Frugal Digitization of Analog Video Endoscopic Medical Records in a Kenyan Rural Medical Center

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Summary

Background: Digitization of healthcare data has led to widespread healthcare transformation. This has been enhanced by the availability of new technologies at lower costs. Video recording can improve the quality of care, provider skills, education, and patient follow-up. However, limitations such as the risk of litigation, patient privacy, and poor legal framework have curtailed adoption. Rural hospitals have older analog equipment due to limited financial resources. **Objectives**: This study aims to present an alternative low-cost option. **Methods**: We present an economical method of recording and digitizing endoscopic and laparoscopic procedures performed on analog video processing towers. We showcase a video of the step-by-step procedure that involves connecting a digital video home system (VHS) video recorder to an analog Olympus endoscopy machine (Model CV-100) and transferring media via a portable storage device to an electronic medical record database. **Conclusion**: Using simple home video recording devices provides a low-cost solution to creating digital records from analog video endoscopic machines. The technique, however, creates additional steps to the endoscopy process and the need for capacity building of the endoscopist. Patient consent forms should cover video creation. Medical centers should have a robust information management system to securely store and retrieve digitized video records.

Keywords: Endoscopy, Records, Digitization, Analog, Innovation

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Introduction

The digitization of healthcare data in the past few years has led to innovative transformations in the industry. It has increased access to healthcare data enhancing transparency to public and private stakeholders. In addition, the advent of smartphones, tablets, and other e-devices aid in easing communication and connections with medical equipment, thus improving access to healthcare services (1).

Surgeons and patients refer to the Internet and websites such as YouTube™ to learn about surgical procedures. However, videos on these platforms are of low quality and have poor educational value (2). More effort should be placed on improving the surgical video availability and quality (3). Although there has been an increase in the prevalence of recording and archiving of digital medical records, the digital data produced during medical procedures such as endoscopy and laparoscopy are still minimal. The field of systematic digital recording and documentation (DRD) of endoscopic procedures is generally at the infant stages. It has been

demonstrated that in some regions, such as Israel, despite having high access to DRD equipment, the actual recording rates remain low among doctors (4).

Factors limiting the widespread adoption of endoscopic video recording include (i) doctors' concern about the potential risk of lawsuits, (ii) privacy concerns from both the patients and professionals, and
(iii) lack of a clearly defined legal framework for video recording in medical practice (4, 5).

The described benefits of video recordings include (i) improving quality, efficiency, and safety of care,
(ii) improving clinical skills of healthcare providers, (iii) medical education, and (iv) improved patient follow-ups (3, 4, 6–8).

Rural hospitals lack access to resources to support the purchase of new, often expensive digitized medical equipment or DRD devices. This, however, can be solved by using low-cost non-medical digital video recording equipment, readily available off the shelf.

Table 1. Step-by-step endoscopy video digitization process

Step	Equipment	Process
Step 1	Diamond VC500ST One Touch Standalone Digital Converter (VHS digitizer)	(i) Inspect device; (ii) connect external USB storage; (iii) power the device
Step 2	Olympus endoscopy video processor, model CV-100	(i) Power on the device; (ii) connect the RCA output cable to the VHS digitizer; (iii) confirm output signal/video is transmitted on VHS digitizer screen
Step 3	VHS digitizer	(i) Start video recording when the endoscopy procedure begins; (ii) confirm output signal is transmitted on digitizer screen and recording is ongoing; (iii) stop video recording at the end of the procedure
Step 4	Computer	(i) Remove the external USB storage device from the VHS digitizer and connect it to the computer; (ii) extract and save the video files on your secure HMIS or storage repository

Abbreviations: HMIS, Health management information system; RCA, Radio Corporation of America; VHS, video home system.

Methods

We present a low-cost, novel method of recording and digitizing endoscopic and laparoscopic procedures performed on analog video processing towers. Our method involves the connection of a video home system (VHS) video digitizer device, costing approximately US$150, to an existing endo/laparoscopic video processor using analog cables. Media recorded on the VHS digitizer is then transferred via a portable storage device to a computer and any electronic medical record database where it can be used as needed. The step-by-step process is described in detail in Table 1. A video of the same is available on this link https://osf.io/5m8wr/files/osfstorage/633bd767d5b01009361f9878 or https://drive.google.com/file/d/1zl6yzeA52o9FKnf1V0RsLUKYGGa4DunA/view?usp=sharing.

We selected Diamond VC500ST One Touch Standalone Digital Converter (available at: https://www.diamondmm.com/product/diamond-vc500st-one-touch-standalone-digital-converter/) as our VHS video digitizer. The device has the ability to

receive analog video signals transmitted via Radio Corporation of America (RCA) or Separated (S-video) analog cables. Video images were transmitted from an Olympus endoscopy video processor, model CV-100. The video unit can distribute its video output on two simultaneous output channels: one to a video monitor and the second to a printing device. Video output from the CV-100 is delivered using either S-video or RCA to the receiving devices. We connected one of the output channels to the VHS digitizer. The VHS digitizer can directly record all input signals received while simultaneously displaying the output on a screen on the device.

An auxiliary storage device should be connected to the VHS digitizer prior to recording. The recorded video is saved onto the external storage device, that is, a USB flash/pen/thumb drive or Secure Digital (SD) memory card. Video recording is started at the start of the endoscopy procedure, and the VHS digitizer screen is monitored to ensure active recording is taking place as the procedure continues. The video is recorded in Motion Picture Experts Group 4 (MP4) video format, at 640 by 480 pixels standard definition. On completion of the procedure, the video recording is stopped. The external storage device is safely removed from the VHS digitizer and connected to a computer. Saved video files can be retrieved from any computer, indexed/labeled, and securely stored on the medical center's information system for future reference. Depending on the device's memory capacity, multiple recordings can be stored on the external storage device. A 10- to 15-minute video typically takes up 400–500 MB of storage space. The VHS digitizer also allows the capturing of still images. The same process as above is employed; however, instead of pressing the record button, the VHS device has a separate button for still image capture. A still image measures 640 by 480 pixels standard definition and occupies approximately 1 MB of space.

Discussion

We demonstrated an economical alternative method of capturing digital endoscopic videos and images without investing in newer, more expensive endoscopic machines with these built-in features. The VHS digitizer was selected due to its relatively lower purchase cost at US$150 compared with surgical video recorders, which ranged from US$400 to US$600 (9). The device was purchased directly from an online store.

Additional cost savings were realized from the lower cost of printed reports. Printing endoscopy reports from a standard office printer was cheaper than from the medical-grade digital color endoscopy printer. However, the quality of these images was seen to be lower than those from the medical-grade printers.

The videos and images generated from the endoscopies have been used internally for training purposes. Historical reports are easily accessible by local clinicians during patient reviews, thus enhancing continuity of care.

Some institutional adjustments were made to cater for video recording. Endoscopy consent forms were updated to accommodate consent for video recording. Secure online cloud storage was needed for archiving of the video endoscopies. However, due to the rising cost of storage, it was agreed institutionally that, not all videos would be stored, but all digital images would be preserved. Our Health management information system (HMIS) is not robust enough as it was not designed to store such information. As a result, files were kept in an external cloud storage server.

It was found that the process of manual digitization of video endoscopy reports took a longer time as compared with creating a traditional written report. The longer time requirement resulted in longer turnaround times in the endoscopy unit and reduced operational efficiency. The increased number of steps needed to perform an endoscopy was seen as a potential area for resistance by clinicians. Endoscopists need to be trained in the new method to build capacity and acceptance of the technique.

Challenges

There are some limitations to the proposed method. These include (i) need for technical capacity on the use of these video recording devices, which can be resolved by providing training to the endoscopists,

(ii) limited compatibility of analog machines to the digital video recording equipment, resolved by having a

variety of cable adaptors and connectors, (iii) these devices may also break-down or have technical challenges, thus the need to have back-up, (iv) inability to produce high-definition videos and images, thus users and institutions eventually need to upgrade to newer endoscopy devices, (v) need for additional storage to archive the videos, institutions and providers need to invest in HMIS with robust capabilities or subscribe to a cloud storage service, (vi) longer documentation and procedure time, which may lead to resistance and poor uptake by clinicians; integration of digital recording devices to automate data transfer may resolve this in the longer term, and (viii) consenting patients for videos and images requires healthcare providers to update their consent forms to cover this.

Conclusion

We found that the use of simple home video recording devices is a frugal alternative for digitization of older analog video endoscopy and laparoscopy units. However, the quality of videos generated is not high-definition. Ultimately, medical centers will need to upgrade their endoscopy units to newer, high- definition equipment. The digitization of endoscopic records is helpful in medical training and improves information management at a low cost, thus enhancing patient care. Despite the availability of these devices, some factors still limit their broad adoption. Patient consent forms should be updated to cover video creation. Medical centers should have a robust information management system to store and retrieve digitized video records securely. A broader study including multiple service providers of endoscopy and laparoscopic services should be conducted to learn more about their current experiences and challenges with similar implementations.

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