The 160-Pound Computer That Can Be Mass-Produced by Unskilled Labor

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After three years of training, John Glenn rocketed into space aboard the Mercury capsule Friendship 7. He became the third American in space and the first to orbit Earth. The historical flight was no easy feat. At the end of his first orbit, a yaw attitude jet clogged, forcing Glenn to abandon the automatic control system and use the manual electrical fly-by-wire system.[1]

Astronaut Glenn's landmark flight took place in 1962, supported by then state-of-the-art technology. Plans for the flight took into account the possibility that system components could fail or malfunction, with catastrophic results, so backup strategies addressed the need for a manual control system.[2] In fact, although the historical flight overall was a resounding success, some components of the spacecraft did not function properly,[1] requiring Glenn's knowledge and skills.

In accounts of the postflight debriefing, Scott Crossfield, a test pilot and aeronautical engineer,[3] asked, "Where else would you get a non-linear computer weighing only 160 pounds, having a billion binary decision elements, that can be mass-produced by unskilled labor?"[4] His recognition of the important capabilities of humans is relevant to our understanding of processes that support safer healthcare.

In working toward safer healthcare, we seek causes for outcomes that are perceived as unsafe or are thought to be less satisfactory than might have been expected. Various investigative processes may be used, such as root-cause analysis.[5] It can be tempting, and may be a fundamental psychological tendency (e.g., hindsight bias) as well as an industry norm, to try to identify the action (or inaction) of a person as a cause for an unsatisfactory outcome, despite teachings to the contrary.[6] Although many of the healthcare conditions we treat are biologic and not man-made, all of the healthcare delivery systems that we work within have been created by humans. If they fail, or do not succeed sufficiently, and we search for what we think may be a cause, we are bound to find a human:

> The search for a human in the path of a failure is bound to succeed. If not found directly at the sharp end—as a "human error" or unsafe act—it can usually be found a few steps back. The assumption that humans have failed therefore always vindicates itself.[7]

Sometimes we are reminded that "to err is human,"[8] or even "to err is human—and let's not forget it."[9] Indeed, humans do make errors, and according to the Institute of Medicine (IOM), one of the greatest contributors to accidents in healthcare is human error.[8] However, IOM, Lucian Leape, and others explain that human errors are often induced by system failures.[8,10]

It is also humans who solve problems and rescue patients, humans who figure out compensatory strategies when expected resources are not available or do not function as expected or when novel circumstances arise. People working in healthcare are among the most educated and dedicated workforce in any industry.[8] Rollin J. (Terry) Fairbanks asserts that "to better is human"[11] and Richard Holden states that "to blame is human, but the fix is to engineer."[6] Safety is not inherent in systems. The systems themselves are contradictions among multiple goals that people must pursue simultaneously. People create safety.[6]

Computers and other technologies have improved the safety and capabilities of healthcare, just as they have improved the safety and capabilities of aeronautics. The contributions of technology are integral and essential in healthcare delivery. However, when our protocols are insufficient for the tasks at hand and our technologies

malfunction, it is the human element that we rely on to adapt, just as the human capabilities of John Glenn ensured the success of the Friendship mission. When caring for patients within our complex healthcare delivery systems, there are many aspects of care that can and should be standardized and computerized, but the unique skills, knowledge, and even compassion of this special type of 160-pound computer remain essential.

NOTES

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10. Leape L. Cultivating and sustaining respectful behavior. Keynote presentation at: 17th Annual NPSF Patient Safety Congress; 2015 Apr 30; San Antonio (TX).

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