Lauren Gaither

Professor Béhague

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<p align="center">The Intersection of Health Literacy and Technology on Patient Outcomes</p>

Introduction

Overview

Whether by means of surgery, medication, or intervention, the primary focus of physicians is to improve the health and well-being of their patients. The well-being of the patient is influenced by the patient-professional interaction, and a slew of factors go into building that relationship (Cramm & Nieboer, 2015). One of these factors is the education level, and more specifically the health literacy level, of the patients. Health literacy is defined as "one's ability to obtain, understand, and use health information to make appropriate health decisions," and it governs not only the doctor-patient relationship, but also has influences on the accrued cost, quality of, and access to medicine (Clark, 2011). A 2014 review by Kelley et. al defines the doctor-patient relationship as having two facets: emotional and cognitive care. A poor educational background or insufficient health literacy may interfere with both forms of care, but directly impairs cognitive care, as it is based on the ability to share information and manage expectations. Rothman et. al (2004) found that patient literacy may also be a significant predictor of intervention success rates and is therefore crucial in managing patient outcomes. As technological advancements increasingly become a part of healthcare and hospital day to day activities, it is crucial to understand the effects it may have on patient-physician interactions, patient financial burden, and patient health outcomes. Though definitive results may be difficult

to achieve due to the subjectivity of the data and the opinions surrounding technology in healthcare, the analysis is a necessary one (Junewicz & Youngner, 2015). Ultimately, the effects of health literacy and technology on patient outcomes may be the difference between worsening conditions and patient recovery.

Questions and Aims

The main aim of this literature review and the associated interview is to investigate how the interaction of technology and health literacy affects patient outcomes. Because health literacy has no universal method of measurement and is therefore rarely mentioned as a measurable quality in the literature review materials, education level and overall literacy, the level of which an individual can read and write, will often be referenced in its place, as the two are correlated with one another. As discussed in this review, technology will include hospital machinery in the interview portion, but largely will refer to electronic medical records (EMR) and telehealth. The definition of "technology" can be broad, and a lack of clarity can lead to different interpretations, as seen later in the interview. Sub-aims include examining the effects of hospital technology on doctor-patient interaction, patient financial burden, patient advocacy, and patient health outcomes. Finally, this review aims to discuss the benefits and limitations of technology and how technology and its effects may alter the current healthcare system.

Methods

Literature Collection

I aimed to collect a mix of both interdisciplinary academic literature and personal accounts of patient experiences. To collect a comprehensive, interdisciplinary pool of literature regarding the effect of health literacy and technology on various outcomes, a slew of databases and sources were used that were collected from the fields of sociology, public health, and psychology.

Among these databases were PubMed, JSTOR, and the Social Science Research Network. In addition to these scholarly databases, social media and YouTube videos were analyzed to better understand differing perspectives that may have not been captured in formal literature. These articles were selected as a result of consideration of the matter at hand. Many articles address both sides of the specific argument they are addressing, for example an article may detail why physicians are worse off with technology but the hospital may run smoother with its integration. These concessions are mentioned in this thesis, however a large portion of the literature that examines technological effects on human interactions makes conclusions that are largely discussed here. The personal experiences were selected because I believed they summed the other videos I had seen and were either published reputably or connected to a larger reputable organization. All of the sources examined the American healthcare system and a few used international perspectives on the issue.

Interviewing Methods

An unstructured interviewing model was followed for the interview of a male pre-medicine student. The interview was anonymous, and participation was not rewarded. *Bernard Interviewing* (n.d.) suggested allowing the interviewee to decide where the interview led, defining relevant information and divulging information that the interviewee found interesting as they saw fit. I used the neutral probing technique to encourage the interviewee to continue speaking if I thought it would further my understanding of his sentiments. The interview was recorded so that direct quotes could be referenced, as suggested in *Bryman PDF*. The interview questions were written with the goal of introducing concepts in a logical manner so the interviewee could build upon past thoughts and provide developed answers.

Patient Perspective

The patient is a major cornerstone of the healthcare system- without them the system falls apart. Many hospitals aim to serve their patient populations equally, but with that issues arise. All patients are different, and their race, medical history, religious practices, income level, and education can affect the way they are treated in hospitals and how well they adhere to recommendations after leaving the presence of their physician. Examining how patient education/health literacy affects them is crucial is ensuring a healthy patient population. Clark (2011) found that sufficient health literacy allows for patient autonomy and effective consent, which is why physicians need to actively take steps to ensure that patients understand both their diagnosis and treatment plan. How does one know that the patient understands? Some would suggest examining objective patient outcomes, like their weight, blood pressure, or the absence of symptoms, but Kelley et. al (2014) suggests using both objective and subjective methods, like the patient's pain scores and feelings about the treatment and its results. They found that the patient-clinician relationship does have a statistically significant effect on objective and subjective patient outcomes. Rothman et. al (2004) found that a patient's literacy influences their interaction level, and in that way an individual's health literacy influences their health outcomes. Ultimately, various studies have concluded that involved patients have lower morbidity rates (Ward et. al, 2003). In addition to this, Shaw et. al (2009) found that many of the patients in their study with low health literacy levels felt that health information should be provided in simpler terms, and that educational leaflets were confusing and worrying, leaving them unable to understand and unwilling to ask for assistance.

Patients and their interactions with hospital technology is unique. Patients generally interact with imaging machines, computers to sign in, and smaller machines to track vitals.

Because of this, many patients enthusiastically welcome technology into their treatment plans, as they feel it provides them with the autonomy to decide between treatments and allows for more definitive diagnoses (Safi et. al, 2018). Patient opinions on technological interventions in their healthcare vary, but generally studies have found that patients favor them.

Patient Perspective: Pre-Medicine Student Interview

In order to collect primary information of the patient experience, I conducted an interview of one male pre-medicine Vanderbilt University student. The interviewee has family members who work in the healthcare field and has participated in a number of activities that have exposed him further to the medical field, including clinical shadowing, research, and pre-medical coursework. The interview explored topics such as medical field technology, health literacy's effect on the healthcare system, and how the two affect patient advocacy and adherence to different types of treatment plans.

Technology in Hospitals

As a result of the interview format, the interviewee took many liberties in interpreting the questions. When I asked his thoughts on technology, the participant had a more holistic view of hospital technology, and largely focused on the imaging machines and surgical machines as he saw these as the most important forms of technology in hospitals. With this definition, he often positively regarded technology, often citing the opportunities for complex diagnoses and procedures it allowed for.

He clarified that though these technologies were useful, they also striated patient populations based on the funding of the hospital and the community the hospital belonged to. He claimed that patients with access to hospitals with a greater technological presence would experience different levels of care, and those without this access may suffer as a result of this. He

also noted that the increased presence of technology in hospitals "requires a lot more transparency between a doctor and the patient so that the patient knows why [they] need… the specific medical care that they are receiving." He mentioned that this transparency is relevant so the patient can make conscious decisions about the treatment plan and the cost associated with it. Eventually, he claimed, the patient would bear the financial burden of paying for whatever advanced treatment methods they may have and more advanced, technological treatments are generally more expensive.

Health Literacy in Hospitals

The interviewee had a general understanding of the definition of health literacy, defining it as "knowing medical terms or being knowledgeable about medical terms." The interviewee expressed concerns that measuring health literacy would be a difficult task, as it is difficult for one to assess their own mental acuity and because health literacy depends on what the situation requires. This aligns with the information I found in the literature review. I found only one study with a method to assess health literacy in a paper by Shaw et. al (2009). This method was called the Rapid Estimate of Adult Literacy in Medicine (REALM), but this method was not mentioned in any other studies and Kelley et. al (2104) went on to say that there were no effective methods to measure health literacy in the population. More often than not, studies do not determine participants' health literacy, but instead measure the patient's level of formal education and use that as a predictor of their subjective and objective outcomes (Kelley et. al, 2014). The interviewee also acknowledged that his health literacy was probably greater than the general public's due to the experiences he has had in and out of university. Even so, the interviewee believes that he would have trouble following certain treatment plans, as understanding the reason behind lifestyle changes and translating doctor's instructions to real life is "difficult."

The interviewee also alluded to the power dynamic between the doctor and the patient, saying that he would never challenge any doctor recommendations because "they are more knowledgeable and have had more education" when compared to the knowledge he has gained from the internet, undergraduate courses, and his friends. Later when he becomes a physician, he believes that he would trust his own intuition more than both the patients and other physicians. He notes that the only input he may value more than his own would be that of a specialist.

Health Literacy and Patient Advocacy

In the final portion of the interview addressed the effect of health literacy on the doctor-patient relationship. The interviewee spoke of low and high health literacy levels, and that he thought higher health literacy would lead to greater decision-making power in the treatment plan, saying:

> "It could go in two ways, where the patient just doesn't completely know what the doctor wants, or what the doctor is trying to say so then the doctor would have to be a lot more informative with the care that they are giving the patient. At the same time if the patient feels like they have this high sense of medical literacy they're going to try to be a co-doctor in a sense. They're gonna be like 'oh why can't you prescribe me this,' or 'why can't I do this procedure' and that kind of … makes it more that the whole process is kind of directed by the patient, but at the same time the doctor still has that ultimate decision of what procedures are going to be done or what care you need."

Essentially, the interviewee claims that differing health literacy levels introduce different opportunities for patients to advocate for themselves. The interviewee, an educated man, claims that he would feel comfortable asking questions about diagnoses and procedures unless the

physician had a negative attitude. He also noted that he understands that not everyone shares this same sentiment.

Patient Advocacy

Though the interviewee noted that he would not have problems advocating for himself, many people cannot effectively advocate for themselves. As a result of this, patient advocacy organizations (PAOs) have formed in order to "provide direct counseling and education for patients, engage in policy advocacy, and shape research agendas" (Rose et. al, 2017). These organizations largely claim to be non-profits, but often receive money from the healthcare industry, meaning that the policy influence PAOs have may be influenced by hospitals and pharmaceutical companies. There are different organizations surrounding various diseases, and I found one Facebook group, the Patient Education Forum (PEF) that is specifically dedicated to "guide/counsel and tell (in a very simple language) the common people about various diseases" (*(20+) Patient Education Forum (PEF)*). Forums such as these recognize that there is a gap between patient understanding and physician language and aim to close that gap via interactions with other people with similar conditions or physicians and consultants who have volunteered to assist the members. The page does clarify that people should not seek formal consultation or medication on the forum.

Financial Burden

As a result of poor opportunities to advocate for themselves, patients may also experience higher costs of treatment. Some patients do not know why they need certain imaging done and therefore cannot adequately consent, and other times the patient does not know how their insurance works with the healthcare system, and they end up saddled with a life changing bill. One man misunderstood how his insurance applied to emergency medical interventions and

faced a $108,951 bill after having a heart attack (France 24 English). Only after reading the itemized bill did he understand what he was charged for but was still confused as to why the cost was so astronomical. The video even went as far as to call United States hospitals "profit-chasing private companies," and explained to its mainly French audience that bills such as these surprise Americans, that their amount is random, and that the costs are never fully covered by insurance companies. Almost admitting that the costs were superfluous, after the man's case captured the media's attention, his costs were waived. As a result of the patient not initially understanding the limits of his insurance and the procedures that had been performed, he accrued a massive, unexpected bill that many others are unable to afford.

Physician Perspective

Physicians on Technology

Safi et. al (2018) found that different medical professors have different opinions on the impact of technology in their field. Generally, medical staff were more in favor of technological advancements as they thought it would allow them to spend more time with the patients. Contrastingly, medical professionals believed that increasing technological presence would interfere with their ability to make diagnoses as well as their relationships with patients. Technology that has been implemented more recently, like EMR, was found to lead to physician burnout (7*What This Computer Needs*). These differing opinions are exactly what the debate around technology in hospitals is about: Will technology negatively impact the patient experience? Do the benefits outweigh the costs? How much technology is too much?

The iPatient and Patient Interaction

Doctor Abraham Verghese wrote an article and performed a TEDTalk on the doctor-patient relationship in a technology centered healthcare system. In his TEDTalk, *A Doctor's*

Touch, he claims that imaging devices are overused and often take the place of physical examinations that may be better for the patient. These physical examinations are "rituals" that create trust between the physician and patient, and these interactions paired with interpersonal connections strengthen their relationship. These rituals should go hand in hand with new technological advances in order to create a better patient experience and improve outcomes.

In his article, *Culture Shock-Patient as Icon, Icon as Patient,* he elaborates on the concept of the iPatient. He coined the term to apply to patients who were seen largely as a collection of scans, tests, and diagnoses that serve as a surrogate for the patient. iPatients are treated in an expedient manner as opposed to a thorough one, and therefore miss out on crucial elements of the doctor-patient relationship. Patients, as he claims they should be treated, are constantly changing "texts" that need to be continuously inspected for changes. Because of this, he emphasizes the importance of bedside skills and traditional rituals concerning patient care so that new developments in the patient are not overlooked and superfluous tests are not ordered.

Doctor Verghese's pieces show the deleterious effects of an excessive focus on technology in the healthcare field and show one doctor's perspective on it. He, as well as others, calls for a balance of technology and traditional medicine to truly enhance the patient experience.

Social Biases Surrounding Education

Access to Education

Though health literacy and education are important determinants of patient advocacy, outcome, and other measures, access to either is restricted to the privileged. Educated individuals generally become wealthier, and as a result wealthier people are generally more educated or have access to better venues of acquiring the necessary knowledge (Bartscher et.al, 2020). Though money is often a barrier to care, Fuchs et. al (2010) found that education is a greater barrier in

underdeveloped countries. They conducted a study in which they determined that maternal

education level matters more than household income in determining infant survival. Maternal

education included their health, health-specific knowledge, and other factors. Pfeffer (2018) even

goes as far as to say that the distribution of educational opportunity is concerning and shows that

individuals with lower family incomes and net worth have a lesser likelihood of attaining a high

school diploma, attending college, and graduating college. In America, race and socioeconomic

class are closely related, so often black and brown populations occupy the lower classes and have

a decreased chance of attaining higher education. Literacy rates are lower among African

Americans than White Americans when corrected for age in the most recent national literacy test

in 2003, the National Assessment of Adult Literacy (Cohen et. al, 2012). The lack of access to

education is reflected in adult literacy rates and may have a direct effect on patient outcomes.

Power Dynamics Between Doctors and Patients

Power dynamics between doctors and patients have generally been that the patient values

the doctor's opinion over their own, yielding their power to them. As a result of this, the patient

adheres to the doctor's recommendations, trusting them with their lives. Patient trust was found

to be largely based off of "role perceptions, demonstrated competence, and… good

communication" (McDonald et. al, 2012). As information becomes increasingly accessible via

the internet, some patients are arriving to clinics armed with their preconceived diagnosis and

treatment plan and are eager to take a more substantive part in their healthcare decisions

(Akerkar & Bichile, 2004). This could be positive and help close the education gap, but more

often than not the patients are misled by the information they find online and are left more

confused and less willing to listen to the advice of experts. Vanguard Communications created a

video accessible on Facebook that explained five reasons why 60-80% of patients do not provide

relevant healthcare information to their provider, all of which centered around the power differential. Patients were embarrassed, did not want to waste time, wanted to avoid judgement and lectures, and wanted to be seen as a good patient, and so they left out habits that may have affected their treatment plan. Vanguard suggests that stripping physicians of the "doctor" title may help with this problem, but the power dynamics may be deeper than their occupational title and need to be further examined to increase patient benefits.

Coronavirus and Telehealth on Medicine

In the age of COVID, telehealth is more prevalent now than ever before. The need for social distancing leads doctors to hold virtual consultations and only see patients in-person when extremely necessary, like for surgeries. Telehealth seems to be an effective alternative to in-person contact in various fields and was found to be most effective in the areas of chronic disease management, hypertension, and AIDS (Hersh et. al 2001). Yellowlees et. al (2015) found that telehealth is a better practice than traditional in-person consultations for certain identities in psychiatry. In a systematic review, Young et. al (2011) found that "tele-ICU coverage was associated with a reduction in ICU mortality" and length of stay. There is also evidence that telemedicine is comparable to in-person care in surgical and neonatal ICUs. Klonoff (2012) suggests that telemedicine in the presence of adequate patient education is beneficial to patients with diabetes and can also have benefits in relation to the management of other diseases. Theoretically, the education gap would still exist through an online medium, but perhaps the power dynamic would shift, allowing patients to be more comfortable with their physicians. Even if this were true, the effects of income on access to telehealth measures may continue to striate patient populations and negatively affect patient outcomes. If telehealth really does produce better patient outcomes, and the pandemic may force social distancing for the next few

years, what does that mean for in-person clinical interactions? How will the doctor-patient

relationship evolve? Can there be a mix of traditional and technological practices if our

healthcare is based online? These questions must be explored, and ultimately, post-pandemic, the

telehealth experience that the American healthcare system is experiencing now may be continued

to save the cost of in-person visits, possibly striating the patient population even further.

Other Technological Advancements in Medicine

Though this review was focused on telehealth and EMR, other technological

advancements may also need to be discussed in order to find the proper place for technology in

the healthcare field. One that is up and coming currently is artificial intelligence. Ramesh et. al

(2004) defines artificial intelligence (AI) as "a field of science and engineering concerned with

the computational understanding of what is commonly called intelligent behavior, and with the

creation of artefacts that exhibit such behavior." AI can be applied to almost every medical field

as it can be used in patient diagnosis, treatment, and outcome predictions, and can also be used in

various technological subfields, including EMR and telehealth. More trials need to be conducted

to see exactly how AI could be effectively used in clinical settings, but many articles, including

What This Computer Needs Is a Physician: Humanism and Artificial Intelligence, *Latent Bias*

and the Implementation of Artificial Intelligence in Medicine, and *Adapting to Artificial*

Intelligence: Radiologists and Pathologists as Information Specialists already point to its

possible deleterious effects. These articles also offer alternatives and ways to incorporate AI into

different fields, but each have the stipulation that the integration must be done in a certain way as

to not increase latent biases and/or put physicians out of work.

Future Research Endeavors

Ultimately there are still many questions surrounding the intersections of technology, health literacy, and patient outcomes. As we move forth into an increasingly technological era during a pandemic, technology may be our best option of continuing a healthcare system similar to that in place before the pandemic. To do this effectively, the effect of technology, including telehealth and AI, on patient experience needs to be explored more and a balance must be found so that they do not decimate the doctor-patient relationship. It would also be helpful to find and use a universally accepted method of measuring health literacy so that the healthcare system can cater to those individuals in an effort to improve their health outcomes and decrease their financial burdens.

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