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An Interdisciplinary Review of Surgical Data Recording Technology Features and Legal Considerations

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Abstract

Surgical data recording technology has great promise to generate patient safety and quality data that can be utilized to potentially reduce medical errors. Variations of these systems aim to improve surgical technique, develop better training simulation, and promote adverse event investigation similar to the aims of black box technology utilized in other industries. However, many unknowns remain for surgical data recording utilization in operating rooms and clinical settings in the United States. This includes the need to appropriately design systems so they collect meaningful and useful data that can be discussed by surgical team members in an open and safe environment to optimize clinical care processes. In order to better understand the clinical and regulatory environment for surgical data recording systems, we conducted an interdisciplinary review to identify key technology approaches, and assess legal and regulatory implications associated with this potentially disruptive technology. We found technology ranging from audio and visual data, to systems utilizing mobile applications, and kinematic data capture. The data collected present legal questions over ownership of information and privacy, along with regulatory issues at the federal and state levels. The benefits of these data should be balanced with the need to develop appropriate policies and regulations that protect the interests of both clinicians and patients in order to encourage further innovation and better realize the potential of surgical data recording technology to improve clinical decision making and patient safety outcomes.

Keywords

surgical data recording technology, surgical black box, operating room black box, audio-video recorder, surgical workflow, quality improvement, patient safety

Introduction

Iatrogenesis is a leading cause of death in the United States.[1] An accurate assessment of its scale has been difficult to quantify throughout the years, but a recent analysis of iatrogenic events estimated that more than 250 000 deaths per year in the United States alone can be attributed to medical error.[1] Similarly distressing conclusions can be drawn about surgical error. A systematic retrospective record review of over 16 000 patients concluded that more than a third of surgical adverse events were preventable.[2] Addressing preventable error in the surgical theatre is particularly imperative, as intraoperative mistakes may have more serious consequences for patients. Even the most extreme forms of surgical error, or "never" events, which include wrong site or wrong patient procedures, occur at a greater frequency than previously assumed.[3]

With the ongoing goal to optimize patient safety and achieve positive health outcomes, a sharp reduction in the incidence of medical error is paramount. Negligent or improperly trained health providers do not explain the large prevalence of error; rather, systemic issues at the diagnostic, treatment, and preventive stages lead to adverse health events.[4] Defective coordination of clinical care delivery is attributable to a combination of factors and chains of events, some of which include equipment and personnel mistakes, improper communication, and poor situational awareness due to distraction or burnout.[5] Though health organizations have implemented safety and quality interventions, to understand the underlying causes of medical error, capturing the details of its

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occurrences to identify errant practice patterns and pinpoint opportunities for corrective measures is necessary.

Other industries employ technologies to protect the public from preventable accidents, as employing safety measures is a common legal requirement across several sectors. In the aviation industry, all aircraft are required to carry a flight data recorder and cockpit voice recorder (ie, "black box"), which collects data and details of the events immediately preceding a safety hazard encounter or airplane accident.[6] Such technology allows investigators to analyze and recreate the events of an accident to determine its probable cause. Specifically, the black box records aircraft performance parameters, as well as communications between the cockpit crew and traffic control personnel.[6] Variations of this technology are being used in other sectors, including police taskforces, commercial vehicle operations, and also operating rooms.[7-9]

Fundamentally, data recording technology is used to examine performance retrospectively or in real time, and the events that lead to adverse outcomes in order to prevent the same mistakes from recurring. These overarching principles translate well to clinical settings, particularly in the operating room. Surgical data recording technology, sometimes referred to as a "surgical black box," has been used to objectively and accurately record details of a procedure, providing the opportunity for more targeted retrospective case review, technical improvement, and error detection, thus serving the overall purpose of improving the quality of care.

Though the adoption of surgical data recording technology in health care settings carries much promise, the varying characteristics of these solutions have not been well explored, nor the multitude of legal and regulatory challenges associated with their potential use. Specifically, there is a great deal of variation in what constitutes a surgical data recording system. This can include systems that digitize existing medical information (such as notes taken by staff), incorporate the use of different devices (eg, cameras and microphones) that record clinical operations, along with more advanced systems that actively record and analyze data in real time. Hence, this review seeks to characterize the types of surgical data recording technology and its potential impact on patient safety by examining case studies, assessing legal implications of this technology in clinical settings, and exploring regulatory challenges in facilitating use and implementation of these systems.

Methods

We conducted an interdisciplinary literature review examining original research, commentaries, review articles, and other journal articles in 3 databases. We queried search terms on PubMed (articles focused on medical and life sciences literature), IEEE Xplore (articles on information, communication, and engineering research), and ACM Digital Library (articles on computer science and engineering) that contained the words "surgical black box," "operating room black box," "operating room data capture," "operating room video," "operating room workflow," and "surgical data recording" in the Title and Abstract field. We also used the same search term queries in Google Scholar (excluding patents and case law) and limited our review of articles to the first 10 pages of results (see Figure 1 for summary of methods).

This narrative review focused on literature about characteristics of surgical data recording technologies, advantages and future prospects of these technologies, and different use cases. The specific focus on data recording technologies necessitated that literature regarding robot-assisted surgical technology, implantable medical devices, simulation models, imaging technology, remote patient monitoring, and IoT (Internet of Things) devices be excluded if they did not interface with perioperative surgical data recording technologies. Furthermore, literature using colloquial definitions of the term "black box" was excluded.

In total, 22 articles about surgical data recording systems were extracted and reviewed in depth (see Table 1). To supplement information in the primary literature, we also examined the gray literature, which included legal and regulatory analytical pieces, interviews, news reports, and general descriptions of black boxes in various fields. Examination of both peer-reviewed literature and gray literature allowed us to characterize the technology of surgical data recording systems currently used, and the legal and regulatory implications and challenges in more depth.

Results

Reflecting growing interest in leveraging surgical data recording technology to improve patient safety, a number of published studies indexed in PubMed have specifically examined the use of different types of surgical data recording technologies spanning different medical specialties, including pediatric cardiac surgery, thoracic surgery, general surgery, and urological surgery (Table 1). However, we were not able to identify any articles on the subject in IEEE Xplore or ACM Digital Library, indicating that device development and product engineering efforts are primarily represented in the medical literature. These systems vary on levels of engagement with technology, types of data collected, and how data are utilized to effectuate change in the delivery of health care. Below, we outline key technology features used by these systems supported by case studies, and also detail legal and regulatory considerations that can enable or impede its adoption.

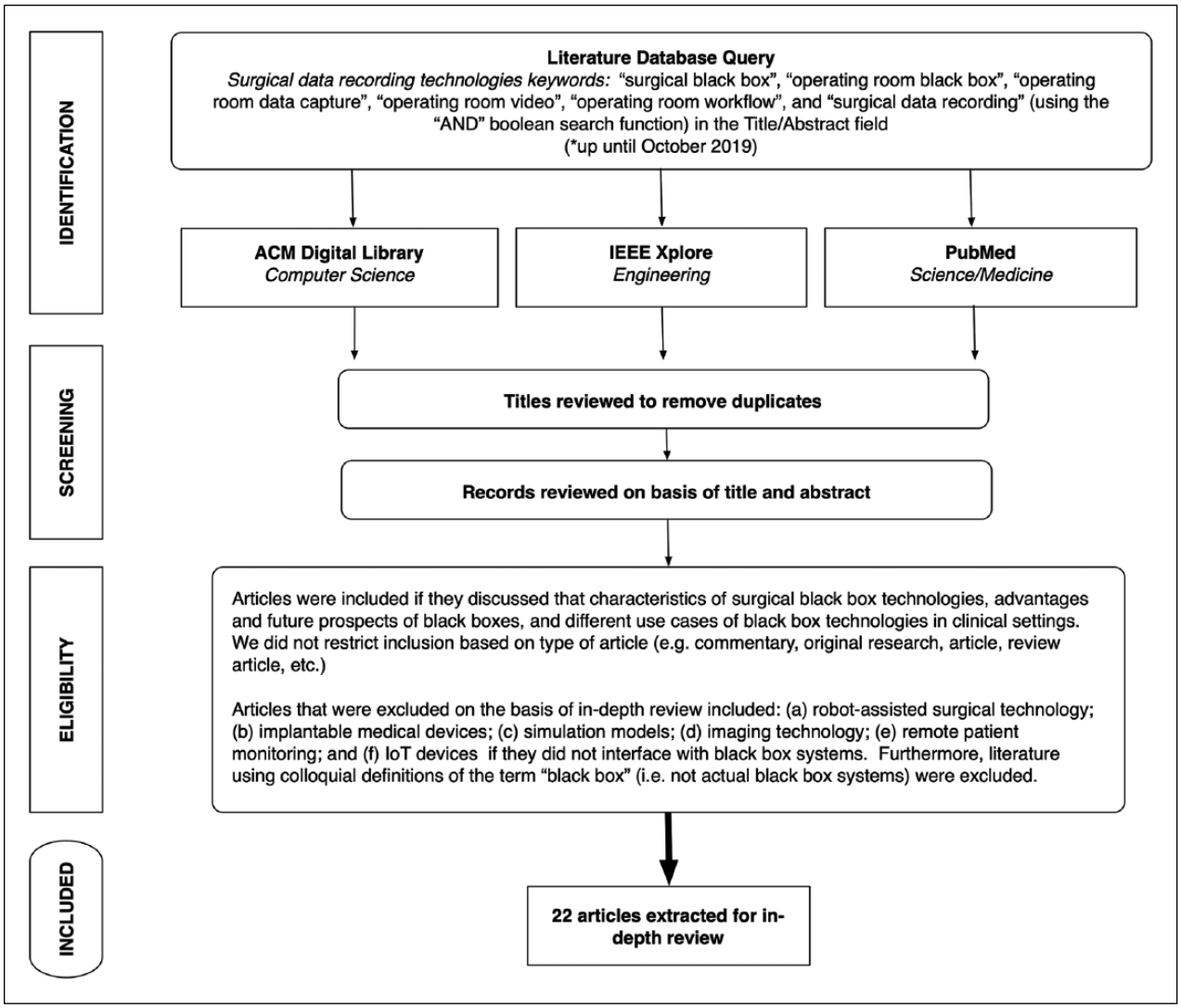

Figure 1. Summary of search methodology.

Technology Features and Use Cases

Surgical data recording technologies primarily differ in technological complexity and the nature of data collected. We detected 3 major technology feature categories including audio-video data recording, the operating room black box, and mobile and sensor data recording. Below, we outline use cases characterizing the function of these systems and their technological features.

Audio-Video Data Recording. Surgical data recording systems often include an audio-video component to capture auditory and visual data in the operating room; such data are particularly useful to quantify distractions, capturing instances of error, and informing error reduction practices.

A Washington University in St. Louis study spanning from 2008 to 2010 illustrated tangible benefits of black box principles, particularly after technology integration. After initially documenting failures on index cards during procedures, pediatric cardiac surgeons at St. Louis Children's Hospital developed a more structured mechanism to categorize the time of specific observations and errors through the use of a nurse circulator who time stamped the index cards.[10] The data recording methodology eventually incorporated video recordings for an added a layer of verification, as they could confirm the time-stamped intraoperative observations by the surgical staff.[10] Advancement of the surgical data recording technology was correlated with higher frequencies of error and adverse event identification and revealed that mistakes were often bundled into a recurring chain of events.[10] For instance, communication issues and improperly designed blood-delivery protocols were tied to greater rates of blood failure in patients.[10] These

Table 1. Summary of Peer-Reviewed Articles Extracted.

Author	Year	Content Type	Technology Description	Regulatory/Legal Challenges
Bowermaster et al[10]	2015	Original research	Video surveillance and analysis	Ownership of information, patient/provider consent, medical malpractice concern
Etherington et al[29]	2019	Original research	Multifaceted system with visual and auditory data, sensors, and intraoperative data	Ownership of information, patient/provider consent, medical malpractice concern, federal and state level technology regulation
Fesco et al[22]	2018	Original research	Multifaceted system with visual and auditory data, sensors, and intraoperative data	Ownership of information, patient/provider consent, medical malpractice concern, federal and state level technology regulation
Gambadauro and Magos[30]	2012	Commentary	Video surveillance and analysis	Ownership of information, patient/provider consent, medical malpractice concern
Göras et al[24]	2018	Original research	Mobile tablet data entry platform	Ownership of information, patient/provider consent, medical malpractice concern
Guerlain et al[28]	2005	Original research	Digital audio-video recording system, with software to collect and synchronize data	Ownership of information, patient/provider consent, medical malpractice concern
Hu et al[14]	2006	Original research	Video-based surveillance system with variable image quality, visualization from different computers	Ownership of information, patient/provider consent, medical malpractice concern
Huang et al[25]	2017	Original research	"SmartOR" data recording system containing sensors for automatic data capture	Ownership of information, patient/provider consent, medical malpractice concern
Jung et al[17]	2018	Original research	Multifaceted system with visual and auditory data, sensors, and intraoperative data	Ownership of information, patient/provider consent, medical malpractice concern, federal/state level technology regulation
Jung et al[20]	2019	Original research	Multifaceted system with visual and auditory data, sensors, and intraoperative data	Ownership of information, patient/provider consent, medical malpractice concern, federal/state level technology regulation
Jung et al[21]	2019	Original research	Multifaceted system and visual and auditory data, sensors, and intraoperative data	Ownership of information, patient/provider consent, medical malpractice concern, federal/state level technology regulation
Kranzfelder et al[27]	2011	Literature review	Radiofrequency identification, sensors, barcode, vocal recognition software	Ownership of information, patient/provider consent, medical malpractice concern, federal and state level technology regulation
Lane et al[23]	2012	Original research	Mobile application with visual and auditory data, patient vital signs, other intraoperative data	Ownership of information, patient/provider consent, medical malpractice concern, federal/state level technology regulation, security concerns
Levin and Tan[38]	2015	Commentary	None	None
Moulton[32]	2015	Commentary	None	Medical malpractice concern
Reinersman and Blackmon[11]	2015	Original research	Digital health database	Ownership of health information, confidentiality, adverse event reporting
Shah et al[31]	2019	Commentary	None	None
Verdaasdonk et al[35]	2008	Original research	Audio-video recording system to create handwritten equipment checklist	Ownership of information, confidentiality, adverse event reporting, medical malpractice concern
Wasserman[36]	2015	Commentary	Handwritten notecards, multifaceted system with visual and auditory data, sensors, and intraoperative data	Ownership of information, confidentiality, adverse event reporting
Weigl et al[13]	2018	Original research	Multifaceted system with visual and auditory data, sensors, and intraoperative data	Ownership of information, patient/provider consent, medical malpractice concern, federal/state level technology regulation
Xiao et al[15]	2008	Original research	Video-based surveillance system with variable image quality, visualization from different computers	Ownership of information, patient/provider consent, medical malpractice concern
Zheng et al[12]	2008	Original research	Audio-video recording system to quantify disruption/distractions	Ownership of information, patient/provider consent, medical malpractice concern

observations effectuated corrective measures to transform the blood product delivery workflow in the department, leading to reduction in blood-related failure.[10]

At the Mayo Clinic, video recording supplemented digitized health information for patients who underwent video-assisted thoracoscopic surgery lobectomy.[11] The analysis identified patients who encountered a catastrophic complication, which was defined as an event that resulted in an additional unplanned major surgical procedure.[11] The study determined that surgeons who were aware of specific intraoperative risks were better prepared to respond to complication encounters that required unplanned and additional surgery, an awareness that ultimately led to a decrease in morbidity.[11] This could allow for the integration of visual heuristics that simulate validated intraoperative complications into surgical training programs, better preparing novice surgeons yet to encounter an intraoperative complication. This data recording system utilizes an existing database of medical records and video recording, which is then used to conduct a retrospective review of surgical outcomes in order to improve technique, awareness, and processes.[11]

Synthesis of audio and video input expands the scope of collectable data—particularly, surgical workflow and disruptive events.[11-13] An audio-video data recording system in Oregon quantified disruption in the operating room.[12] During laparoscopic antireflux surgery, physicians identified 114 disruptive events per hour, including instrument changes, surgeon position changes, shift changes, conversations, and phones and pagers going off.[12] Most frequently, intraoperative conversations were the largest source of distractions, occurring about 71 times per hour.[12] However, these did not delay cases or disrupt workflow; the event that most commonly delayed cases was waiting for unavailable instruments, which caused over 4 minutes of delay per hour.[12] Similarly, another study that assessed surgical workflow disruptions during robotic-assisted radical prostatectomies using audio-video data recording systems identified 16.27 disruptive events per hour, most commonly during the robot docking phase.[13]

Reflecting the utility of audio-video surgical data recording systems, an automated system visualizing the operating room by gathering video from within the operating room and patient vital signs has been developed at the University of Maryland.[14] The Video Board System also has controllable image quality, and its output is displayed at 4 different visualization stations.[14] The most frequent physician users of this system were anesthesiologists, who stated its utility to examine case completion time, and to check whether a room is available during periods of high operating room occupancy.[15]

Operating Room Black Box. Currently, the most widespread surgical data recording technology in use and that is being studied is that of Dr Teodor Grantcharov at St. Michael's Hospital in Toronto.[16] Called the "OR Black Box," this surgical data recording system incorporates cameras, microphones, sensors, and error analysis software connected to a series of computers to capture intraoperative details, operating room environment data, auditory distractions, interpersonal and communication dynamics, nontechnical data, and technical data.[16,17] Technical data captured by this system mainly identifies intraoperative performance error—specifically, when, why, and how likely it is to happen. An initial analysis of laparoscopic procedures using the "OR Black Box" at the University of Toronto determined that some form of auditory disruption occurred nearly every minute of a case, with operating room doors, loud noises, pagers, or telephones being the primary causes.[16] Within the defined phases of the laparoscopic procedures, error most likely occurred during dissection, resection, and reconstruction.[17] The types of technical error most likely to occur were improper estimations of force applied to tissue and distance to the target tissue during operative steps.[17]

Further trials of the OR Black Box yielded insightful conclusions about where mistakes were most likely to happen, and the nature of adverse events.[18] One study of gastric bypass surgeries yielded an observed 86% of surgical errors were made during the 2 steps, suturing and grafting the bowel.[18] Another study identified 66 adverse events in 38 bariatric laparoscopic procedures; most adverse events were either hematoma, minor bleeding, or thermal injury to nontarget tissues, with 75% of such events going unnoticed to the surgical team.[19] A cross-sectional study of elective laparoscopic general surgery cases between April 2014 and 2016 using the OR Black Box identified 30% of cases that contained a device-related interruption.[20] These interruptions were most common in sleeve gastrectomy and oncologic gastrectomy.[20] This surgical data recording system also demonstrated a significantly better ability to identify and report veress needle injuries when compared with traditional chart review.[21] Using the OR Black Box, 12 veress needle injuries were identified as opposed to 3 through traditional chart review, and 47 near misses were identified as opposed to 0 by chart review analysis.[21]

OR Black Box data have also been applied to better analyze nontechnical performance, including teamwork and interpersonal dynamics.[22] In one study, surgeons, fellows, scrub nurses, and circulating nurses were rated for specific nontechnical behaviors, including leadership, situational awareness, decision-making, communication, and teamwork.[22] The study concluded that surgeons most commonly exhibited adept situational awareness and leadership, while the nurse team excelled at task management and situational awareness.[22] Of the total care provider team

studied, the surgeon and scrub nurse demonstrated the most positive nontechnical behavior.[22]

With the ability to collect highly specific surgical, perioperative, and behavioral details, this surgical data recording system provides a glimpse into what is possible with a semi-integrated, multiuse system that combines the use of different monitoring devices and software.

Mobile and Sensor Data Recording. Surgical data recording systems have also been integrated into mobile platforms to increase visualization and accessibility in the hospital setting. At Vanderbilt University Medical Center, a mobile application called VigiVU provides access to operating room video feeds, voice and text communication, electronic health record access, patient vital signs, and anesthetic interventions, all of which are accessible on an iPhone.[23] In Sweden, a portable touchscreen tablet was used as a data recording device.[24] Information was collected for each observed task and entered into a mobile application, which would require the task, interruption, cause of interruption, and the "who," "what," "how," and "why" of each interruption.[24] This study was used to identify multitasking and interruptions experienced by the surgical team at a county hospital, and it ultimately found that the surgical team faced multiple instances of interruption and multitasking, with the potential to adversely affect patient outcomes.[24]

At the University of Houston, a data recording system called the "SmartOR" was developed and composed of 3 sensors, a wireless network, and a data capturing computer to automate data collection.[25] The system automatically collects data on room activity, patient movement, turnover time, and patient identification in real time, and identifies outliers for further examination.[25] Because these data are automatically captured and no manual entry is required, it can allow the care team to maintain its focus on a case.[25]

Non–audio-video sensor data utilizing software can also enable collection of specific information to better analyze particular procedures. The "dvLogger," employed by urology surgeons at the University of Southern California, adds a new data point, kinematic data, to evaluate surgeon performance during robot-assisted prostatectomies via the da Vinci Surgical System.[26] On review of 100 cases, the review team was able to notice strong differences between expert and novice surgeons, by looking at time of completion of operative steps, camera movement frequency, instrument idle time, camera path length, and instrument travel distance.[26] These metrics highlight the increased efficiency that expert surgeons brought to cases and where the greatest technique discrepancies were, which can serve as a basis for more targeted training and improvement.[26]

A review of information retrieval in the operating room in 2011 identified bar code, radiofrequency identification, and vocal and emotional recognition technologies as additional promising sensor and tracking technologies.[27] Bar codes were placed on surgical instruments and material in the operating room, which was proven to be effective for automatic surgical instrument identification and reducing instances of retained foreign objects.[27] Radiofrequency identification was deemed promising for continuous personnel tracking in the operating room to better understand workflow dynamic, and vocal and emotional recognition software was also posited as a feasible, though challenging means to analyze communication in the operating room.[27]

The aforementioned studies suggest that information collected via surgical data recording systems can benefit physicians and improve patient safety in a multitude of ways, allowing surgeons to review and critique their surgical technique, distractions, and interpersonal dynamics, which enable discussion of performance improvement, situational awareness and judgment in light of an adverse event, along with more targeted teaching mechanisms and opportunities.[20-22,26-28]

Legal and Regulatory Consideration for Black Box Use

A survey of the OR Black Box revealed differing attitudes by patients and physicians regarding the technology.[28] In general, whereas patients were as a whole supportive and comfortable by its use in the operating room, physicians were more concerned about the consent process, security, and medicolegal issues.[29,30] Ultimately, surgical data recording technologies vary in the amount and types of data collected, degree of technology integration, and related utility in the clinical setting. However, because data recording technologies may capture audio, video, patient, and provider data associated with sensitive protected health information, they inherently carry medicolegal questions. The handling of all of these records carries a number of potential legal implications that require further exploration.

An analysis of the medicolegal landscape of surgical data recording technologies proposed a transparent and comprehensive patient informed consent protocol outlining the technology's use and how data collected in these systems could be used.[31] If the data were to be used for quality improvement or research purposes, the information captured on the surgical data recording device would belong to the hospital and physicians for case review, clinical research, or morbidity and mortality (M&M) conferences, and protected from litigation.[31] If captured data were to be included as part of a patient's medical record, that would render it potentially discoverable for litigation in malpractice cases.[31] These additional details by way of factual, audio-video recording, instead of witness/defendant recall in absence of concrete camera and microphone evidence, could obviate lengthy litigation, as the record

could confirm or deny accusations of meeting or failing to meet the standard of care.[32] If an error in the operating room causes injury, there may also be opportunities to not only learn from unanticipated mistakes but also promote early resolution or an alternative dispute resolution prior to formal litigation.[32]

Ultimately issues related to data and patient privacy, device regulation (including for the different components of surgical data recording device systems), and concerns about implications for medical malpractice will need to be assessed within the context of a multitude of clinical, legal, and business factors. This principally includes the technology features of the devices, what data it stores, how that data interacts with other systems, and the purpose of collecting said data from these systems.[33] Arguably, a "one-size-fits-all" approach to addressing outstanding privacy, legal, and regulatory considerations will fall short, but these issues will need to be resolved prior to more widespread adoption of these systems in broader patient safety interventions.

Discussion

The adoption of surgical data recording technology carries the potential to capture robust intraoperative data about adverse events, technical performance, equipment checklists, surgical workflow, and distractions.[13,14,16,17,22] These technologies can span from audio-video recording systems, multifaceted systems incorporating sensors and audio-video, mobile applications, and kinematic data capturing systems for robot-assisted surgeries.[16,17,23,26] Precise data like these can inform better error detection protocols, situational awareness, workflow processes, positive interpersonal communications, and teaching methods, all while improving patient safety outcomes. At the same time, the benefits of this technology should be balanced with the need to develop appropriate policies and regulations that protect the interests of both patients and clinicians.

Lessons from outside of the United States on the use of surgical data recording systems may serve as models and offer glimpses on the future application of this technology. At the AMC Hospital in Amsterdam, the strategy of the OR Black Box implementation leveraged its strengths, while mitigating challenges associated with economic cost and legal issues.[34] Comprehensive Black Box data at the hospital was discussed postoperatively by the surgical team, with the goal of creating a safe learning environment for physicians to properly review cases.[34] Importantly, the data from the system are not included as part of the medical record; however, patients still have some level of access to data.[34] A patient can request data if something goes wrong after a surgery, but identifying factors of the health care personnel remain anonymous.[34] All of the data of a particular case is only kept for a few days, and subsequently destroyed after postoperative analysis.[34] AMC's use of these data represents one strategy of promoting this technology's potential, by keeping the primary focus error identification, case review, and improving patient safety outcomes. The focus of this surgical data recording system is on objective and anonymized data generation, not its use to assign blame or fault in the event that there is an adverse outcome.

Importantly, the interest garnered by surgical data recording systems is rooted in more than just the ability to capture data; the literature confirms that data captured has informed better system-wide clinical practices in the hospitals that used them. Notably, at St. Louis Children's Hospital, the blood delivery system was replaced with a more efficient, time-sensitive blood delivery workflow process.[10] Medication detection failure tied to the implementation of a new electronic health record system triggered hospital-wide change—the information technology department at the hospital addressed glitches and shortcomings of the new electronic health record system, thus resulting in a hospital-wide decrease of software glitches.[10] At the Mayo Clinic, the realization that important intraoperative details were absent in medical record reviews led to a change in error detection strategies, and thus informed, data-driven teaching methods and simulation models to train newer surgeons.[11] In the Netherlands, surgeons used these data to develop a 28-item checklist to assess laparoscopic equipment issues during laparoscopic cholecystectomies. The checklist reduced instances of improper equipment positioning and settings/connections issues.[35]

From a legal standpoint, in the United States, many physicians traditionally deal with medical complications by way of M&M conferences. Such conferences heavily depend on discussion; memory recall during M&M case reviews about adverse events fuel analysis about the factors leading to iatrogenic events, in order to implement corrective measures and avoid recurring mistakes.[36] In the absence of precise data about how, when, and where specific types of error occurred and their root causes, M&Ms may have shortcomings. Bridging M&Ms with surgical data recording systems can strengthen the postoperative analysis. Legally, information discussed in M&M conferences and clinical peer reviews is protected under the Healthcare and Quality Improvement Act.[36,37] Such discussions are privileged, confidential, and generally shielded from being presented as evidence in litigation, essentially allowing health care providers to assess care openly and safely without the looming threat of liability or litigation.

Despite clear benefits to surgical data recording systems, in order to encourage widescale adoption and investment, existing legal and regulatory challenges must be resolved or clarified. This may require new patient-centered informed consent for this technology,

incentivization for both patients and providers to use these systems for shared goals and decision-making, and allowing for appropriate legal protections to encourage clinical adoption.

Conclusions

Technological advancements allow for patients to be active players in their own health care. Examples of such advancements include portal technology (ie, allows physicians and patients to access medical records and interact online), mHealth (mobile health promotes use of wireless devices that allow physicians and patients to access and send health information such as blood pressure checks and electrocardiogram results), remote monitoring tools (eg, home monitoring system where a device such as a pacemaker automatically transmits data to a remote center that would allow for a patient to be contacted by health care providers), and now surgical data recording technology.

This novel data collection technology can enable health care providers with crucial information about procedures in their respective fields, while facilitating coordination of care through enhanced data sharing, and allowing clinicians to understand why suboptimal outcomes occur within their team dynamics. A process of reviewing such details can encourage adherence to existing protocols as anomalies would be detected and variations in practice patterns could be corrected intraoperatively as well as postoperatively.

Furthermore, though the utility of surgical data recording systems has only been demonstrated in surgeries, its applicability can extend to other medical specialties. In anesthesiology, arguments have been made that the role of anesthesiologists in perioperative care and the general importance of quality and safety are both highly compatible with audio-video recording technology.[38] Critically, surgical data recording systems can provide mutual benefit for physicians and patients—the main stakeholders of health care systems. Though navigating the legal and regulatory questions will present its own challenges, the opportunity to introduce a potentially revolutionary technology for shared goals of patient safety necessitates further exploration.

Author Contributions

Study concept and design:
Acquisition of data: JJ and NAS contributed to acquisition of the data for this literature review
Analysis and interpretation: All authors contributed in conducting analysis and interpretation of data
Study supervision: TKM supervised the study

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