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Supporting the Educational, Research, and Clinical Care Goals of the Academic Trauma Center:

Video Review for Trauma Resuscitation

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What Is the Innovation?

Video review technology has changed dramatically over the past 3 decades. Advances in camera technology and information storage efficiency have streamlined a historically cumbersome process, allowing for the implementation of continuous video recording. Hoyt et al¹ described the first use of trauma video review (TVR) as a performance improvement (PI) and educational tool in 1988. Researchers recorded more than 2500 resuscitations using a now archaic portable device and were able to demonstrate a decrease in time to definitive care for matched patient groups treated by the same resuscitation team over a 3-month period. In modern applications, video review technology located in the trauma resuscitation bay can continuously record high-definition video and audio feeds and store these data as encrypted files. These files may be remotely accessible and subject to automatic deletion after a pre-specified period. Reviewing software offers the ability to annotate and timestamp these files as well as rewind, fast-forward, and even zoom playback over critical portions of resuscitations; emerging technology allows for video-based activity recognition.² Innovations in TVR lie in these technological advancements as well as the novel ways in which TVR is used to better patient care.

What Are the Key Advantages Over Existing Approaches?

Traditional methods of PI and resuscitation research have relied on the retrospective review of medical records (MRs) or real-time data collection. The abstraction of data from patient MRs may be limited by a poor or absent capture of variables that are critical for research but

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are not routinely part of the MR, while real-time manual recording of data during resuscitations is challenging, frequently inaccurate, and requires trained personnel. Trauma video review allows for prospective data collection from audiovisual recordings and is ideally suited for projects that require accurate time stamps. In a 2006 study that evaluated deviations from resuscitation protocols in a pediatric population, only 20% of errors that were detected using TVR were detected using MR review.³ Several errors seen on TVR were associated with inadequate physical examinations, delays in therapy, and poor team dynamics, elements that are nearly impossible to extrapolate from the MR.³ In a recent study that used TVR to time emergency department thoracotomies, only 57% of patients had any procedural data times recorded in the MR. Using TVR, data were obtainable in 97% of cases. Trauma video review also allows clinicians to time and characterize critical changes in patient conditions that may not be evident in the MR.⁴

Trauma video review is also a valuable educational tool. Videos can be reviewed in multidisciplinary peer review conferences, allowing “vicarious teachable moments” to be shared with clinicians who are not present for the original resuscitation. Modern applications allow for the simultaneous audiovisual recording of a patient, vital sign monitors, and ultrasonography/video laryngoscope screens. Videos capture the “intangibles” of resuscitation as well as important nontechnical elements that are not evident from the MR, such as team dynamics, leadership, and communication.

The use of wearable cameras in trauma has been studied, although determining a real-time field of view with these devices is challenging. The benefit over traditional mounted recording equipment is unclear, although improved devices are under development.⁵

How Will This Affect Clinical Care?

The widespread implementation of TVR could lead to improvements in our ability to investigate the association of as-yet poorly characterized exposures, such as trauma teamwork, procedural speed, and procedural skill, with resuscitation outcomes. These factors represent “known unknown” variables that are difficult to capture by other existing data collection methods but that practitioner experience would suggest are important in patient outcomes. An improved knowledge of the association between these exposures and patient outcomes coupled with the ability to identify variability in these factors between institutions may reveal opportunities to improve processes of care and patient outcomes. Video-based activity recognition, a technology that allows for the automatic extraction and transcription of human movements, may provide a more detailed characterization of procedures and temporal events.²

Is There Evidence Supporting the Benefits of the Innovation?

The benefit of TVR is associated with the accuracy and reliability with which investigators can collect data and subsequently improve processes of care and identify opportunities for improvement. The literature supporting the benefits of TVR in this capacity continues to grow. For example, using TVR, Oakley et al³ discovered that their trauma team leader was not initially present at 50% of resuscitations. This led to a change in local protocols;

clinician education sessions were implemented to address other errors that were discovered during the review process. More recently, Chreiman et al⁶ used TVR to accurately time vascular access in unstable penetrating trauma patients and concluded that intraosseous access can be placed as quickly and more reliably than peripheral access and much faster than central venous catheters. These findings led to an immediate change in clinical practice at the study institution. In a recent study that evaluated the implementation of a preintubation checklist for trauma resuscitations, video reviews clearly identified that poor team communication was a major contributor to an adverse patient outcome.⁷ Trauma video review has also been used to define quality performance standards for procedures like emergency department thoracotomies in which in-person collection by research personnel is challenging given the unpredictable nature of this procedure and missing data are common.⁴

Video-based activity recognition systems are also currently under development and may further streamline the TVR process. One group has created a model with which to automatically track and transcribe procedures by combining the video detection of medical instruments, clinician actions, portions of the patient's body, and scene context.²

What Are the Barriers to Implementing This Innovation More Broadly?

While the existence of long-standing video review programs at several centers demonstrates that TVR is feasible and sustainable, barriers to implementation exist. Because of medicolegal concerns, we recommend that centers that are considering a TVR program begin with a thorough review of the legal regulations and hospital policies regarding using video recordings and vet all proposals through the administration and legal counsel. In many states, TVR is protected from medicolegal discovery through its status as a PI activity. Concerns about patient privacy can be mitigated through signage notification and incorporating video consent as part of the general hospital consent process. Some clinicians may also have privacy concerns associated with the video recording of work performance. Clear communication of the specific reasons and intentions of starting a TVR program should be messaged to clinicians before implementation. To understand any local cultural barriers to TVR, conducting a clinician stakeholder analysis is prudent. If part of the TVR program includes group feedback settings (eg, educational or PI conferences), care must be taken to emphasize team performance over specific individual actions and to provide examples of exemplary team performance and not just opportunities for improvement. Finally, care must be taken to ensure that TVR is not used as an arbitration tool in interpersonal conflicts that may occur in high-stress situations. The TVR process requires a significant time commitment, although reviewer roles and the percentage of overall videos that are reviewed are institution-dependent.

In What Time Frame Will This Innovation Likely Be Applied Routinely?

Although the overall number of programs currently using TVR is unknown, we believe this relatively underused technology will become standard-of-care for PI and resuscitation research. We anticipate more widespread use over the next 5 to 10 years as programs implement new technologies that are becoming increasingly more available, affordable, and advanced. In recognition of the benefits of this technology, we believe that the American

College of Surgeons' trauma center verification process should consider TVR use as a component of trauma PI programs at level I and II centers.

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