

Studying the Technical Work of Emergency Care

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Several years ago, a modest effort was begun to simultaneously explore the difficulties and promote the benefits of what has come to be called “technical work studies” in health care.¹⁻³ The initiative stemmed from a rich European research tradition of work ecology studies that was imported to the United States in the aftermath of Three Mile Island. Its proponents contended that a multidisciplinary, collaborative study of the details of how clinicians plan and manage their work⁴ could usefully inform efforts to improve safety, quality, and performance in health care in ways that more familiar research efforts have not.

Health care is a complex domain, resulting from the variety of human physiology, the variety of illness and injury, the historical primacy of health care work as a human activity, the explosion of biotechnology and medical knowledge, and the sheer scale of the endeavor (one sixth of the US domestic economy). This complexity has been a particular challenge to those who use traditional, reductionist research methods. To cope with this complexity, these methods either bound it out by narrowly circumscribing the field of inquiry or average it out to avoid getting lost in the details. Although the bounding and averaging approaches have their value, only immersion in the messy details of the clinical work setting can reveal the regularities of cognitive work. Therefore, in contrast to the reigning paradigm that tries to avoid or eliminate the details, technical work studies instead take messy details themselves as the object of study. This enables technical work studies to distinguish between 2 views of work: “work as imagined,” which includes the orderly, algorithmic plans that we develop ostensibly to guide our work, as well as the orderly, algorithmic accounts we develop to justify it after the fact; and “work as performed,” which includes the starts and fits, restarts, blind alleys, workarounds, and adaptations that make it possible for something useful to be accomplished.⁵

Clinical work in the emergency department (ED) would seem both an ideally suited and a particularly challenging subject for technical work studies. The ED work setting is a

swarm of activity, data, and issues that ebb and flow in number and increase and decrease in importance through each shift. As in other acute care settings, emergency care is collaborative, complex, high-hazard, high-tempo work. Although some cognitive activity in these settings is directed at the semantics of the domain such as the pathophysiologies of illness and injury, the majority is directed towards its messy details. This includes the anticipation of future requirements, prediction and resolution of deadlocks, reaction to evolving situations, revision of priorities, coordination or reallocation of resources, and (above all) knowledge of how to get things done quickly. These efforts are applied at both the individual (patient) and the collective (unit) levels. This planning and management of care is a core part of technical work, and it is interwoven with the provision of care.

The study of technical work is difficult because it requires unraveling these factors. To succeed, researchers must know a great deal about a narrow domain and understand all of the dependencies, contingencies, and uncertainties that offer and limit opportunities for action. They must also know a great deal about the nature of human performance in complex, contingent, uncertain, and hazardous settings. Because few individuals excel at both, deep and sustained collaborations are necessary between clinical and human performance experts.

The cognitive elements of technical work can be discovered only empirically by the examination of work when and where it is performed.⁶ Studies of technical work deliberately search for workplace complexities, conflicts, and uncertainties and examine how workers cope with them. These observations expose the judgments and strategies that workers use and suggest the ways in which these approaches are robust or vulnerable. They also point to cases that can be used in laboratory settings to learn more about worker cognition. For example, field observations of clinicians’ difficulties with infusion pumps have suggested that the devices were difficult to understand. Subsequent human factors analyses of pump programming in the laboratory demonstrated that deficiencies in the pumps’ control-display interfaces were the primary source of the problem.⁷ This grounding of the understanding of actual work through technical work studies can protect the health care community from one of its characteristic afflictions, which Kneebone⁸ describes as the “magpie syndrome”: picking up

glittering ideas while remaining ignorant of the philosophies that underpin them and thus being unable to use them effectively to achieve anything of value.

This issue of *Annals* presents 7 articles that represent an initial foray into the study of technical work in the ED. Although there are a few notable predecessors,⁹⁻¹¹ we believe this is the first *set* of such studies in the ED. Thus, they serve as a datum, or starting point, that demonstrates how to conduct methodologically sound, balanced, insightful studies that are well considered and executed. They show how collaboration between human factors and medical professionals generates insights that would otherwise be unavailable and form the beginnings of a durable foundation of knowledge that will eventually serve as the basis for improvements in ED safety.

When there is so much to examine in the ED work domain, what do studies in technical work pay attention to? This set of articles provides us with some insight into what matters in this domain: clinician workload,¹² learning technique,¹³ equipment,^{14,15} and communications.¹⁶⁻¹⁸

The articles explore workflow issues¹² and how the distribution of workload affects a unit's ability to perform. They account for how the simple presence of equipment can influence clinicians' medication choices¹⁴ and how equipment usability and reliability issues affect successful performance of critical tasks.¹⁷ They present evidence for the use of video as a teaching, research, and documentation method for emergency care.¹³ They probe communication patterns to obtain a finer-grained sense of their content and composition,¹⁸ to suggest how technologic solutions might be developed to support it,¹⁷ and explore how physical artifacts can be used to manage it effectively.¹⁶

Studying technical work in health care is difficult for a number of reasons. The knowledge that is necessary to operate on the front lines is dense and understood by very few outside of a field of practice. Equipment and procedures are not assembled beforehand in standard configurations that are amenable to leisurely study but are brought together ad hoc, just in time, to adapt to the unique needs of patients and the preferences of clinicians. As independent professionals, clinicians affiliate in tightly knit workgroups that resist scrutiny by others and have well-developed masks that they present to "outsiders." In addition, these groups often maintain a tense coexistence, and their conflicting agendas can cause the role of unwitting researchers who work in their midst to be misinterpreted or misunderstood.

The high operations tempo and apparent chaos of the ED can be overwhelming to observers without long experience in the domain. Such a visitor can also easily be misled by apparently smooth-running operations. Those who have learned to look beneath the surface can detect the initiatives clinicians constantly take to plan ahead, recognize problems, develop strategies, make tradeoffs among goals, and adapt to the unexpected.¹⁹ These adaptations are so routine that clinicians

take them for granted,²⁰ a phenomenon that has been called "learned intuition."

Finally, these studies face major procedural difficulties. Institutional review boards are confused by unfamiliar methods they have not previously encountered. The studies can raise confusing ethical and regulatory issues that are not easily resolvable, especially in the abstract, such as who is a subject, how collectives such as the ED staff on a given shift can or should consent (or not) to observation, and the extent to which patients are involved.

It takes repeated and deep examination of technical work to develop insight. The longer one stays with such studies, the easier it is to know what to look for. Technical work studies make the messy details visible and possibly amenable to intervention. We hope this early look at technical work in the ED begins a process that will, through time, lead to improvements based on authentic insight into actual work.

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REFERENCES

1. Cook RI, Woods DD. The messy details: insights from technical work studies in health care. In: *Proceedings of the Human Factors and Ergonomics Society 47th Annual Meeting*. Denver, CO: Human Factors and Ergonomics Society; 2003:379-380.
2. Nemeth CP, Cook RI, Woods DD. The messy details: insights from the study of technical work in health care. *IEEE Trans Syst Man Cybernet A Syst Hum*. 2004;34:689-692.
3. Cook RI, Nemeth CP, Brandwijk M. Technical work studies: understanding human work amidst complexity, uncertainty, and conflict. Paper presented at: AHRQ 3rd Annual Patient Safety Research Conference; Arlington, VA; March 8, 2004. http://www.ctlab.org/documents/TechnicalWorkStudies_Mar04.pdf. Accessed November 7, 2005.
4. Barley SR, Orr JE, eds. *Between Craft and Science: Technical Work Studies in US Settings*. Ithaca, NY: Cornell University Press; 1997.
5. Wears R, Perry S, Wilson S, et al. Emergency department status boards: user-evolved artefacts for inter- and intra-group coordination. *Cognit Technol Work*. 2007;9:163-170.
6. Hutchins E. *Cognition in the Wild*. Cambridge, MA: MIT Press; 1996.
7. Nunnally M, Nemeth CP, Brunetti V, et al. Lost in menospace: user interactions with complex medical devices. *IEEE Trans Syst Man Cybernet A*. 2004;34:736-742.

8. Kneebone RL. Crossing the line: simulation and boundary areas. *Simul Healthcare*. 2006;1:160-163.
9. Chisholm CD, Collison EK, Nelson DR, et al. Emergency department work place interruptions: are emergency physicians multi-tasking or interrupt driven? *Acad Emerg Med*. 2000;7:1239-1243.
10. Chisholm CD, Dornfeld A, Nelson D, et al. Work interrupted: a comparison of workplace interruptions in emergency departments and primary care offices. *Ann Emerg Med*. 2001;38:146-151.
11. Coiera EW, Jayasuriya RA, Hardy J, et al. Communication loads on clinical staff in the emergency department. *Med J Aust*. 2002; 176:415-418.
12. Levin S, Aronsky D, Hemphill R, et al. Shifting toward balance: measuring the distribution of workload among emergency physician teams. *Ann Emerg Med*. 2007;50:419-423.
13. Mackenzie CF, Xiao Y, Hu F-M, et al. Video as a tool for improving intubation tasks for emergency medical and trauma care. *Ann Emerg Med*. 2007; 50:436-442.
14. Connors GP, Hays DP. Emergency department drug orders: does drug storage location make a difference? *Ann Emerg Med*. 2007; 50:414-418.
15. Fairbanks RJ, Caplan SH, Bishop PA, et al. Usability study of two common defibrillators reveals hazards. *Ann Emerg Med*. 2007;50:424-432.
16. Xiao Y, Schenkel S, Faraj S, et al. What whiteboards in a trauma center operating suite can teach us about emergency department communication. *Ann Emerg Med*. 2007;50:387-395.
17. Fairbanks RJ, Bisantz AM, Sunm M. Emergency department communication links and patterns. *Ann Emerg Med*. 2007;50: 396-406.
18. Woloshynowych M, Davis R, Brown R, et al. Communication patterns in a UK emergency department. *Ann Emerg Med*. 2007;50:407-413.
19. Woods DD, Hollnagel E. *Joint Cognitive Systems: Patterns in Cognitive Systems Engineering*. Boca Raton, FL: CRC Press/Taylor & Francis Group; 2006.
20. Cook RI, Woods DD. Operating at the sharp end: the complexity of human error. In: Bogner MS, ed. *Human Error in Medicine*. Hillsdale, NJ: Lawrence Erlbaum Associates; 1994: 255-310.

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