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IDEAS AND INNOVATIONS

Untethered and HIPAA-compliant Interactive Livestreaming of Surgery to Residents and Medical Students

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Summary: Traditional livestreaming of surgery to an audience requires stationary video broadcasting infrastructure, with viewers congregating in front of a screen, while audiovisual technicians provide support in the background. In recent years, livestreaming technologies from cameras to teleconference platforms have advanced dramatically, even to allow for compliance with the Health Insurance Portability and Accountability Act of 1996 with web-based encryption. The objective of this article is to show that livestreaming surgery in medical education is possible using portable devices, with the resident and medical students as audience at home interacting on their computer or smart devices. The surgeon utilizes a head-mounted camera transmitting video feed using a wireless transmitter broadcasting to a laptop computer, which is hosting a Health Insurance Portability and Accountability Act–compliant version of Zoom. The entire setup is portable, and the surgeon is tethered neither to a cord nor to the institution's audiovisual enterprise. This prototype setup allows the surgeon to broadcast live surgery interactively at any time and from any operating room with remote medical students and surgical residents. We posit that our medical education industry would need to condense the devices into a turnkey livestreaming camera system with optimized frames per second reception. *(Plast Reconstr Surg Glob Open 2020;8:e3165; doi: 10.1097/GOX.0000000000003165; Published online 28 October 2020.)*

INTRODUCTION

Livestreaming of surgical procedures has previously been described in a variety of surgical fields.[1,8] Recently, remote surgical training has become a relevant solution to address the surgical training gaps that medical students and residents may have experienced as a result of the COVID-19 pandemic.[4] Articles have expressed concerns about the safety of livestreaming surgeries,[3,5-7] but studies have shown that patient safety and outcomes are not compromised.[1,2]

Remote surgical training, therefore, should acclimate to the rise of distant learning culture. Offering livestreaming of surgery at training centers has the potential of simulating the same type of active learning experienced while in the operating room (OR). It is crucial for medical educators to be aware of the available technologies used to implement livestreaming for surgical education. Some centers already have ORs equipped with video cameras configured to broadcast over the Internet to invited viewers remotely. Even when such ORs are available, access might not be guaranteed. Furthermore, a technician would need to be arranged in advance to conduct the broadcast. To our knowledge, there are no reports in the literature that delineate steps in setting up a portable live-surgery streaming system in a Health Insurance Portability and Accountability Act (HIPAA)–compliant manner.[8] This involves the surgeon donning a headgear to wirelessly transmit the camera's video feed to a computer without being tethered to a machine or to the institution's infrastructure and audiovisual cost center. The livestream received on the computer can then be shared using a HIPAA-compliant teleconferencing platform. In this article, we describe a prototype configured to perform such livestreaming of surgical procedures using an untethered setup that captures surgeon's field of view.

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METHODS

We utilized the HIPAA-compliant version of Zoom (Zoom Video Communications, San Jose, Calif.) as our videoconferencing platform.

Hardware

Camera: GoPro Hero 7 (GoPro Inc., San Mateo, Calif.)
Headgear: Cordless headlight (as camera mount)
Capture Card
Wireless video transmitter and receiver
Bluetooth earpiece wireless headset
14.8 V Battery (powering GoPro and transmitter)
Waist holster (carrying battery and transmitter)
Laptop computer

Connections

GoPro connected to the waistline wireless transmitter
Camera and transmitter are connected to battery
Wireless receiver is connected to laptop via capture card (HDMI to USB)
Bandwidth 50–150 kbps

Settings

Camera

1080, 30 fps (frames per second)
Light compensation, −2 (under Protune setting[9])

Zoom Teleconference

Password enabled
Bluetooth earpiece
Screen share the capture-card utility

Fig. 1. Picture of a surgeon equipped with a light-weight headgear, a wireless earpiece, and a belt holster with a battery and a wireless transmitter.

RESULTS

While the patient was being prepared and draped, the surgeon started Zoom conferencing on the laptop with wireless video receiver powered on. The surgeon connected his headset to the laptop using Bluetooth. He donned a waist holster carrying a battery and a transmitter (1304 g) and then the wireless headlight pre-mounted with a GoPro camera (492 g). The camera was connected to the holster's devices by HDMI and power cords (128 g). The surgeon was not tethered to any stationary device or power source (Fig. 1).

After gearing up, he notified the trainees to join the Zoom teleconference, confirmed active livestream connection, and then scrubbed in. With the wireless headset earpiece, the surgeon was able to interact with the trainees regarding the defect, planning of incision, intraoperative pertinent anatomy, basic surgical techniques, tenets of surgery, and assessment of flap perfusion. (**See Video 1 [online]**, which presents excerpts of a livestream recorded by a participant using Zoom app during a latissimus musculocutaneous flap elevation.) (**See Video 2 [online]**, which shows the livestreaming equipment lineup, and excerpts of a livestream recorded on participant's Zoom app during a perianal perforator flap elevation are presented.)

Image brightness tended to be excessive ("bleached out")[10] with GoPro exposure compensation set at 0 under maximal OR illumination. Overexposure was minimized by adjusting the intensity of the OR lights. Adhering to the time conservation principle during surgery, the camera's setting could not be adjusted once the livestream had started. For the second video, exposure compensation was set to −2 to compensate for the bright OR lights. While fps was only 2–3, latency was under 1–2 seconds with no freeze-up or dropped connections, allowing for a satisfactory interactive experience.

DISCUSSION

One of the most widely used communication systems today is video streaming, and video content now accounts for a majority of all Internet traffic.[11] Video communications are a good alternative to face-to-face meetings; however, the utilization of telemedicine has not been fully embraced until emergence of the COVID-19 pandemic, forcing healthcare providers and administrators to scramble in implementing various teleconferencing platforms, while the federal government temporarily relaxed HIPAA regulations. Simultaneously, social distancing mandated from the pandemic is revolutionizing distant learning. While major technological advancements in web-based livestreaming and video gadgetry have taken place over recent years, the field of medicine has been slow to adopt such technologies for training residents and medical students.

Even though many medical centers have ORs equipped with cameras capable of broadcasting, livestreaming surgery to teach residents and medical students has not yet become mainstream. While we have cameras built into OR lights or mounted on booms, such set-ups are expensive and require specialized technicians.[12] Professional livestreaming services also add a significant cost. At our medical center, such equipment is stationed in only 15% of ORs, and access to such rooms is based on surgical and not teaching needs.

Configuring a set of portable equipment in which the surgeon can employ on demand for livestreaming surgery for teaching purposes likely will prove valuable, as medical centers accept such technology for training in the clinical setting and further cultivate the distant learning agenda. This article is proof-of-concept that the surgeon can livestream surgery in a HIPAA-compliant manner without being tethered to stationary equipment or institutional enterprise.

The authors posit that industry should develop turnkey versions of our prototype with enhanced integration with HIPAA-compliant web-based livestreaming platforms for robust framerate reception with minimal frame drop. The entire setup should be simplified to a camera on head gear with Wi-Fi connection to the existing computer in the OR for livestreaming via browser-based encryption.

CONCLUSIONS

We showed that livestreaming at surgeon's vantage point in a HIPAA-compliant manner using portable equipment is feasible. The surgeon was able to move freely without cord attachment to any stationary device. Anatomical planes, including vascular anatomy, were adequately visualized. Our prototype is potentially an effective teaching tool and springboard to promote the current distant learning revolution.

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