Video data for patient safety

Charles McC Mathais Jr[1], Colin F. Mackenzie[2]

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[1] National Study Center for Trauma and EMS, Baltimore
[2] Professor of Anesthesiology, Associate Professor of Physiology
University of Maryland School of Medicine

Correspondence
Charles McC Mathais Jr
National Study Center for Trauma and EMS, Baltimore
Baltimore, MD 21201
USA
E-mail: cmack003@umaryland.edu

ABSTRACT:

Video recording is a rich source of gathering data in complex dynamic settings and is underutilized in healthcare. Video recording has strengths over observation in that video allows fine grained analyses, repeated reviews by multiple experts and playback for clinicians whose care is recorded. These strengths allow multiple uses of video recording for assessing safety performance, training, human factors and ergonomic analyses. This paper describes a task specific approach to gathering video clips that simplifies the logistics of data collection and analysis and a process for gaining consent and participant buy-in to be video recorded. The results of 12 years of video recording and analysis can be viewed at our web-site (http://hfrp.umm.edu). To minimize confidentiality issues, aggregated data should be reported. Examination of the same task performed at two levels of task urgency allows quantitative video data extraction. Video records detect quality assurance and safety issues not detected by self reports. Video clips provide powerful feedback for buy-in and for training.

Introduction

This paper will:

- Identify the strengths of video recording during emergency medical care of the trauma patient.
- Show how a task specific video acquisition and analysis approach is a powerful methodology to detect patient and clinician safety hazards.
- Contrast video data capture with observational data methodology during trauma patient resuscitation.
- Describe our 12 year experience of approaches to consent, confidentiality, privacy and use of video clips.

There is difficulty in gathering data and identifying practices that lessen the margin of patient safety in real dynamic complex medical workplaces. Video clips as data are a rich source to examine safety performance. Video clips have utility for participants to review their activities and for analysts to extract quantitative data. Focusing video data collection around brief, risky but beneficial tasks carried out during trauma patient resuscitation can simplify participation consent, confidentiality and data analysis problems. However such video clips acquisition (5-15 minute duration) does not appear to compromise the quality of the content that can facilitate identification of team performance, communication, ergonomic, and systems factors affecting patient safety. Comparisons of task performance at two levels of task urgency was particularly revealing of areas where patient safety performance can be improved and identified preventive strategies to minimize the effects of safety infractions.

Data collection is a major challenge of studying real complex dynamic settings, yet such examination of real environments where experts perform is important to understand how risk, uncertainty, team and ergonomic factors impact workplace safety performance. Although observational field studies are helpful and have made valuable contributions to the literature (1, 2, 3) these studies are exploratory and cannot provide illustrative examples for systematic feedback to participants.

The advantage of video recording is that fine-grained analysis is possible to detect procedural omissions or non-optimal performance practices. Video analysis can identify both the problem to prevent and provide the solutions to avoid such non-optimal practices. A further advantage of video recording over other means of data collection including observation, is that video recording detects quality assurance occurrences that are not identified by self-reports, or quality management approaches. Frequently participants in emergency trauma care are unaware of their deficiencies in performance. Only after systematic task analysis video review by subject matter experts (SME's) are such performance deficiencies revealed (4). Video as a data source to examine safety in the workspace has been used in several domains to examine remote collaboration (5), conformity to safety practices (6), performance of tasks (7) and as a training tool (8). This paper describes a methodology using video clips of short duration (5-15 min) to provide a rich source of material for targeted safety performance review. This approach simplifies subjects participation, consent, confidentiality and data analysis problems associated with more comprehensive and longer duration video acquisition.

Task specific video acquistion and analysis

Video clip acquisition for safety performance review is particularity powerful when centered around a specific task (7). Tasks are chosen that are brief in duration, have high risk, but when carried out as planned they have great benefit. Examples of such tasks include emergency airway management, chest tube insertion and subclavian central venous access. Because such tasks are well circumscribed and occur frequently in emergency departments, the clinical staff can

1) focus their attention on what aspect of patient safety is under review
2) understand when video recording will start and finish
3) contribute their suggestions as SME's, providing "buy-in" to the project
4) understand the mechanism of breaches in safety performance by themselves and their colleagues when reviewing video clips
5) review video clips, or abstracts of these clips, that are copied onto compact discs (CD holds up to 20 minutes of video) at staff chosen locations and times
6) answer questionnaires (linked to video clips or abstracts from the longer video) which probe specific safety performance aspects of video-displayed individual steps in the studied task (9). Video analysis techniques and software are described at our websites (http://hfrp.umm.edu/) and http://nsc.umaryland.edu (video as research data).

Data from video records compared with observation

The subtleties of body language and eye movements and fleeting utterances captured by video are only able to be included in theories or conceptual frameworks generated by observation. In contrast to a video record, applications of observational studies are more exploratory (7). Observation provides a realistic view of the complexity of the work environment and can be used to develop empirically grounded hypotheses. Observation allows domain experts to uncover collaborative demands and strategies that practitioners have developed in response to those demands. Observations can show how existing artifacts are used to support such demands. In contrast to other scientific methods, observation is focused on discovery rather than hypothesis testing (10). Ambiguous communications central to design interactions cannot be recorded by observation in context as occurs with video (9). In comparison, multiple domain experts and the video recorded subjects can themselves repeatedly review the raw video record after the event. Fine grained analysis can include all the nuances of contextual and systems factors because second-by-second behavioral and verbal interactions are recorded with video. Video recording also allows expanded analysis of time critical brief or uncertain events by repeated replays or even frame by frame analysis.

Applications of trauma resuscitation and surgery video records reported include an examination of collaboration in teams (11) comparison of performance of real video recorded events recreated in a full mission patient simulator (12); occurrence of fixation errors and failure of standard operating procedures in real clinical practice (13); decision making in dynamic environments such as surgical operating rooms (14). We video recorded and identified visual scanning patterns using an eye tracker during remote diagnoses (15) and described metrics of uncertainty during video records of resuscitation of trauma patients (16). Components of task complexity in emergencies were captured on video records (17). An ergonomic analysis of the trauma resuscitation workplace using video was reported (18).

Video recording detected quality assurance occurrences not identified in self-reports such as the anaesthesia record or quality assurance reporting systems (19). Video records, unlike observational data, are a powerful feedback and training tool. Video data can be used in ways not originally envisaged when the record was made. Events or tasks not associated with the original analysis may be detected and data extracted later as, for example, with our analysis of vital signs monitor alarms in association with airway management (20) which used existing records from our video library. Video clips can be used as stimulus material for individual training, distributed team training, examination of the impact of communication media on telemedicine decision making, and expertise coordination and collaboration.

Consent and confidentiality

Protocols that included video recording were approved by the Institutional Review Board (IRB) for human subjects of research. Consent forms were signed by research subjects included anaesthesiology, surgeon, nurse and technician trauma care providers. Permission was obtained from the IRB to retain video abstracts of up to 2-3 minute duration for research and educational purposes, provided the consent of the video recorded subjects was obtained. In these video abstracts all patient (and research subject, if requested) identifiers were removed by image blurring or by using specific camera angles or video segments that did not allow identification or recognition of individuals.

However, video is a very powerful medium. A concern is that even when researchers obtain a subject's consent, it is not always clear that the subject understands the implications of that consent. The process described in Table 1 is used as an extension of fulfilling the obligatory need to have a signed consent form. The consent process explains the implications to as many as possible of those affected by or likely to be included in video recording. It is time consuming, but rewarding, because subjects understand what is happening.

The consent process described in Table 1 for non-research subject clinicians was followed. During the first 3 years only two research subjects would not consent to participate or be included in video recordings. One additional subject agreed to participate only if their image was blurred in any retained video abstracts (9).

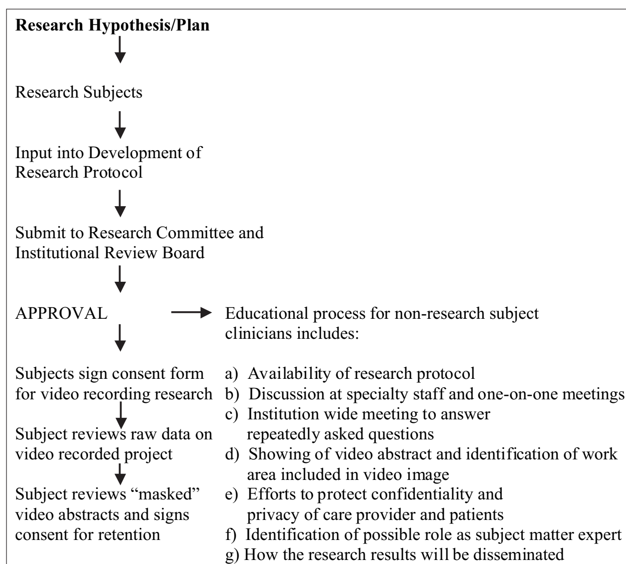

Table 1 Approach for information sharing about video recording.

The IRB agreed to allow video recording without patient consent for research protocols because it was not thought feasible to obtain consent in the emergency circumstances in which the video records were made. However, every effort was made to preserve privacy by using camera angles and tight image border control to avoid recognition of individuals. Patient identifiers were removed from paperwork associated with video records. To preserve confidentiality, only care providers and researchers were given access to the video records which were kept secure under two sets of locks.

Technical approaches used to preserve confidentiality and maintain privacy of the video recorded individuals included video masking with blurring of the face and other distinguishing features. Voices can be disguised, but these digital manipulations can impair video data analysis if qualities of speech or gaze are being analyzed. The key to the consent process and confidentiality is, in our opinion, the development of trust by those who are video recorded that the investigators will not abuse the privilege of being allowed to acquire video data for research purposes (9).

Generally, the original video records were destroyed by degaussing within 4-6 weeks of collection. A sign at the entrance to the operating rooms and inside the trauma resuscitation unt was posted to indicate the image recording was occurring. The wording "Be aware, filming is underway" complies with Joint Commission on Accreditation of Healthcare Organizations (JCAHO) regulations for video recording in hospitals. During 11 years of video recording we have experienced no medicolegal subpoenas and no employment related or liability issues.

We believe that this review of video data extraction and analysis techniques used in a clinical environment may help other researchers in formulating their research plans and in data analysis when using video recording. This belief is based on published reports on video analysis, as well as comments, feedback and personal communication received from a wide variety of sources.

Summary points

It is important to develop trust with video recorded subjects.

Clinician feedback should be obtained on introduction of a new protocol or line of investigation.

Aggregated video recorded data should be reported and clinician reviews used for feedback.

Video task analysis at two levels of task urgency is a powerful tool to extract quantitative patient safety data.

Multidisciplinary experts in surgery, anesthesiology, and nursing should be involved.

Audio records of participants should be used to explain cognitive aspects of events or covert processes.

Where events are uncertain or verbal interactions unclear, participant input is needed for clarification.

Single critical events may reveal underlying systems failures.

Video records detect quality assurance occurrences not identified by self-reports.

Video provides powerful feedback and video clips are important training tools.

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