be intentionally taught to trainees. As larger, hopefully controlled studies evaluate NTS curricula, we will better understand how teamwork, situational awareness, decision making, leadership, resource management, and coping with stress lead to improved surgeon competency and patient outcomes.

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Commentary: Nontechnical skills redux

Marco A. Zenati, MD,^a
Roger D. Dias, MD, PhD, MBA,^b and
Lauren R. Kennedy-Metz, PhD^a

When applying the human factor lens, the practice of surgery can be reduced to a complex sociotechnical system, which to be successful, requires human proficiency in both technical and nontechnical skills (NTS). Appreciation of the importance of NTS in surgery is relatively recent, and education interventions focused on NTS training in surgery are scarce. Although largely still in denial, surgical

CENTRAL MESSAGE

A formalized nontechnical skills for surgeons curriculum embedded into cardiothoracic residency programs is feasible.

From the ^aDivision of Cardiac Surgery, Veterans Affairs Boston Healthcare System, and Department of Surgery, Brigham and Women's Hospital, Harvard Medical School, Boston, Mass; and ^bSTRATUS Center for Medical Simulation, Department of Emergency Medicine, Brigham and Women's Hospital, Boston, Mass.

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Address for reprints: Marco A. Zenati, MD, Division of Cardiac Surgery, Veterans Affairs Boston Healthcare System, 1400 VFW Parkway, Boston, MA 02135 (E-mail: Marco_Zenati@hms.harvard.edu).

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specialties are fraught with high levels of incivility¹ and psychological safety is still an aspiration.²

In 1999, Flin and colleagues³ at the University of Aberdeen in Scotland first applied safety lessons learned in the off-shore oil drilling industry (Aberdeen is the gateway harbor to the North Sea underwater oil fields) and aviation to complex health care environments, including the operating room, and developed a landmark NTS taxonomy called the Anaesthetists' Non-Technical Skills. More recently, Yule and colleagues⁴ developed and validated a behavioral taxonomy specifically aimed at

surgeons called Non-Technical Skills for Surgeons (NOTTS).⁴ The American College of Surgeons realized early the importance of incorporating training in NTS in the general surgery residency curriculum.⁵ However, subspecialty training in NTS has been lagging, in part because of the need to make it relevant to each specific specialty's unique setting.

Kim and colleagues⁶ have done just that for cardiothoracic surgery; the cardiothoracic program leadership bought into the importance of NTS and a multidisciplinary effort was made to break through years of inaction. Their work, albeit still preliminary, demonstrates the feasibility of a formalized NOTSS curriculum embedded into cardiothoracic residency programs, which provides a compelling argument for the utility of such programs. The key strengths associated with this approach are that this curriculum was demonstrated to be feasible even on a small scale and include assessments that are reproducible, in both expert- and self-assessment formats. These features all speak to the potential for future scalability. An important caveat here is that without a fully immersive, well-equipped, high-fidelity medical simulation center available, the possibility of large-scale adaptability of this approach is unclear. Taking measures such as enlisting a real cardiothoracic surgery team who were familiar to the residents to serve as confederates, as the authors of this article have done, could be considered 1 way of overcoming some of these challenges. Other potential alternatives involve on-line learning modalities, including the use of virtual reality to train nontechnical skills in health care teams, which has been increasingly reported in the education literature.^{7,8}

Given their careful and deliberate design, the primary findings reported support the feasibility of improving residents'

nontechnical skills from pre- to posttraining in all 4 NOTSS categories, while simultaneously improving residents' confidence levels. Although promising, this milestone is just the start to a larger conversation. Moving forward, although it is intuitive and convenient to believe that natural, passive exposure to NTS development may be sufficient to produce noteworthy improvements, the authors underscore the importance of deliberate training through formal education. To induce and sustain growth, systematic approaches and reproducible assessments are necessary, and may result in a greater return on investment by enhancing interpersonal skill and emotional intelligence more broadly.

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