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## Crisis in Medical Care: Spotlight Children's Hospital Boston

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The cases at Children's Hospital Boston making headlines last week, and the heart-lung transplant case at Duke University Medical Center profiled earlier this year, illustrate, yet do not capture a pervasive healthcare crisis. The Institute of Medicine estimates that 50,000 deaths annually in the U.S. may be attributable to medical error. When we analyze these events, we see that unnecessary deaths and injuries are rarely due to a single failure by a single provider. Instead, they originate in, or are allowed to progress because of systemic failures in communication, coordination, and role allocation. Traditionally, response to adverse events has been reactionary, focusing on removal or reprimand of an individual provider, piece of equipment, procedure, institution and even patient. While we may be tempted to sanction individuals in the wake of these tragic events, more durable solutions lie in fixing the 'system.' As a first step, we need to identify what aspects of the system contribute to global failure, and proceed from there.

The care of a hospitalized patient is very complex, not only in terms of the specific tasks or procedures, but also in terms of the increasing dependence on technology, the human-technology-interface, and a large and interdependent network of physicians, trainees, nurses, pharmacists, technicians, and other support staff. At the most basic level, what we have learned from the study of other complex, networked systems (there is now a

scientific discipline that studies complex systems), and what is surely true of complex clinical systems, is that the behavior or outcome (good or bad) is not simply the sum of the parts. This has the following important, and sometimes surprising implications. First, highly qualified individual providers, each of whom performs 'their' patient task correctly, may still fail the patient if efforts are not coordinated and decisions not shared. Second, in complex systems, there is not a single mode of success or failure. Repair or revision of one particular component of the system (i.e., fixing a perceived 'defect') may not achieve durable improvements in safety. The great variety of different circumstances that can arise in these complex settings, and the great variety of actions that can be taken in response, are guaranteed to present new opportunities for failure, paradoxically generated by the repair. This is also why efforts to specify and constrain the behavior of the system by strict rules and regulations can be counterproductive. Since effective response varies tremendously from case to case, the more restrictions we place, potentially the worse the system performs. Finally, complexity does not necessarily mean vulnerability. Many large networked systems demonstrate increased resilience and capacity to adapt or compensate for unexpected local failures. With integrated decision-making, interventions and information use, performance of the system, as a whole, can far exceed the cumulative skills of the individual providers.

The solution to the problems that we face today starts with understanding how systems of people work together. When interactions, communication, decision-making and interventions are not appropriately coordinated across these provider networks, problems arise. Major and life-threatening deficiencies in these areas can be traced, in part, to the way that physicians (to a much lesser extent nurses and allied health professionals) are educated. Conventional curricula and values continue to emphasize the individual patient-provider model of care, with very little education or training in how strongly this dyad is influenced by (and strongly dependent on) a much larger and complex system of care. Recognizing this, the American Council for Graduate Medical Education established new guidelines this year that include "systems-based practice" as one of six components, along with "communication skills" and "practice-based learning." Educational programs that help healthcare providers understand how being part of an effective team is different from being individually competent are a crucial step forward.

From the study of other complex systems, we know more than ever before about what can make them function safely and effectively. We can identify relationships between system structure and tasks to be performed, and describe the process by which such complex systems are formed. Applying this knowledge to healthcare to identify system vulnerabilities as well as strengths, we can develop sound interventions to improve system effectiveness. Most importantly, the analysis of system-based errors suggests that reasonable interventions can have dramatic effect on reduction, even elimination of tragic errors.