study in Mexico observed that 58% of prescriptions contained errors, with dosage regimen accounting for most cases (27.6%) (9).

These examples are provided to show that medication errors are a global issue.

The reasons could be ordered as follows (5):
1. "for-profit care,"
2. Hierarchies in human relationship systems (bullying),
3. Overreliance on technologies, stress,
4. Health-care working conditions,
5. Staffing,
6. Legal issues that conflict with safety issues, and cost–benefit issues that put safety on the negative side (spending side), rejecting the savings side of the equation, all of which are directly related to medical errors and/or hospital-acquired infections (HAIs).

The acquisition of knowledge and the mastering and use of rules of evidence-based critical reasoning and

decision making must be a part of a new physician's knowledge, attitudes, and skills. The virtue of the best medicine is not only producing, evaluating, and using the best evidence and modern technologies but also flawlessly finding, evaluating, and using them in the daily life of a physician. This is one of the fundamental ways to avoid errors in medicine. As a matter of fact, the error-free practice of medicine is an important warrant of its success and the overall quality of medical care (10).

Groopman, reminds us that the majority of errors are due to flaws in a physician's thinking, not technical mistakes. Propaedeutics in medical reasoning and decision making should avoid the former. Traditional propaedeutics focuses mainly on the latter (11).

Slotnick, reminds us that "cognitive dimensions encompass what one knows, thinks, and thinks about thinking, knowledge, experience, and insights derived from experience. All of these are essential in helping physicians-in-training and practicing physicians to become progressively more skilful at solving problems …." One wonders if this is a part of the theory of medicine or of its practice. It is probably a part of both (12).

Good clinical judgment has always been an ideal aspired to by everyone in clinical care, and patients expect it from their physicians, nurses, and other health professionals (13).

Clinical judgment means "the application of information, based on actual observation of a patient combined with subjective and objective data that lead to a conclusion." In the world of informatics in medicine, it is "a framework in which brilliant pieces of understanding are routinely assembled into a working unit of social machinery that is coherent and as error free as possible." (114).

Exact information, reality without error, is the ideal and the basis for the deterministic paradigm of medicine. All clinical decisions are and will be made with a variable degree of uncertainty depending on a variable probability of events and outcomes. Neglecting those leads often to medical error and medical harm (15).

Reasoning, deciding, or acting poorly can lead to **medical errors and harm**. **Medical error** may be defined then as an individual and/or system failure resulting from human behavior made by a health professional who, in a health establishment or community setting, provides direct clinical or community care, acts, or services (e.g., operating surgeon, prescribing internist, consulting psychiatrist, nurse at floors or in a surgical or office setting). It may be knowledge-based, rule-based, or skill (execution)-based and often (but not always) produces medical harm. These two entities, however, must not be confounded. **Medical harm** is a temporary or

permanent physical impairment in body functions (including sensory functions, mental functioning, social and occupational functioning, pain, disease, injury, disability, death) and structures and suffering that disrupts a patient's physical, mental, and/or social well-being. Some errors result in medical harm, but many errors do not. Conversely, many incidents of medical harm are not the results of any errors (16).

Medical error, therefore, is a reasoning- and decision making–based inaccurate or incomplete assessment and management of patient risks and diagnosis, choosing and executing radical or conservative treatment, making prognosis, and extending and widening patient and community care. Such faults fall into the category of fallacies, biases, and cognitive errors. Absence of errors and harm in medical practice is an important warrant of patient safety and quality of clinical and community health care (17). Medical errors are preventable. Understanding and improving medical decision making is one way to make the "epidemiology of medical errors" easier (18).

Failures in communication anywhere in multistage process may be behind numerous cases of medical error and harm (15).

ECRI Institute is providing abridged version of its 2016 Top 10 list of health technology hazards as a free public service to inform healthcare facilities about important safety issues involving the use of medical devices and systems (19). The list for 2016 is as follows:

1. Inadequate Cleaning of Flexible Endoscopes before Disinfection Can Spread Deadly Pathogens
2. Missed Alarms Can Have Fatal Consequences
3. Failure to Effectively Monitor Postoperative Patients for Opioid-Induced Respiratory Depression Can Lead to Brain Injury or Death
4. Inadequate Surveillance of Monitored Patients in a Telemetry Setting May Put Patients at Risk
5. Insufficient Training of Clinicians on Operating Room Technologies Puts Patients at Increased Risk of Harm
6. Errors Arise When a health IT (HIT) Configurations and Facility Workflow Do Not Support Each Other
7. Unsafe Injection Practices Expose Patients to Infectious Agents
8. Gamma Camera Mechanical Failures Can Lead to Serious Injury or Death
9. Failure to Appropriately Operate Intensive Care Ventilators Can Result in Preventable Ventilator-Induced Lung Injuries
10. Misuse of USB Ports Can Cause Medical Devices to Malfunction

Following topics summarize some of the key factors associated with medication errors, including the provider, patient, care team, work environment, task, computer system and the primary-secondary care interface (6,20):

Factors associated with health care professionals:
- Lack of therapeutic training
- Inadequate drug knowledge and experience
- Inadequate knowledge of the patient
- Inadequate perception of risk
- Overworked or fatigued health care professionals
- Physical and emotional health issues
- Poor communication between health care professional and with patients

Factors associated with patients:
- Patient characteristics (e.g., personality, literacy and language barriers)
- Complexity of clinical case, including multiple health conditions, polypharmacy and high-risk medications

Factors associated with the work environment
- Workload and time pressures
- Distractions and interruptions (by both primary care staff and patients)
- Lack of standardized protocols and procedures
- Insufficient resources
- Issues with the physical work environment (e.g., lighting, temperature and ventilation)

Factors associated with medicines

- Naming of medicines
- Labelling and packaging

Factors associated with tasks
- Repetitive systems for ordering, processing and authorization
- Patient monitoring (dependent on practice, patient, other health care settings, prescriber)

Factors associated with computerized information systems

- Difficult processes for generating first prescriptions (e.g. drug pick lists, default dose regimens and missed alerts)
- Difficult processes for generating correct repeat prescriptions
- Lack of accuracy of patient records
- Inadequate design that allows for human error Primary-secondary care interface
- Limited quality of communication with secondary care
- Little justification of secondary care recommendations

A Reducing medication errors and improving medication safety requires a systems approach.

According to the report of WHO (21); reducing medication errors and improving medication safety requires a systems approach. Potential solutions were reported as follows topics:

1. Medication reviews and reconciliation: Medication review is a

process of patients` medicines evaluation in order to improve the health outcomes and mitigate the drug-related problems. A systematic review of 38 studies of primary care interventions designed to reduce medication related adverse events found that most successful interventions included a medication review conducted by a pharmacist or other clinicians, or focused on multicomponent interventions, which had a medication review by a primary care professional as one component. Studies showed that pharmacist-led medication reviews reduced hospital admissions (22, 23).

2. Automated information systems: A review of 10 randomized trials of computerized interventions found a reduction in medication errors in half of the studies (24).

3. Education: A review of 47 studies found that educational interventions to improve the prescription and dispensing of antibiotics may impact on clinician behavior with improved adherence to guidelines (25).

4.Multicomponent interventions:

Many studies include more than one intervention. Evidence supports the use of multifaceted approaches for improving medication practices. In a review of 10 studies on improving the appropriateness of polypharmacy in the elderly, nine studies involved

complex interventions (the remaining one employed computer decision support). Overall, there were reductions in inappropriate prescribing and the number of adverse drug events (26).

Lieber outlines six additional strategies hospitals and physicians could adopt to make a big difference for reducing medical errors. Practical, common sense, effective ways to prevent medical mistakes, reduce deaths, and lengthen lives. (27):

1. **One of the biggest contributors to serious medical errors is miscommunication among staff during shift changes.**

2. **Pharmacists must directly participated in patient treatment.** Adding pharmacists into the mix for doctors and nurses to make the rounds with patients together. That way, doctors can get direct information about how different drugs may adversely affect patients' conditions – and which ones they should prescribe instead. Pharmacists may also be able to more easily catch mistakes involving medication, such as ordering the wrong dosage or drug for a patient.

3. **Infections must be reduced.** Hospital-acquired infections are some of the most dangerous complications patients experience during their hospital stays. Germs must be blocked out from spreading, hospitals must be vigilant about following the guidelines for disinfecting patient rooms, surgical

tools, labs and other areas. Facilities must also make sure staff are following best practices for hand hygiene.

4. **It must be avoided from diagnostic error**. It has been suggested that diagnosing patients should involve the entire care team, from physicians to radiologists. If each person uses his or her expertise effectively, and isn't afraid to speak up if he or she sees any inconsistencies, diagnoses will be more accurate.

5. **Make electronic health records (EHR) systems more interoperable.**

6. **All Medical Errors must be reported.** There are two big debates about the reporting of medical errors. One is whether to make reporting mandatory or voluntary. The other is whether to report all medical errors or merely the most serious ones.

We live not only in a world of uncertainties, probabilities, wrong, missing, and almost never complete but required information. We also live in a world of errors, which may lead to harm to patients. Our mistakes in reasoning, decision making, and communication should not contribute to such often dramatic events for patients and their physicians. We must think as correctly as possible.

To achieve more reliable healthcare systems, the science of improving safety should benefit from sharing data nationally and internationally.

References

1. Moriyama IM, Loy RM, Robb-Smith AHT, et al. History of the statistical classification of diseases and causes of death. National Center for Health Statistics, 2011.
2. Deaths: final data for 2013. National vital statistics report. http://www.cdc.gov/nchs/fastats/ leading-causes-of-death.htm
3. Makary MA, Daniel M. Medical error— the third leading cause of death in the US *BMJ* 2016; 353 doi: https://doi.org/10.1136/bmj.i2139 (Published 03 May 2016) Cite this as: BMJ 2016;353:i2139
4. Ghaferi AA, Birkmeyer JD, Dimick JB. Complications, failure to rescue, and mortality with major inpatient surgery in Medicare patients. Ann Surg 2009;250:1029-34. doi:10.1097/ SLA.0b013e3181bef697 pmid:19953723.
5. Epidemic of Medical Errors and Hospital Acquired Infections, CRC Press is an imprint of theTaylor & Francis Group, an informa business Boca Raton London New York-Edited by William Charney, 2012
6. Avery A, Barber N, Ghaleb M, Franklin BD, Armstrong S, Crowe S, et al. Investigating the prevalence and causes of prescribing errors in general practice: the PRACtICe study. London: General Medical Council; 2012.
7. Claesson CB, Burman K, Nilsson JLG, Vinge E. Prescription errors detected by Swedish pharmacists. Int J Pharm Pract. 1995;3:151-6.

8. Khoja T, Neyaz Y, Qureshi NA, Magzoub MA, Haycox A, Walley T. Medication errors in primary care in Riyadh City, Saudi Arabia. East Mediterr Health J. 2011;17:156-9.

9. Zavaleta-Bustos, Miriam, Lucila Isabel Castro-Pastrana, Ivette Reyes-Hernández, Maria Argelia López-Luna, and Isis Beatriz Bermúdez-Camps. Prescription Errors in a Primary Care University Unit: Urgency of Pharmaceutical Care in Mexico. Revista Brasileira De Ciências Farmacêuticas Rev. Bras. Cienc. Farm2008;44:115-25.

10. Jenicek M. A Primer on Clinical Experience in Medicine. Taylor & Francis Group, 2013

11. Groopman J. How Doctors Think. New York: Houghton Mifflin Company, 2007.

12. Slotnick HB. How doctors learn: Education and learning across the medical school-to-practice trajectory. Acad Med, 2001;76(10):1013–26.

13. White S, Stancombe J. Clinical Judgment in the Health and Welfare Professions. Extending the Evidence Base. Maidenhead/Philadelphia: Open University Press/McGraw-Hill Education, 2003.

14. Mosby's Medical Dictionary. Eighth Edition. St. Louis, MO: Mosby, Inc., 2009

15.Jenicek M. Medical Error and Harm. Understanding, Prevention, and Control. Boca Raton/London/New York: CRC Press/Taylor & Francis/Productivity Press, 2011.

16. Institute of Medicine, Committee on Quality of Health Care in America. To Err Is Human. Building a Safer Health System. Edited by LT Kohn, JM Corrigan, and MS Donaldson. Washington, DC: National Academy Press, 2000.

17.Dowden B. The Internet Encyclopedia of Philosophy. Fallacies. 44 pages at http://www.iep.utm.edu/f/fallacy.htm, retrieved October 31, 2006.

18. Jenicek M. Medical Error and Harm. Understanding, Prevention, and Control. Boca Raton/London/New York: CRC Press/Taylor & Francis, 2011.

19. Top 10 Health Technology Hazards for 2016 A Report from Health Devices November. ECRI Institute 2015. www.ecri.org/2016hazards

20. Slight SP, Howard R, Ghaleb M, Barber N, Franklin BD, Avery AJ. The causes of prescribing errors in English general practices: a qualitative study. Br J Gen Pract. 2013;63:e713-20.

21. Medication Errors: Technical Series on Safer Primary Care, World Health Organization, 2016

22. Pharmaceutical Care Network Europe. Medication review definition approved. 2016 (http://www.pcne.org/news/35/medication-review-definition-approved, accessed 19 September 2016).

23. Royal S, Smeaton L, Avery AJ, Hurwitz B, Sheikh A. Interventions in primary care to reduce medication related adverse events and hospital admissions: systematic review and meta-analysis. Qual Saf Health Care. 2006;15:23-31.

24. Lainer M, Mann E, Sönnichsen A. Information technology interventions to improve medication safety in primary care: a systematic review. Int J Qual Health Care. 2013;25:590-8.

25. Roque F, Herdeiro MT, Soares S, Teixeira Rodrigues A, Breitenfeld L, et al. Educational interventions to improve prescription and dispensing of antibiotics:

a systematic review. BMC Public Health. 2014;14:1276.

26. Patterson SM, Hughes C, Kerse N, Cardwell CR, Bradley MC. Interventions to improve the appropriate use of polypharmacy for older people. Cochrane Database Syst Rev. 2012;5:CD008165.

27. Lieber JB. Killer Care: How Medical Error Became America's Third Largest Cause of Death, And What Can Be Done About It . 2015.