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Using video-based observation research methods in primary care health encounters to evaluate complex interactions

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Abstract

Objective—The purpose of this paper is to describe the use of video-based observation research methods in primary care environment and highlight important methodological considerations and provide practical guidance for primary care and human factors researchers conducting video studies to understand patient-clinician interaction in primary care settings.

Methods—We reviewed studies in the literature which used video methods in health care research and, we also used our own experience based on the video studies we conducted in primary care settings.

Results—This paper highlighted the benefits of using video techniques such as multi-channel recording and video coding and compared “unmanned” video recording with the traditional observation method in primary care research. We proposed a list, which can be followed step by step to conduct an effective video study in a primary care setting for a given problem. This paper also described obstacles researchers should anticipate when using video recording methods in future studies.

Conclusion—With the new technological improvements, video-based observation research is becoming a promising method in primary care and HFE research. Video recording has been under-utilized as a data collection tool because of confidentiality and privacy issues. However, it has many benefits as opposed to traditional observations, and recent studies using video recording methods have introduced new research areas and approaches.

Keywords

Primary care research; Video recording; Observations

1. Introduction

The health care system is complex and involves a range of people from various backgrounds and perspectives who communicate, interact, and collaborate. Several US Institute of

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Medicine reports have addressed major problems in healthcare delivery, such as medical errors, poorly designed medical technologies, and poorly designed work environments.[1] To this end, an Institute of Medicine (IOM) report proposed a partnership between health care and industrial and system engineering, including Human Factors Engineering (HFE), to create solutions for these problems.[2] HFE is the study of interactions of humans with the systems, products and environment and takes a system approach to study interactions.[3] Primary care is one of the main components of the health care system and involves the widest scope of health care, including a variety of demographics such as patients of different ages and socioeconomic backgrounds as well as patients with different kinds of chronic and acute health problems.[4] There are several HFE issues specific to the primary care environment that human factors researchers can address with various methods. Some of them are related to information processing, standardization, simplification, work pressure and work load, organizational design, information access, technology acceptance, usability, and the effect of EHR use on doctor-patient interaction.[5] Depending on the context, HFE researchers are tasked with determining which components of the system are likely to influence patient outcome measures (e.g. satisfaction, trust, and adherence to treatment). Therefore, the HFE discipline can play a major role in improving overall primary care health systems, leading to better health outcomes.[4]

Observational research is a commonly used method in primary care studies. However, direct observation is not always the best choice for analysing primary care encounters[6], as it is difficult for researchers to capture all details in a live setting, particularly when components occur simultaneously.[7] Video recording may eliminate some of the challenges that occur in direct observation research in a primary care setting[8,9], since video recording accurately records clinical events, allows researchers to verify their observations, and allows for the collection of systematic feedback by means of strategic participant review.[10] Video data can also give researchers insight into the consistency between self-assessment and observable behavior. Finally, the video recording of subjects' ongoing activities in their natural setting[11] can also be a particularly useful way to employ ethnographic studies in a complex primary care environment.

However, using video effectively requires determining appropriate research questions and identifying types of data required beforehand, to inform study design. Video recording research also requires technical knowledge to ensure the appropriate selection of cameras, video quality adjustment, and positioning of cameras.[12,13] Currently, enhanced video technology allows for richer data and facilitates the data collection process with alternatives such as multi-channel streams and remote controlled cameras.[14,15] It is essential to note that the research purpose may affect the type of technology used in the study design.

This paper outlines the steps for using video methods in a primary care setting. This paper also addresses potential benefits of using video observation and video analysis methods, which can be used by human factors and health care researchers in primary care settings.

1.1. Background on the use of video recording in primary care research

Primary care researchers began using video recordings to study consultations in the late 1970s.[16] In one early study, a communication analyst videotaped primary care consultations

with a single video camera and subsequently analyzed the communication patterns between doctors and patients to improve doctors' communication skills.[17] The results showed that doctors' communication styles affected patient satisfaction. Recent studies have used video data to analyze nonverbal communication cues to inform more effective doctor-patient interactions.[18–20] Video data was also utilized to train doctors to improve their interactions with patients.[16] In addition, studies have used video recordings to explore doctor-patient-computer interactions.[21–29] These studies were instrumental in identifying the best spatial organization of an exam room, better design of exam-room computers, impact of computer use on communication and effective use of the computer by the doctor during the clinical visit. Several studies also utilized video elicitation interviews (which are basically interviews done after the recording, asking the doctors or patients to reflect on what they see on the video) to analyze doctor-patient interaction in the visits for teaching purposes.[30,31] Video elicitation allowed researchers to integrate the data from the video recording and participants' related thoughts, beliefs and emotions obtained from the elicitation interviews.[32] Although traditional observation can provide a range of interesting and insightful information about primary care encounters, the encounter occurs through complex and multiple interactions, which can be explored by video data better. Finally, video data has also been used in health care settings in addition to primary care consultation for various purposes.[33]

2. Considerations for collecting video data in primary care

Video-recording methods require careful planning in order to gather data that effectively answers potential research questions. Table 1, which is derived from our experience of several studies[26–28], summarizes the steps to conduct a video observation study in a primary care setting for a given problem.

Some of the elements listed in different categories in table 1 have inter-dependent nature, for instance, number of participants, time frame of the study, time needed for ethical approval and the instruments may all have mutual effect. Furthermore, video data might have "identifiable private information" and involve human subject data, therefore requires some additional requirements for IRB review.[34] In video data collection, compared to traditional observation, studies conducted in US showed that physicians might have concerns about potential liability.[35] Therefore, there should be a consensus between administrators and investigators about the purpose of the research and the methods used. Studies in US reported that it can also be effective to have some strategies to overcome doctors' concerns with confidentiality and liability, such as obtaining certificates of confidentiality[36] or becoming familiar with the liability coverage at the clinic where data will be collected.[37] As added protection, a previous study reported that patients were generally less worried than doctors about being videotaped.[32] However, it is still essential to get certificates of confidentiality to protect the participants' identifiable information from forced disclosure. IRB approval requires confidentiality, but in the case of some sort of legal case (such as a malpractice case), the court might be able to force researchers to reveal this information. Certificates of confidentiality-which allows the investigator and others who have access to research records to refuse to disclose identifying information on research participants in any civil, criminal, administrative, legislative, or other proceeding, whether at the federal, state, or local level-

might prevent this potential conflict between IRB and legal jurisdictions with respect to discoverability.[38]

With technological advancements, some researchers have started to use more complex video methods for data collection to capture all interactions in detail - such as body language and gazing direction.[9,14,39] A multi-channel video might be a superior method to single-channel video depending on research question as it collects a greater amount of information, allowing the research to see both the care-provider and the patient simultaneously from different angles.[14] For instance, some researches created a multi-channel video technique and software to capture all the computer use (including screen-capture, key stroke, and mouse movement), and doctor-patient interaction in detail, which enabled them to view simultaneously all data relating to any time or activity.[25] Another study used multi-channel video recording focusing on the patient's face, the physician's face and the overall interaction to capture eye gaze patterns.[27,28]

Furthermore, as video recording technology becomes more complex, researchers are faced with a wide variety of options, so it is important to choose the methods and equipment best suited to a given study. Researchers should standardize the camera operation protocols and have back up cameras in case of malfunctioning. In addition, multi-channel video and audio recording can collect so much data that the process of analysis becomes more complicated and time consuming. Therefore, it is essential to determine the specific research problems to minimize data collection and analysis time.

3. The benefits and drawbacks of video methods

Table 2 illustrates the pros and cons of traditional human observation method and video recording by "unmanned" cameras. This table was established based on our own experience and previous studies.[6,7,36,37,39,40–42]

Video methods can be effective for research that can be conducted in a single room (e.g. the patient exam room in a primary care clinic), since the cameras can be set up in a fixed position, specifically focusing on the interaction in the exam room. In addition, cameras can also be used in various ways based on research questions, because cameras can be carried, placed in multiple rooms, or cameras' angle can be changed in real-time by remote control. When the required conditions are met, the video method can provide a rich collection of data. For instance, in one study, we used multiple small cameras with sufficient battery time and SD cards and hooked them to the walls or side of the desks in the room. Remote control was utilized to start and stop the camera and a remote control was left with the doctor so the doctor could stop the recording if the patients did not feel comfortable or the conversation topic becomes highly confidential, such as drug use or suicide.

Furthermore, video method also limits the Hawthorne effect -which is the possibility of altering the behavior of participants-, since video cameras have been shown to influence participant behavior far less than a human observer.[43] However, some people may be less willing to be videotaped as opposed to live observation and feel there is more risk involved in video data due to the several reasons: a) video recordings may be viewed by multiple people over time, b) outsiders may gain access to video data that is improperly stored, and c)

a person's identity may be more readily determined from a video recording than from written data. On the other hand, video data might improve ecological validity, since the video data gives more complete (and visual) information about the real environment rather than traditional observers' observation notes.[44]

4. Video data management and analysis

Observation data, including both video and non-video data, are confidential. However, video data introduce more risk to overall confidentiality because video data keeps all interaction in a high fidelity format for several years and might be accessed by multiple people for research or non-research purposes unless sufficient precautions are taken. Video data should be stored on a secure storage without links to other identifiable information, such as address, name, social security number.[32]

Coding is a standard procedure to analyze the video data. Coding is an established procedure that facilitates analyzing the video by identifying the tasks and interactions in the video.[19] A coding scheme classifies variables of interest in the video according to the purpose of the analysis, and it speeds up the coding process. Development of coding scheme should be informed by the literature.[45] Each variable in the coding scheme should be well defined, and the start and stop time of all variables should be standardized. This may help to improve the reliability of data coding and decrease biases of different coders. For example, in one study, coders were interested in the gaze direction of the doctor and patient[46] and created a coding scheme including the subject (patient or doctor) and the object of the gaze (patient, care provider, computer, chart, etc.). This scheme allowed for a thorough and specific analysis of gaze based on subject, object, and duration, such as total duration of doctor's gaze at computer and patient during a visit.

Video data can be coded both quantitatively and qualitatively depending on the purpose of the research. Quantitative data might include the duration of specific behaviors in the visit. Software packages can help quantify all continuous behavior (such as gazing or typing) to obtain relevant data with respective time frames.[27] It is also possible to visualize the sequence of the behaviors using software. Qualitative analysis might be a thematic description of a practitioner's behavior during the entire visit, such as patient-focused or computer-focused. Qualitative data might also be gathered based on verbal communication, such as analyzing turn takings, sequence of utterances.[18] Some studies also used tools such as check lists (physicians' behavior checklist) to capture human performance data from the video recording[47], such as counting the occurrence of specific doctors' behaviors during the doctor-patient encounter in the video data.[48]

4.1. Video analysis tools

Several computer programs have been used to analyze videos effectively and accurately. These programs comprise different features to capture and analyze video and audio and can produce different types of results, such as numeric and visual. A few of these programs used in previous studies[27, 44, 49, 50] are listed in Table 3 below.

5. Potential uses of video data in primary care research

Evaluating complex constructs and interactions in real, complex, and dynamic clinical environments plays an important role in improving health care system; thus, it is a priority for HFE researchers. Effective functioning of the health care system depends on the interactions among people (patients, physicians, and other medical staff) and the interaction between people and technology.[4] Therefore their interactions should be explored in detail to improve overall health care systems. Video data can contribute to studies exploring doctor-patient interaction for different research purposes, such as analysing the decision-making process between doctor and patient[30], determining the effects of nonverbal behaviors between patient and doctor that influence their decisions[31], exploring factors which yield misunderstanding and disagreement during the interactions[51], and investigating patients' responsiveness to specific doctor behaviors.[52] One study also reported a list of seven different goals to use video recorded consultations.[39] Furthermore, video data can also contribute to the analysis of people-technology interaction in primary care settings.[53] For instance, it is critical to capture accurately both the pathways users take and the errors users commit while conducting a usability test of a mobile device. The traditional observation method might fail to obtain all data related to pathways and errors during real patient encounters, so video recording could record all necessary data from the screen to be analysed. In addition, with the integration of an eye gaze tracker, video data can provide rich information about eye gaze pathways to analyse the usability of medical software programs.

Video data has also been used to create and test a number of different interactions models in the primary care environment. Provided below is a list of several studies that used video data, along with the various methods and models they used to analyze verbal, nonverbal, and technology interactions in the clinical environment (Table 4).

Video data can also contribute to doctors' training since it provides an opportunity for doctors to review their own activities.[40] Multiple studies have recorded consultations in the primary care environment to assess clinical competence and design educational interventions.[14] Video data were also used with simulations for medical education.[67] Clinicians' interaction style with patient and computer during the visit can influence patient outcomes such as satisfaction, trust, and adherence[68], so video data analysis can also contribute to teaching medical students better ways of interacting with patients and EHRs during the encounter.

5.1. Video data and sociotechnical design

The components of a sociotechnical system include the individual (such as health care workers), tasks, tools and technologies, the physical environment, and organizational conditions.[69] It is essential to understand users of the system and interactions among these users in real settings to address socio technical design concerns.[70] It is also necessary to better understand the impact of boundaries on sociotechnical systems and their implications for physical, cognitive, and psychosocial ergonomics. Furthermore, effective design, implementation, and use of newly introduced technologies into the overall system is strongly related to the fundamentals of human factors ergonomics.[71] A number of studies have focused on the concept of sociotechnical factors that complicate health information systems

deployment[72], including the interaction between the technical features of a health information system and the social features of a health care work environment.[73] After a new system implementation, sociotechnical interactions have a direct effect on the success of the process. In the future, many new medical technologies will be introduced into the system. Video recording might also be a strong tool to explore technology interventions, which can make sociotechnical systems more effective and efficient. For instance, video data can be used to analyze the current medical technology such as Electronic Health Records (EHR) and to inform how new EHR can be integrated into the sociotechnical system more effectively.

6. Conclusion

Video-based observation research is a promising method in primary care and HFE research. Video recording has been under-utilized as a data collection tool because of confidentiality and privacy issues. However, it has many benefits, and recent studies using video recording methods have introduced new research areas and approaches. There are several possible applications of video recording in HFE and sociotechnical research as well as in traditional clinician training, such as performance evaluation and analyzing clinician-patient interactions. This paper is intended to prepare researchers for using video-based observation studies in primary care settings by evaluating the necessary steps involved, including the legal and confidentiality processes, technical aspects, data collection, and data analysis, and by describing its contribution to human factors research.

A systematic analysis of video recordings gives researchers opportunities to find solutions for human factors-related problems, as well as a sociotechnical systems analysis of interventions in primary care. Video recording method will be increasingly used in future research not only in the health care domain but also in other domains, such as usability and, social interaction. Video recording observation studies in primary care environment will continue helping to answer a variety of emerging research questions in primary care.

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Table 1

Steps followed to conduct this video study

1. Conceptualizing the study
a. Choose an appropriate research question which can be answered by video data
b. Identify potential time frame of the study
c. Decide on the scope of the data collection
d. Decide on any additional data collection instruments such as interviews and surveys
e. Decide on the required number of personnel for data collection
f. Decide how to link the data from video recording with the other interview and survey data
g. Choose method to analyze the data (Quantitative, Qualitative, or mixed methods)
2. Legal and Ethical issues
a. Ensure the study meets with ethical guidelines for human subjects research
b. Describe all details of the procedure of the study
c. Comply with all legal requirements for recording in real environments
d. Obtain legal consent for video recording
e. Ensure all privacy and confidentiality issues related to participants' ID preservation and identifiable video data storage
f. Complete and comply with all local regulations, such as online HIPAA training in US to be eligible for human subject research
g. IRB application and final approval in order to start the project
3. Participants and Sampling
a. Determine the number of participants you need
b. Determine the unit of analysis and sampling frame that will most effectively help answer your research question(For example, do you need a certain number of patients in general or a certain number per physician? Will you recruit physicians or patients first? Will you randomly recruit the physicians or have certain eligibility requirements, such as people within a certain age range? Will participants be paid?)
c. Inform all participants about the benefits and risks of your study
d. Conduct the recruitment as planned in the IRB
e. Get informed consent of all people who agreed to participate to the study
4. Data Collection and Management
a. Decide on all technical specifications of the equipment you need
b. Choose an appropriate high quality camera or cameras
c. Choose the best audio recording style (built into camera or separate)
d. Determine the camera layout of the room; get the best angle to ensure a clear view of the patient and doctor
e. Establish a protocol for recording the interactions
f. Maximize the captured area by adjusting the camera angle
g. Create protocols to link the data
h. Sync the audio and video data for the analysis.
i. Determine protocols for storing video recordings
j. Secure the hard drives for privacy protection
k. Back up the data
l. Train all researchers, camera persons, interviewers, etc.
5. Data analysis

a. Review the quality of all data

b. Identify the software you will be using to analyze the data

c. Clearly distinguish the research questions and analyze accordingly

d. Create coding schemes to analyze the video based on the variable of interest

e. A pilot run/trial analysis after collecting the data from a smaller sample to prevent potential mismatch

Table 2

The benefits and drawbacks of video method and traditional observational method

	Pros	Cons
Traditional observational method	Enables rich data	Researcher may be intrusive
	Can capture events before and after the consultations	Aspects of interactions may be missed
	Allows researcher to ask follow up questions during the observation	Does not allow for data validation through cross-coding
	More effective while shadowing a specific person in multiple locations	Prior work is necessary to prepare organized and standard observation tools
	Researcher is able to see all space in the room	Hard to catch nonverbal cues during the encounter
	Gives opportunity to concentrate on one individual continuously	Cannot capture all interactions in a complex clinical environment such as a surgical room
	Effective for medical students for training purposes	Possibility of Hawthorne effect
		Prior training of observers necessary
		Cognitive workload for observers
		Low inter-rater reliability
Video method	Less intrusive method for data collection (Avoiding the observer effect)	Reviewing and coding video data is labor intensive
	Provides enough detail to analyze the work environment and human interactions qualitatively and quantitatively	Requires additional IRB procedures
	Allows researchers to analyze events retrospectively	Raises concerns about the discoverability and confidentiality of participants
	Allows researchers to capture simultaneous complex interactions	Additional equipment cost
	Allows researchers to review consultations repeatedly	Additional data management concerns
	Creates a permanent and complete record	Aggregation can be difficult and intrusive
	Potential for multiple viewing/reviewing	It can limit range of settings
	Higher inter-rater reliability (with the help of practice coding)	Possibility of Hawthorne effect
	Can be used to establish connections between perceptions and the observed activities during the visit	Higher overall cost
	Retains the captured data with no loss of its richness for reviewing	
	Enables self-evaluation and reflection	
	Generates a large amount of data	
	Allows researchers to capture activities in much of their complexity in their natural settings over an extended period of time	
	Allows for scientific rigor when conducted by trained researchers	
	Can be reviewed by both researchers and participants, increasing the scope of interpretation	

Table 3

Video Analysis Computer Programs utilized in several studies- partially adapted from (4, 43)

Programs	Features
Observer/Noldus (www.noldus.com)	Allows users to annotate and log video data and analyze time line.
MacSHAPA (http://acs.ist.psu.edu/dismal/macshapa.html	Integrated with VCR (video cassette recorder) control, annotation and coding, and post-coding analysis function.
A.C.T	Touch coding (i.e. one key stroke input) for reviewing videotapes in real time observations.
OCS Tools (http://trctech.com/send.php?ocs.php)	Set of tools that enable VCR control, time code reading, input of annotation, and coding.
Vanna	This can display multiple video sources along with other time -stamped information on a single computer monitor.
VINA	Manual and scripted VCR control VCR control by pointing Touch coding of events and activities Temporal graphic representation Data synchronization with VCR.
Tagging Software	Specifically to capture several behaviors.
Computer assisted time and event recorder (CATER)	This computer program has been used to help record extensive observational data from consultations.
The ALFA (Activity Log Files Aggregation) toolkit	A method for precise observation of the consultation with multiple video channels.
Atlas.ti (www.atlasti.com)	Organize text, graphic, audio, and visual data files, along with coding, memos, and findings, into a project.
QSR Nvivo (www.qsrinternational.com)	Analyze, manage, shape and store qualitative data.
HyperRESEARCH (www.researchware.com)	Easy to use qualitative software package enables researchers to code and retrieve, build theories, and conduct analysis of the data.

Table 4

Type of analysis used by video observation studies

Type of Analysis and Methods (Corresponding Reference)	Explanations of what to measure
Observation (Hermansson et al., 1988)[54]	The authors observed positive behaviors such as gazing, body directions and gestures to see if the patient was satisfied with the behaviors of the doctors.
Roter Interaction Analysis System (RIAS) (D. L. Roter, 1977)[55]	A content analysis system for verbal communication.
Lag-Sequential Analysis (Connor, Fletcher, & Salmon, 2009)[56]	Two-way analysis of nonverbal cues or verbal communication cues between doctor and patient.
Gender-based observation studies (Hall, Irish, Roter, Ehrlich, & Miller, 1994)[57]	Specific correlation of doctor's gender's effect on verbal and nonverbal communication.
Bales Interaction Analysis System (Ong et al., 1995)[47]	Analyzes interaction and information exchange between doctor and patient; focuses on instrumental behaviors.
Interpersonal skill evaluation (Burchard & Rowland-Morin, 1990)[58]	Analyzes surgeon's interpersonal skills and the appropriateness of the physician's behavior for a clinical visit.
Maastricht History-taking and Advice checklist (Kraan et al., 1989)[59]	Analyzes physician's interview skills during initial interviews in the primary care units.
Observer Checklist (Ong et al., 1995)[47]	Analyzes specific interactions between doctor and patient.
Factor Analysis (Duggan & Parrott, 2001)[60]	Based on coding of nonverbal behaviors from videos. The mean scores for use of each type of nonverbal and verbal behavior were computed separately for the introduction and diagnosis segments to allow comparisons between these interaction events.
Retrospective Approach (Als, 1997)[61]	The videos were watched with doctors to analyze their behaviors in the consultation together.
Correlational Analysis (Collins, Schrimmer, Diamond, & Burke, 2010))[62]	Analyzes the relationship between verbal and nonverbal communication skills.
Nonverbal Accommodation Analysis System (NAAS) (D'Agostino & Bylund, 2010)[63]	The NAAS enables researchers to investigate the ways in which physicians and patients manage social distance through nonverbal behaviors within medical interactions from a theoretically- informed perspective.
Conversational Analysis (Newman, Button, & Cairns, 2010)[64]	Specifically, turn taking in the communication of the doctor and patient in the clinic.
Goffman's dramaturgical methodology (Pearce et al., 2008)[65]	Dramaturgy analyzes the consultation as though it were a dramatic play where the consulting room is the stage and the participants are actors playing roles.
Observational Quantitative (Mast, Hall, Klöckner, & Choi, 2008)[66]	Quantifies nonverbal behaviors in the patient visits using a special software tool.