Sociotechnical Factors Influencing Unnecessary Medical Care

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

The COVID-19 pandemic has brought the term “medical waste” to the foreground of many conversations, and the term is often associated with single-use materials such as disposable masks, syringes, and gloves. However, current medical practices in the United States encourage more than the waste of single-use materials; it promotes unnecessary medical care. Unnecessary medical care can be loosely defined as any medical action that is not useful. One prevalent example of unnecessary medical care is patellar instability pathologies.

Patellar instability, a common condition among young athletes, is characterized by displacement of the patella, more commonly known as the knee cap, from its intended resting position. Surgical planning to resolve patellar instability is highly subjective because the optimal surgery varies depending on the unique anatomy of each patient. It is therefore not uncommon for patients to return to the operating room for a subsequent surgery. The patient, therefore, requires two sets of radiographic imaging scans, clinical visits, and sterilized operating room equipment. From the clinical standpoint, copious expensive medical equipment is wasted and superfluous time is spent on a singular patient that could be used to benefit other patients in need. From the perspective of the patient, they must spend double the amount of money and time on a second medical procedure that could have been avoided.

The waste observed among patellar instability cases is not rare in current medical practices. While the topic of unnecessary medical care has been on the radar of larger hospital organizations, very little has been publicized regarding the extent of harm that the phenomenon causes. The financial burden put on victims of unnecessary medical care reduces their spending on basic life necessities such as food, clothing, education, and necessary healthcare. The current

estimated amount of money wasted on excessive and/or unnecessary medical testing and treatment annually in the United States is approximately $78.2 billion (Shrank et al., 2019).

However, this waste is not limited to finances; time, energy, and materials are all wasted in this process. Current data indicates that there is a large volume of superfluous low-cost medical care, such as cervical cancer screening for women younger than 21 years of age (Mafi et al., 2017). Nonetheless, unnecessary high-cost procedures, such as arthroscopic partial meniscectomies, still contribute to the wasted energy, time, and finances (Sihvonen et al., 2013; Stahel et al., 2017). Over-prescription, over-administration, over-testing, and over-screening cannot be solved without understanding the multi-faceted cause of the problem. To narrow the scope of this investigation, the focus of unnecessary medical care centers on the excessive and unnecessary administration and ordering of medical scans and tests.

The purpose of this study is to identify what the major contributors are to the continuation of unnecessary medical practices and analyze how these factors perpetuate this type of care. The following sections accomplish this by first determining how interactions with common informational resources might affect a clinician's decision to order a test or scan. This discussion focuses on how medical technology innovations such as magnetic resonance (MR) and computed tomography (CT) imagining have molded the diagnostic processes. Subsequently, this report discusses how some cultural, psychological, and financial factors contribute to excessive medical care and over-screening. Only through this comprehensive analysis of medical diagnostics and external sociotechnical factors will unnecessary medical care in the United States be diagnosed, hopefully pointing society towards a plausible solution.

Methods

This study was performed in two stages: a systematic literature review and clinical interviews. Because this study did not involve active treatment of human participants and the results were mainly based on interview responses, no international review board was required to perform this research.

Systematic Literature Review

Two systematic literature reviews were performed to identify the primary factors contributing to unnecessary medical care. The first literature review focused on medical training and the use of technological innovations in the diagnostic process. The majority of the University of Virginia's science, technology, and society (STS) databases were searched using keyword combinations of "diagnosis", "diagnostics", "medical training", "medical education", and "clinical investigations". The sources used mainly consisted of peer-reviewed published papers, one exception being a lecture by Dr. Robert Powers at the University of Virginia.

The second literature review centered around the external factors influencing increased unnecessary medical care. A similar process was used with the keywords of "unnecessary medical care", "over-screening", "over-scanning", "medical malpractice", and "excessive medicine". The sources for this review consisted solely of peer-reviewed published papers. For both of the literature reviews, searches were minorly adjusted based on findings to dive deeper into a prevalent example of one of the factors.

Clinical Interviews

To test the validity of and examine the extent to which these factors influence unnecessary medical care, field research was performed. Clinical interviews were determined to

be an appropriate method to collect input from medical professionals on this subject. Clinical interviews are an effective method to gather opinion-based and anecdotal clinical data that is difficult to quantify, as demonstrated by copious previous studies (Rohr et al., 2016; Weigner et al., 2012).

Because of complications in gathering this type of data, due to confounding variables such as the amount of experience, type of medical practice, and medical field, this study only questioned medical professionals in orthopedics. Orthopedics was chosen because the field is known to rely on medical imaging. A preset list of questions was created to gather input from orthopedic physicians on the subject of unnecessary medical care. Consent was obtained before recording any interview audio and no personal information was collected.

Results

Systematic Literature Review

Medical Training & Technological Innovations

The diagnostic process determines a patient's future. A quicker and more accurate diagnosis increases the chances of a positive health outcome because clinical decisions for proper treatment may be made sooner. As instructed in medical school, medical professionals draw from multiple sources of information to accurately diagnose a patient. These sources may include medical images, patient medical chart information such as blood glucose levels and white blood cell count, patient history, book knowledge of common symptoms from pathophysiology classes and textbooks, and experiential knowledge from previous patient cases. While the diagnostic process varies between specialized medical fields and professions, some commonalities and generalizations remain. Analytics of this process shape clinical guidelines

and policies, causing downstream effects on “payment policies and resource allocation decisions” (Committee on Diagnostic Error in Health Care et al., 2015).

Similarly, technological innovations in medicine significantly impact finances. The development of complex medical imaging machines such as MR scanners proved to dramatically increase the quality of care to patients due to finer resolution tests and complex treatment options (*Medical Innovation in the Changing Healthcare Marketplace*, 2002). However, the costs of the energy and labor associated with using this machinery are extremely expensive. Thus, there is a fine line between providing high-quality diagnostics and over-spending.

It is evident that current diagnostic processes either contribute to or are themselves excessive and unnecessary medical care. An understanding of medical training of the diagnostic process and awareness of increased expenses due to technological advances may therefore provide insight as to the continuation and progression of unnecessary medical care. The development of medical imaging exemplifies this concept.

The medical imaging field has revolutionized how medical professionals diagnose patients. Technology such as MR and CT imagining provides a method of “visualizing a patient’s body” which was previously not possible. The possibilities with these technologies are endless: cancer tumors may be detected and located with ease, bone fractures and spurs may be identified, and fat infiltration of vital and secondary organs can be measured with astonishing accuracy. The immense visual power that medical imaging technologies possess in turn decreases clinician reliance on traditional resources such as patient history, physical examination, and laboratory tests (Burri, 2013). Consequently, the number of ordered medical imaging scans drastically increased in recent years (*Medical Innovation in the Changing Healthcare Marketplace*, 2002).

Despite this advancement in technology, the general outline of a cyclic diagnostic process remains: gather information, interpret this information and integrate current knowledge, and determine a working diagnosis (see *Figure 1*). Common methods for clinicians to gather information include patient clinical history and interviews, physical exams, referral and consultation with specialists, and diagnostic testing such as blood work and imaging scans (Committee on Diagnostic Error in Health Care et al., 2015). While these actions are performed for nearly every patient, the order in which they are performed is not set, and the order matters.

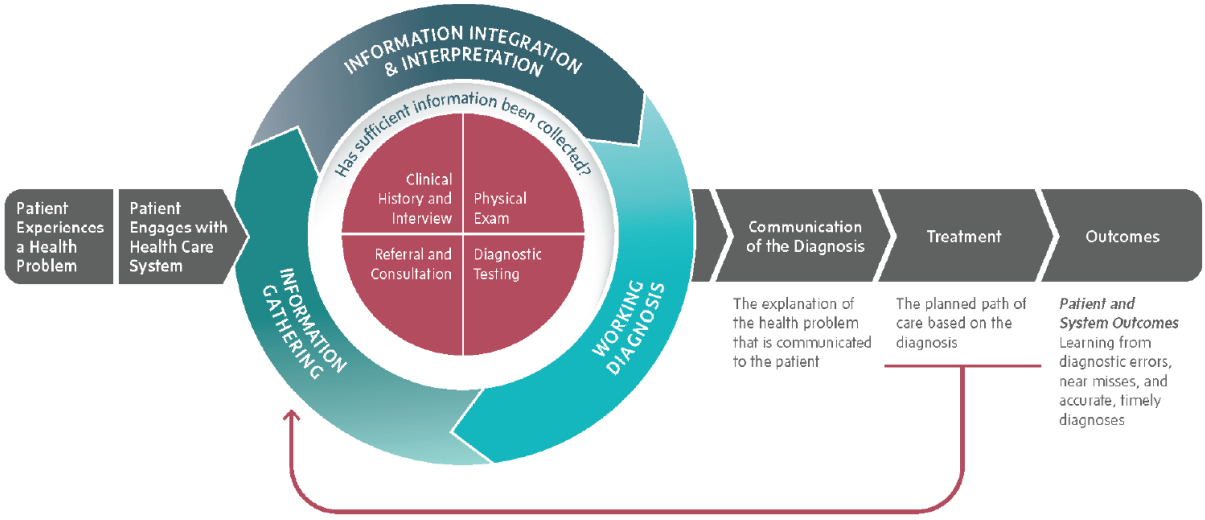

Figure 1. A depiction of the general diagnostic process as conceptualized by the Committee on Diagnostic Error in Healthcare in Improving Diagnosis in Health Care.

By performing the patient clinical history and interview along with a physical exam first, a clinician may be able to narrow down the list of possible diagnoses, eliminating the need for excessive diagnostic testing. The previously described recent advancement of medical imaging causes clinicians to hyperfocus on the benefits of the testing and they "often bypass the bedside evaluation for immediate testing" (Committee on Diagnostic Error in Health Care et al., 2015). Clinicians are therefore failing to use what has been described to be the "most versatile diagnostic and therapeutic tool" that may reduce the number of tests required and thus reduce the

expenses of the patient and the healthcare system as a whole (Lichstein, 1990). Furthermore, the Committee on Diagnostic Error in Health Care recently demonstrated concern that a lack of emphasis on physical examinations during medical training and education might be leading to unnecessary diagnostic testing (Kugler & Verghese, 2010).

Minor alterations in medical training and education curriculum or teaching foci could cause a significant positive impact on our health care system. Medical training and education instructors must put a higher emphasis on prioritizing patient clinical history and interviews as well as physical exams, resulting in a significant decrease in the number of unnecessarily administered diagnostic tests as well as health care expenditures.

In addition to hyper-focusing on diagnostic testing benefits, clinicians must cope with the general population challenging their authority. Enhancement in artificial intelligence and big data technology demonstrates the potential to predict, diagnose, and propose the optimal treatment solely based on diagnostic testing. Because of this, patients adopted a "see it to believe it" mentality, pressuring clinicians to order an MR or CT scan to provide visual proof justifying their conclusion. One radiology professor conveyed this idea through an extremely relatable analogy: "If you watch television and see the images, you also believe a story more likely than if you just read it in the newspaper" (Burri, 2013). There appear to be few consequences to ordering an MR scan because they are non-invasive, do not use radiation, and are often covered by insurance for the majority of patients, so MR images only seem to help a clinician's case. This begs the question: how do we as a society change this mindset to avoid excessive and unnecessary MR imaging scans?

External Sociotechnical Factors

Medical diagnostic training and technological innovations neglect to account for the "socio" part of the sociotechnical system under analysis. External sociotechnical factors might influence diagnostic decisions equally, if not more than the more the aforementioned factors. These external factors encompass a wide range of components including hospital and federal guidelines for medical practices, personal finances for clinicians, performance-based incentives, and even regional/geographical medical culture. For example, medical treatment for the same pathology is dramatically different in southern Texas than it is in Minnesota (Powers, 2022).

Furthermore, patient-clinician interactions introduce copious other factors that could influence diagnostic decisions. Patients may pressure clinicians to "do something" during a visit, possibly increasing the clinician's likelihood to comply and order a diagnostic test. If a clinician does not "do" anything, there could be worry of malpractice concerns in the chance that they made a mistake. Thus, cultural, psychological, and policy artifacts influence a professional's decision to order medical tests, possibly contributing to excessive and unnecessary medical care. These artifacts are easily explained through the analysis of cancer screenings within oncological practices in the United States. (Allen, 2018; Gawande, 2015; Stahel et al., 2017).

The onset and treatment of cancer are heavily studied, yet no cure has been discovered or manufactured. It is a puzzle that medical scientists are unable to solve. What is known is that cancer has a severe negative impact on a patient's health. Early identification of cancer increases a patient's life expectancy because tumor size may be regulated, mitigating the damage. For this reason, the United States Preventative Services Task Force recommends that adults within specific age ranges are routinely screened for colorectal, cervical, and breast (females only) cancers. However, over 45% of adults older than these age ranges continue to undergo screening, doing more harm than good (Moss et al., 2020; Schoenborn et al., 2020). The remainder of this

section discusses evidence indicating potential psychological and financial reasons for this over-screening.

Medical providers' attitudes contribute to over-screening for cancers. Two major factors play into a clinician's mentality with these decisions: clinical performance measures and malpractice concerns. Clinical performance measures are a method to quantify a clinician's ability to follow a set of standards and processes, a concept borrowed from quality assurance in industrial processes. The initial intention of these measures was to ensure that all patients would receive medical care that "increase the likelihood of desired health outcomes and are consistent with current professional knowledge" (McIntyre, 2001). In the context of cancer screenings, the American Society of Clinical Oncology has historically set measures that are highly dependent on cancer screening results. Little focus has been put on analyzing the net value of screenings, factoring in the cost to the patient. Clinicians might interpret these measures as an indication that they should recommend screening in the majority of clinical situations. The interpretive flexibility of clinical performance measures has, therefore, led to deviation from the artifact's intended design. Instead, the artifact has incentivized low-value, over-screening.

Medical professionals may have their medical license revoked if they lose a medical malpractice lawsuit. Medical malpractice is the act of a medical professional deviating from the established clinical standards for a given patient condition or situation, often involving the medical professional neglecting to perform a specific scan/test or procedure. Clinicians, patients, and personal injury attorneys all orbit around these clinical standards, but each user is interpreting the standards in different ways to protect themselves, their interests, and their responsibilities. Over-screening is not yet included in these standards, so clinicians commonly over-screen to prevent a lawsuit from ever occurring.

The results of a study by Sirovich et al. provide data to support the impact of both clinical performance measures and malpractice concerns. A survey was sent to the United States primary care providers, inquiring about reasons for excessive medical care. The results from this investigation revealed that primary care physicians were more aggressive with the administration of scans, tests, and treatments because of clinical practice measures (53%) and malpractice concerns (76%) (Sirovich, 2011). While this study might be a little dated, the findings in 2018 from Kistler et al. reflect the findings from 2009 (Kistler et al., 2018). It is therefore evident that the psychological impact of clinical performance measures and malpractice concerns increase over-screening in cancer diagnostic settings.

Lastly, the financial artifact contributing to over-screening in oncological diagnostics deals with patient return rates and clinician payment methods. Some regions and medical providers, such as many California medical practices, are based on a "pay by performance" framework. By increasing the rate of cancer screenings regardless of the value to a specific patient, these providers will have a higher chance of identifying a cancerous tumor. In turn, the provider will have a larger financial compensation and more public recognition. Moreover, a handful of clinicians have been honest enough to report that the frequency of cancer screenings they perform comprises a significant portion of their income (Boone et al., 2016), demonstrating that financial artifacts directly influence the practice of over-screening.

Clinical Interviews

An orthopedic surgeon and an orthopedic clinical researcher were interviewed and asked the same set of questions. These respondents were provided with an introduction and background information to provide context to the questions that would follow. No findings from the

systematic literature review were presented during this introduction to prevent bias in the responses.

First and foremost, the respondents were asked the following: “when you are with a patient, what resources do you draw from that shape the eventual diagnostic choices?” This question was intended to extract information regarding the clinical, information-gathering portion of the diagnostic process. Because both respondents asked for clarification, the question was rephrased to “what clinical tools and information do you mainly rely on to determine what actions to take to properly treat a patient?” Responses to this question agreed with the literature findings, reporting that patient history, physical examinations, and patient interviews provide important information before ordering a diagnostic test. When followed up with a question regarding why they use these techniques, both respondents spoke of hands-on, experience-based training and lecture-based medical education. However, both respondents heavily emphasized that no further action would be taken, including physical therapy, unless an MR or CT scan is performed and the resulting images supported the proposed treatment plan.

Interview results also agreed with the findings of the systematic literature review regarding external factors influencing diagnostic decisions and excessive medical care. When asked, “are there other external factors that might force you to perform these diagnostic scans even though you may believe it is unnecessary? If so, to what extent do these factors influence your decisions?”, malpractice concerns were the immediate focus of discussion. Originating from this discussion, one of the respondents went on a side tangent about the price of medical care and these scans. They conveyed that society should not entirely blame the orthopedic surgeons for the high costs, stating that, “there are a lot of costs… but it’s tough because what is

more “costly”? Spending more money [on a scan] or missing something that could cost you your [medical] license.

Interestingly, one of the respondents brought up an external factor that was not uncovered in the literature review when discussing the patient perspective during the diagnostic process.

> “[As a patient], I don’t want there to be a whole lot of guesswork. I’m a measurement type of a person. Think about it, you can’t treat a fever without knowing the temperature via the thermometer. It’s one tool in the toolbox, just like MR imaging. What’s unfortunate is that insurance coverage determines a lot, and when insurance will cover the MR scan, the doctors will often use what is commonly seen as the most useful tool in that toolbox for orthopedics.”

No in-depth research on insurance coverage was found in the systematic literature review. One possible explanation for this is that insurance coverage plays a bigger role in orthopedics than it does in other medical fields, so it has not been studied to the same extent as malpractice concerns. A more likely reason, however, is that insurance discussions are considered to be lumped in with an analysis of general patient finances. It is important to note that no discussion of clinical performance measurements occurred during any of the conversations, possibly indicating that this is not as important for orthopedics as it is for other medical fields such as oncology.

The final question of the clinical interview asked if orthopedic clinicians viewed excessive and unnecessary medical care as a prevalent and significant issue in the United States, and both respondents believed that the majority of orthopedic physicians would agree that excessive and unnecessary medical care is both a prevalent and significant issue in the United

States. Recognition of the problem is important because it indicates that people within the field may advocate for positive change. That said, why are discussions of excessive and unnecessary medical care not as widespread as expected?

Discussion

Absurd quantities of time, money, materials, and energy are wasted each year on excessive and unnecessary medical care. Superfluous diagnostic scans and other tests are ordered and administered, decreasing the amount of money patients could put into other basic life necessities. The objective of this study was to identify the sociotechnical artifacts contributing to the continuation and progression of excessive and unnecessary medical care practices in the United States. A systematic literature review was performed to determine these factors stemming from medical training, medical innovations, and external sociotechnical interactions. Following the literature review, clinical interviews were used to gather opinion-based and anecdotal data on the subject. The results from the interviews were compared to the literature findings, and conclusions were drawn.

The systematic literature review identified a major potential issue leading to excessive and unnecessary care: medical innovations are incentivizing clinicians to bypass integral steps in the diagnostic process and immediately perform diagnostic tests such as MR and CT scans. This problem originates from the medical images causing clinicians to simultaneously disregard the benefits of patient history/interviews and physical exams and hyperfocus on the power visualization has to remove all patient doubt. The literature also revealed that medical malpractice concerns, clinical performance measurements, and financial artifacts possibly incentivize oncologists to order more diagnostic tests than necessary. The majority of the results from the clinical interviews agreed with these findings. Interestingly, the responses uncovered

that insurance rules might also serve as an external sociotechnical factor when making diagnostic decisions such as ordering an MR or CT scan.

One significant limitation to the current state of this study is the success of field research. Currently, only two interviews were performed. Emails have been sent to more orthopedic surgeons to increase the number of responses. Following further literature research, the prevalence of excessive MR imaging scans in the emergency department might also be valuable. Interviews with this demographic would therefore provide deeper insight into this topic (Ohana et al., 2018). A larger volume of more representative data will expand the current result section to include a deeper insight as well as provide more anecdotal statements about excessive and unnecessary medical care.

Many opportunities for continuation research exist. Because this investigation focuses on patient financial loss and United States health care spending, there is reason to believe that the attitude toward excessive and unnecessary medical care differs from private practice and public practicing medicine. Private practices have fewer governmental guidelines and mandates they must follow, further decreasing the consequences of ordering an MR scan even if it is not absolutely necessary and increasing the financial expenses of the patient.

Another intriguing avenue for future directions of this project looks at regional differences in diagnostic accuracy, specifically comparing urban and rural areas. Rural areas generally have smaller hospitals and less access to high-tech medical equipment like MR imaging. Furthermore, patients in rural areas tend to revisit the same medical practitioner in a given period, increasing patient-physician trust levels and decreasing challenges in medical authority. That said, how does the diagnostic process differ between these regions, and are there more diagnostic errors in one region compared to another? If so, why?

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