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Safety of Automation Technologies in Healthcare

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Over 10 years ago, the Institute of Medicine (IOM) released "To Err is Human" [1], a now oft-quoted report on the outcome of errors that occurred secondary to healthcare provided in United States hospitals. At the time of the report in 2000, nearly 100,000 people were estimated to die each year due to in-hospital errors, over 10 times the average number of people who died from aviation-related accidents [2]. Although systems, safety, human factors, ergonomics, and other engineering methods have long been available for application to healthcare system improvements efforts, another IOM report in 2006 "Building a Better Delivery System" [3] noted that systems engineering and the healthcare disciplines had only joined forces in a sporadic manner. For this reason, publications such as the Journal of Ergonomics are welcome additions to the literature, providing an opportunity for multi-disciplinary discussions regarding best practices in development and evaluation of new and existing healthcare automation-based technologies.

As automation and information technology systems have been developed with the goal of providing safer health care with better outcomes, other problems have arisen relative to our ability to use and apply technology safely in the patient care arena. The medication use process (prescribing/ordering, transcription, preparation/dispensing, and administration to end user) has been subject to a science and technology explosion over the past 30-40 years not only with drug products themselves, but also relative to automation-based devices than can impact each phase of the process. Bates et al. [4] estimated that the majority of adverse drug events (ADEs) occurred during the ordering (56%) and administration (34%) phases, and millions of dollars have been spent devising automated systems for each step of the process that will outwit human propensity for error. However, we understand little more of how to circumvent healthcare-related errors than we did over a decade ago [5].

Safety engineering evaluation methods such as Root Cause Analysis (RCA) and Failure Modes and Effects Analysis (FMEA) have been applied to healthcare settings in order to better understand the systems in which and reasons why errors occur. Of greater concern is that these tools are applied after the fact when an error is recognized as having occurred and serious consequences have potentially resulted ("tip of the iceberg" events). Although preventive measures can perhaps be designed into systems to allow more effective identification of errors prior to their occurrence, what we cannot identify as leading to a less than optimal healthcare outcome or even death should be priority #1. The Institute for Healthcare Improvement (www.ihi.org) has promoted use of its "Global Trigger Tool" [6] in order to identify adverse medical events that were neither reported nor detected post occurrence. A recent evaluation by Classen et al. [7], estimated that the IHI "Global Trigger Tool" could potentially identify 90 percent more adverse medical events from billing records than other available detection tools. Although useful and certainly important, events identified after they have occurred allow little advantage from an error prevention perspective.

Since medications are responsible for a large number of adverse medical events, how might we make better preemptory strikes to prevent errors in the first place? As examples, medical informatics systems including electronic medical records and computerized prescriber order entry (for prescribing/ordering and record maintenance), automated dispensing and compounding machines (for dispensing), and medication (and patient) bar coding, sophisticated drug administration devices such as "smart pumps" and other combination drug-administration devices (for end user administration), have all been created and implemented with the intent of making patient care safer. However, with technology meant to ultimately reduce medication use process errors, the potential to exchange one type of error for another is also possible. Work-arounds used by health professional to circumvent automation processes that are inconsistent with work flow can also lead to new types of errors that may be unrecognizable at the time of occurrence. Few controlled, generalizable, technology-focused safety studies have been performed, and health professionals continue to struggle with application and usage issues. Future developments in drug delivery systems and processes may impact safety in a positive manner, yet safety will be difficult to demonstrate without consistent evaluative methods such as those widely used in the human factors and ergonomics engineering disciplines.

In this light, technology that serves the health professions well should also serve patients and society well to assure the safe application of drug therapy and medical care to disease treatment. Systems, ergonomics, and human factors engineering evaluative tools and principles have been successfully applied in other high-risk industries, and their application to healthcare-related processes and systems will continue to be a welcome partnership of disciplines and professionals in the reduction of error-prone incidents and practices in healthcare.

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