



INNOVATING EMERGENCY NURSING TOOLS AND TECHNOLOGY: WORK DESIGN FOR QUALITY AND PATIENT SAFETY



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“We can choose a technological solution to the profound humane disconnection that exists today in healthcare; a more humane medicine, enabled by machine support, can be the path forward.”¹(p.309)

In the book *Deep Medicine, How Artificial Intelligence Can Make Healthcare Human Again*, author Eric Topol delivers a futuristic glimpse of the optimistic possibilities that artificial intelligence technology might add to everyday healthcare practice.¹ Synthesizing research studies and case examples for a lay audience, the book presents a compelling argument that the next generation of health care, supported by artificial intelligence, will seamlessly integrate genetic, wearable sensor, medical record, and social media data sources to optimize and personalize diagnostic accuracy, clinician workflow, and patient education and health coaching.¹ New tools and technology enable care decisions to be made remotely, which means components of future care may be provided entirely separate from traditional, physical emergency department spaces.^{2,3} Unfortunately, realizing the full promise of the next generation of tools and technologies can easily be derailed by failing to adequately integrate ethical decision-making and urgent

clinical priorities, overlooking programming bias, neglecting data security and privacy problems, and failing to structure decision-making transparency (especially if this decision-making lacks nursing representation).^{4,5}

Tools and technologies are “the objects that people use to do work or that assist people in doing work.”⁶(p.5) Emergency care work systems are dependent on multiple tools and technologies.^{6,7} This issue of the *Journal of Emergency Nursing (JEN)* features tools and technologies for emergency care. Publications in this issue test, develop, review, and discuss these pertinent tools and technologies. Two randomized control trials of devices are included in this issue: Buzzy and Shotblocker distraction devices to reduce pediatric pain and fear from intramuscular injections⁸ and a novel funnel urine collection system with silver-colloidal cleaning wipe to reduce midstream clean-catch urine contamination.⁹ Low fidelity simulation as a professional development education tool was also tested in a single group pre-test, post-test design.¹⁰ Three studies focus on tools and technologies for patient education in this issue, which are essential innovations to address patient health literacy and health disparity in the current wave of technology proliferation.¹¹ Winokur, Rutledge, and McGowen developed innovative picture-based discharge instruction tools in response to the low health literacy findings of their descriptive study.¹² Likewise, several educational hand-out tools with simple illustrations for urine specimen collection, used in the Lough and colleagues study, have been reprinted in this issue for *JEN* readers.⁹ Sheele and colleagues tested patient preferences for education instructions delivered using low-tech written handouts and video technology.¹³ One study included in this issue of *JEN*, by Favot and colleagues, used a chart review design focused on ultrasound technology to guide the insertion of peripheral intravenous catheters.¹⁴ Commentary published in this issue of *JEN* includes recommendations for several types of weight scales to improve the safety of weight-based medication calculations and recommendations on the size and length of needles used for decompression in tension pneumothorax.^{15,16} This technology-rich issue of *JEN* is timely and coincides with the 2019 Emergency Nurses Association’s annual conference in Austin, Texas. Austin is also home to a National Institutes of Health, National Institutes

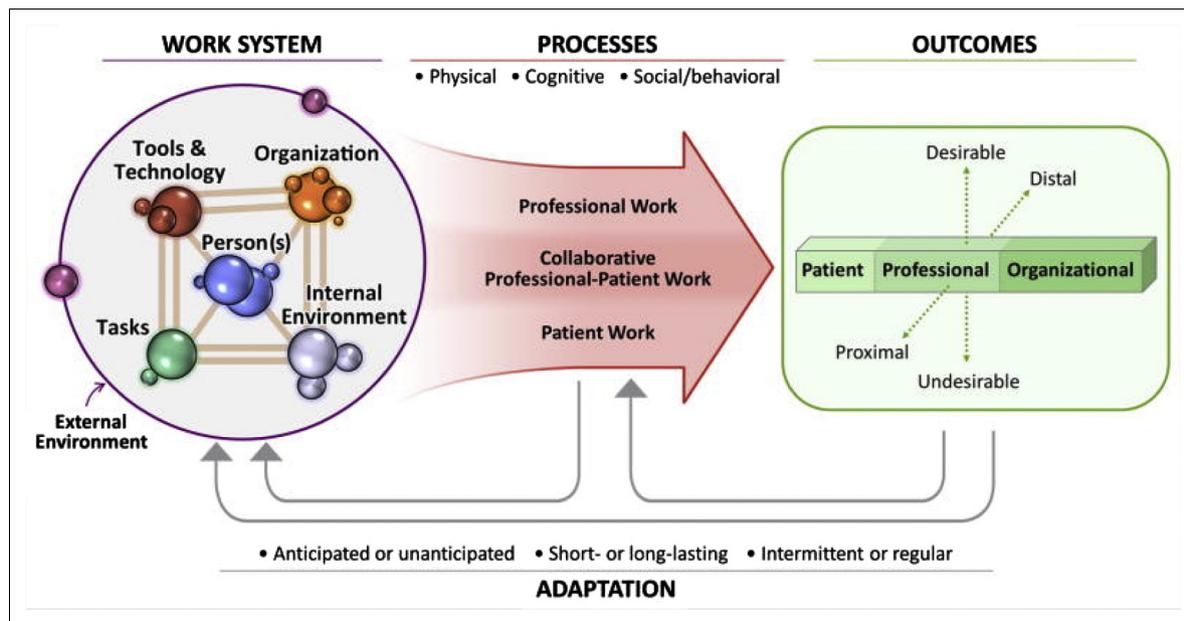
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FIGURE

Emergency nursing examples for six work system components of the Systems Engineering Initiative for Patient Safety (SEIPS) model 2.0. Reprinted with permission from Holden RJ, Carayon P, Gurses AP, et al. SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*. 2013;56(11):1669-1686.

of Nursing Research Center Core Grant (P30) recipient, the University of Texas Austin, leading innovative methods and technology care.¹⁷

How do we ensure new tools and technology actually contribute to improved care, rather than act as a “cool new toy” or replacement for other essential components of the emergency health care system?³ New tools and technologies alone may not improve patient, emergency nursing workforce, or emergency department outcomes. As depicted in the Figure, the Systems Engineering Initiative for Patient Safety (SEIPS) model 2.0 provides an important framework and systems thinking perspective to tie these tools and technologies into the overall contribution to emergency nursing job design for quality and patient safety outcomes.⁶ Using this mental model, the emergency nursing work system is composed of six interacting components, of which the tools and technologies category is only one component (Table). The remaining five work system components are person, tasks, organization, internal environment, and external environment. See the Table for brief examples of each component. The theory posits that all six of these components must be adequately balanced in the

job design to positively impact patient outcomes, professional emergency nursing outcomes (e.g., reduced burnout), and improved organizational metrics. This balance in job design likely comes as no surprise to emergency nurses, who may have experienced the introduction of new technology with the reduction of staffing. Another example of failing to positively balance job design is the introduction of technology that increases, rather than decreases, the number and complexity of tasks. A third example is the introduction of technology without consideration for the patient or professional competencies needed to adequately utilize the novel device. Alternatively, an emergency care team with excellent competency, preparation, and teamwork cannot perform their jobs optimally with outdated and fragile equipment. Overall, the emergency nursing work design must include excellent support and commitment to innovative improvements in all six areas of the work system for optimal job performance, patient health, patient safety, and quality of nursing working life. At *JEN*, we look forward to publishing continued innovations and achievements to inform all components of the ideal job design of the emergency nurse.

TABLE

Emergency nursing examples for six work system components of the Systems Engineering Initiative for Patient Safety (SEIPS) model 2.0

Component	Example
Person	Patient health literacy level; emergency nurse competency
Organization	Policy and procedures; safety culture; rewards for patient satisfaction; incentives for quality metric achievements
Technology and tools	Electronic whiteboards depicting patient diagnoses and treatment bay; usability of a new ultrasound device; patient monitor; stretcher
Tasks	Inserting peripheral intravenous line; patient assessment; nurse-initiated triage protocols; phlebotomy; medication administration
Internal environment	Distance from work station to patient room; positioning of security personnel workstation relative to treatment bays; lighting and noise levels
External environment	EMTALA regulation and enforcement; third party payer reimbursement changes; weather extreme events or disaster; availability of primary and preventive care

Note: EMTALA=Emergency Medical Treatment & Labor Act.

REFERENCES

1. Topol E. *Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again*. New York, New York: Basic Books; 2019.
2. Albahri OS, Albahri AS, Mohammed KI, et al. Systematic review of real-time remote health monitoring system in triage and priority-based sensor technology: Taxonomy, open challenges, motivation and recommendations. *J Med Syst*. 2018;42(5):80. <https://doi.org/10.1007/s10916-018-0943-4>.
3. Hollander JE, Davis TM, Doarn C, et al. Recommendations from the first national academic consortium of telehealth. *Popul Health Manag*. 2018;21(4):271-277. <https://doi.org/10.1089/pop.2017.0080>.
4. Castner J. The ethics of time: Care for your patient or nurse your charts. *J Emerg Nurs*. 2008;34(6):558-560. <https://doi.org/10.1016/j.jen.2008.08.019>.
5. Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. *Nature Medicine*. 2019;25(1):44-56. <https://doi.org/10.1038/s41591-018-0300-7>.
6. Holden RJ, Carayon P, Gurses AP, et al. SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*. 2013;56(11):1669-1686. <https://doi.org/10.1080/00140139.2013.838643>.
7. Carayon P, Hundt AS, Karsh B, et al. Work system design for patient safety: the SEIPS model. *BMJ Quality & Safety*. 2006;15(suppl 1):i50-i58. <https://doi.org/10.1136/qshc.2005.015842>.
8. Yilmaz G, Alemdar DK. Using Buzzy, Shotblocker, and bubble blowing in a pediatric emergency department to reduce the pain and fear caused by intramuscular injection: A randomized controlled trial. *J Emerg Nurs*. 2019;45(5):502-511. <https://doi.org/10.1016/j.jen.2019.04.003>.
9. Lough ME, Shradar E, Hsieh C, Hedlin H. Contamination in adult midstream clean-catch urine cultures in the emergency department: A randomized controlled trial. *J Emerg Nurs*. 2019;45(5):488-501. <https://doi.org/10.1016/j.jen.2019.06.001>.
10. Saqe-Rockoff A, Ciardiello AV, Schubert FD. Low-fidelity, In-situ pediatric resuscitation simulation improves RN competence and self-efficacy. *J Emerg Nurs*. 2019;45(5):538-544. <https://doi.org/10.1016/j.jen.2019.02.003>.
11. Kim H, Xie B. Health literacy in the eHealth era: A systematic review of the literature. *Patient Educ Couns*. 2017;100(6):1073-1082. <https://doi.org/10.1016/j.pec.2017.01.015>.
12. Winokur EJ, Rutledge DN, McGowan JJ. A picture is worth a thousand words: Pictographs to improve understanding of discharge instructions. *J Emerg Nurs*. 2019;45(5):531-537. <https://doi.org/10.1016/j.jen.2019.01.007>.
13. Sheele J, Bhangu J, Wilson A, Mandac E. Patient preference for medical information in the emergency department: Post-test survey of a random allocation intervention. *J Emerg Nurs*. 2019;45(5):517-522. <https://doi.org/10.1016/j.jen.2019.05.009>.
14. Favot M, Gallien J, Malik A, Kasten A, Wells R, Ehrman R. Contrast extravasation as a complication of emergency department nurse performed ultrasound-guided peripheral intravenous catheter placement. *J Emerg Nurs*. 2019;45(5):512-516. <https://doi.org/10.1016/j.jen.2019.05.016>.
15. Bhalodia A, Hammam M, Paparella SF. Weight! Weight! Don't tell me! *J Emerg Nurs*. 2019;45(5):572-575. <https://doi.org/10.1016/j.jen.2019.06.004>.
16. Gurney D. Tension pneumothorax: What is an effective treatment? *J Emerg Nurs*. 2019;45(5):584-587. <https://doi.org/10.1016/j.jen.2019.06.003>.
17. University of Texas at Austin. Innovative methods & technology core. Center for Transdisciplinary Collaborative Research in Self-management Science; 2019. <https://sites.utexas.edu/tcrss/about/innovative-methods-technology-core>. Accessed June 24, 2019.