The Influential Factors Embedded in Surgical Decision Making and Resulting Variation – An Analysis of Surgical Networks with Actor-Network Theory

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Sabrina Alessi

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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

Advisor

Travis Elliot, Department of Engineering and Society

INTRODUCTION

I was fifteen when I fractured my nose. The emergency doctor did not see a reason for surgery because my airways did not seem blocked, and surgery could disrupt the total formation of my facial features. However, at a routine visit to the ear-nose-throat (ENT) doctor, my CT scans displayed concha bullosa (an air-filled cavity within the nasal concha) or enlarged turbinates, and copious bone spurs which contributing to my persistent nasal inflammation and difficulty breathing properly (*How an Air Pocket Can Cause Concha Bullosa*, n.d.). Although the fracture is not to blame, the doctor stated that the injury further deviated my septum and contributed to the blocked nasal airway (PITTORE et al., 2011). I was told I had been breathing with 20% capacity and required surgery to remove the bones and turbinates in order to breathe properly.

This diagnosis, along with the fractured exterior, prompted my mother and I to search for the right procedure, surgeon, hospital, and financial coverage to adequately address each issue. We weighed the outcomes of surgery or other rehabilitation methods, compared different surgeons by their surgical plans and experience, as well as assessed the long-term outcomes regarding inflammation on the final shape of my nose following each procedure. I was fortunate to have received multiple answers, but the variation between each made it difficult to determine the right decision. I questioned how a problem such as obstructed breathing could warrant five different surgical approaches. This experience opened my eyes to the complexity of surgical decision making, and allowed me to recognize the multitude of factors necessary to consider before making a decision.

Surgery is an indispensable part of healthcare as there are numerous reasons an individual requires surgery (Meara et al., 2015). Unlike emergency procedures, elective surgery is

conducted at the patient's discretion. A doctor may either require or recommend a procedure but it does not need to be conducted immediately, and often scheduled following an agreement between the patient and provider (*Elective vs. Nonelective Surgery*, n.d.). The decision making process looks different for each party involved: the patient, hospital providers (doctor or surgeon), as well as insurance or financial provider. Further, there are a multitude of factors to consider when choosing to undergo surgery: rehabilitation time and requirements, severity of the issue or necessity of procedure, accessibility to facilities, adequate materials or technology, and financial burden. To gain a better understanding of why surgical variability exists, this paper will utilize the STS framework Actor-Network Theory and assess the key influential factors relevant to the process of surgical decision making (Cresswell et al., 2010).

BACKGROUND

Influences Involved in Decision Making

For a patient seeking an elective procedure, there are multiple considerations prior to scheduling a consultation. Firstly, there are the financial considerations. Patients must ensure their procedure is covered by their insurance as elective procedures are not universally covered unless deemed medically necessary. The patient must also consider feasibility outside of finances. This entails reasonable access to facilities or specialists as well as a rehabilitation plan that fits with their schedule (*Elective vs. Nonelective Surgery*, n.d.). For these reasons, elective procedures are contingent on the patient's opinions, desired goals, and personal schedule which additionally contributes to the intense decision process.

Doctors leverage a clinical decision making (CDM) thought process which integrates a subconscious/intuitive decision with the clinical and operative context (Crebbin et al., 2013).

Found in Appendix A, this diagram identifying the cognitive continuum medical professionals must exercise to determine diagnosis or clinical plan is quite exhaustive: physicians consider all information and desired outcomes dictated by the patient, their previous knowledge of the condition, and correlating procedure conditions in order to deduce the proper method for addressing the patient's needs. Previous standards have enabled physicians to control the patient's surgical decision. This was due to the limited public information available as well as the level of superiority granted to medical professionals. The issue of surgical variability complicates the decision process because there are now numerous options, either for or outside of surgery, available to patients.

Shared Decision Making

As medical content has become widely shared, patients are able to form personal opinions outside of the hospital. Further, as patients educate themselves on medical options, there is an increased push for joint decisions regarding surgery (Shinkunas et al., 2020). This introduces the complexity surrounding surgical decision making. Additional discoveries and nuanced technology in the medical field has also shifted the dynamic as there now exist multiple medical techniques that can be applicable to one condition (Birkmeyer et al., 2013).

The competing options and countless opinions available to both the patient and physician have shifted the industry and introduced the concept of shared decision making (SDM) as an approach to clinical counseling (Shinkunas et al., 2020). SDM enables both patients and physicians to choose the best treatment option together (de Mik et al., 2018). Studies have proven that over ten metrics can be considered during the decision making process which culminates to over twenty unique outcomes, not even considering newer interventions (de Mik et

al., 2018). As this method of surgical assessment becomes more popular with elective procedures, it is reasonable to uncover how each metric contributes to a final decision, and what is most influential to each party involved in SDM.

FRAMEWORK & APPROACH

STS Framework – Actor-Network Theory

STS – Science, Technology and Society – is an interdisciplinary research area concerning how social, political and cultural values impact scientific and technological innovation and vice versa (*About STS - Stswiki*, 2018). Actor-Network Theory (ANT) is a social theory and theoretical perspective on networks of relationships. This framework was developed by Scholars Callon and Latour, and Sociologist Law, who described the ANT method as material-semiotic (*Actor-Network Theory (ANT) - Stswiki*, 2016). This enables a holistic mapping of materials, concepts, and human or non-human entities assuming all things exist together in a network of relationships. With this method, one may capture all factors involved with a system on the same level by positioning each interaction within the network on an equal field. Cresswell's framework provides a methodological approach to investigating how each manifests into the system of healthcare and surgical procedures (Cresswell et al., 2010). I intend to utilize this framework to assess main stakeholders within the surgical network by addressing current standards and practices to investigate how key actors and factors influence surgical decision making.

Defining Actor-Network Theory in Healthcare

To adequately analyze the network, it is important to define key terminology and concepts in the lens of ANT and healthcare/surgical industry. This framework is centered around actors, human or non-human, which are defined as an 'entity that does things'. While difficult to define, relationships between each actor within the system are denoted as a network. Under this perspective, actors only exist within a network, and are not tied to social formalities of society (Jones, 2009). The actions and value attributed to each actor or factor are determined by the relationship with other actors or network, not from external forces. The network of healthcare is considered a heterogeneous network which involves socioeconomic, political, environmental, and technological factors that influence both human and non-human actors (patients, hospital providers, insurance and pharmaceutical companies etc.). ANT provides a methodology for assessing each entity involved in healthcare equally and without consideration of universal inequalities or bias.

ANT explains how something can be both a network and an actor. In the context of surgery, a hospital is both an institution and an actor therefore acting as a single entity. It is important to note that Latour believes that unpacking a network with ANT resembles that of opening a black box: all elements, factors, and influences become visible and it is hard to delineate the actor from its structured network (*ANT Vocabulary – Table | Actor Network Theory*, n.d.). For clarity purposes, this paper will blackbox private and public insurance companies to focus on their impact as a unit, as well as the surgeon and their respective hospital to minimize bias that may arise from different physicians in one department. Additionally, because there are finances attached to each actor, financial considerations will act as a factor in

specific network entities – insurance companies, the hospital or surgeon, and accessibility – as well as the overarching decision-making system.

Methods

To assess the influences within surgical decision making which lead to variability in healthcare, I intend to focus on patients, doctors and insurance providers as separate entities. In order to simplify the exhaustive list of influential factors involved in the decision making process, I have chosen to focus on financial considerations, geographical accessibility, injury or condition severity, the desired outcome of the procedure, and surgeon expertise or specialty. Leveraging ANT as a method of analysis, I intend to assess how each entity, factor, and metric relate to one another and culminate to a final decision regarding surgery.

In an effort to best understand which factors hold the most influence within the network, I collected different cases regarding surgical-SDM and conducted an interview with a young woman who recently went through the surgical decision process for an elective bunionectomy (Appendix B). Her story with SDM and ultimately following through with the procedure, provides insight into what factors are heavily considered by patients. Her experience and responses is leveraged as evidence in the overarching analysis of influential factors.

ANALYSIS

Landscape of Healthcare Industry & Relevant Inequities

Healthcare has never been uniform across the United States and disparities are infamously driven by social and economic inequalities. Narrowing the influential factors, variability in care can be attributed to geographic locations as well as the systems of healthcare or insurance coverage.

Geographic Considerations

A study found that patient and doctor bias contribute to the variation of surgical intervention apparent across the U.S.. Firstly, there is varying patient demand for surgery: minimal disease incidence of hip arthritis correlates to lower hip fracture surgery rates in Hawaii (Birkmeyer et al., 2013). Secondly, a physician's opinion has influence over the number of procedures conducted per region: variation of tonsillectomy rates in one school district drastically increased after the head surgeon was replaced and more examinations were performed (Birkmeyer et al., 2013).

There is also the question of resource accessibility. Often viewed through the lens of race and ethnicity, a study conducted on the impact of systematic racism identified communities of ethnic groups located farther from hospital resources with ZIP Code Tabulation Areas (ZCTAs) (*Health Equity - Inequitable Access to Healthcare's Racist Roots | RTI*, 2022). These findings confirm socioeconomic factors are being upheld when determining where to place a hospital – proving geographical location will hinder the care an individual receives. Further, in urban ethnic communities, the number of care centers accessible does not make up for the overwhelming lack of resources per facility. For instance, of patients in need of chemotherapy in Iowa,

approximately 30% had to travel over an hour to access treatment as there was only one facility with adequate materials (Ward et al., 2014). Recent studies have indicated a lack of sufficient surgeons in the workforce (*Data Reveal the Details about the Surgeon Workforce Shortage*, 2022). Loss of surgical services at hospitals forced over 100 rural hospitals to close, which has only been exacerbated following COVID-19. This perpetuates the problem of unequal care based on geography because patients must travel to receive adequate treatment.

Financial and Insurance Considerations

Discrepancies are further perpetuated with unequal coverage. The US healthcare system does not provide universal coverage as there are multiple methods to pay for healthcare: publicly financed health coverage, privately financed market coverage, as well as out-of-pocket payments (Pollitz et al., 2019). Private insurance is typically received through an individual's employer which differs based on the company's plans. There is a possibility that a specialized surgeon is 'out-of-network'. The term out-of-network refers to a provider who does not participate with your insurer – this occurs when the doctor is unwilling to accept the insurer's rates, often due to low compensation (*How U.S. Health Insurance Works | Vaden Health Services*, n.d.). Many specialists provide a niche care that is not covered by insurance, typically to ensure the doctor is rightfully compensated for their expertise. Hospitals will receive payment from any financing source but are typically paid through a diagnostic-related group which assists for payments based on Ambulatory Payment Classifications (APC) or Healthcare Common Procedure Coding Systems (HCPCS) numerical codes associated with different treatments or procedures (*ISPOR - US Healthcare System Overview-Backgound*, n.d.). Insurance companies utilize Current Procedural Terminology (CPT) codes which reference HCPCS to set their standard costs with

doctors and other healthcare professionals. There is however a possibility that the insurance company does not cover specific procedures or CPT codes. In any instance, the patient must pay a larger fee to utilize the doctor or go through with a procedure that is not covered.

Defining Relevant Actors and Networks

Stakeholders

Patients

In this paper, patients refer to individuals of all ages seeking options or receiving treatment for an injury, condition, or deformity they believe needs to be addressed by a medical professional. Examples of conditions include rhinoplasty, tonsillectomy, hernia repair, or cataract surgery (*Elective vs. Nonelective Surgery*, n.d.). In this position, patients are responsible with scheduling the procedure and any subsequent appointments, adhering to rehabilitation needs pre/post-procedure, as well as assuming any costs or medical accessories regarding the operation (*Elective Surgery*, n.d.). To simplify, this entity encompasses all aspects of the patient including their occupational needs, socioeconomic status, geographical residence, and support system outside the individual.

Doctors/Providers

Providers include both facilities – hospitals, clinics, and rehabilitation centers – as well as medical professionals – general or specialized surgeons, all doctors, physicians, and nurses etc. The individuals listed are highly educated and capable of providing care to all patients. Within this group exist specialists or experts within a particular field. By considering the doctor as an

equal entity to the hospital with which he/she resides, bias pertaining to individual educational background is removed. An example of this is Hospital for Special Surgery (HSS). HSS houses doctors, nurses, and therapists who each specialize in musculoskeletal conditions and will provide a different level of expertise when compared to Weill Cornell Hospital (*Reasons to Choose HSS | #1 in Orthopedics #3 in Rheumatology*, n.d.).

Insurance Companies

Insurance companies act as financial protection to individuals with the intent of keeping healthcare at an affordable cost for the majority of people. The overarching role of insurance companies is their ability to cover patients in the form of financial discounts when paying medical bills (Dey & Bach, 2019). These companies are able to enhance and ensure the quality of clinicians and hospitals by providing patients with broad access to healthcare for a small usage fee. Health insurance can be viewed like car insurance: it intends to protect from unpredictable and financially detrimental events (Dey & Bach, 2019).

Actors & Factors

Finances

Financial considerations refer to monetary value placed on providers, procedures, external care or accessories as well as insurance coverage. This includes out-of-pocket payments for procedures, appointments, or medical devices. When considering the financial burden an elective surgery may have, patients typically include extraneous costs, out-of-pocket or additional payments for procedures, appointments, or medical products. Older patients typically consider additional rehabilitation following procedure, time off work, and assistance while

recovering as each come with an associated price (*Decision-Making About Elective Surgery | National Poll on Healthy Aging*, 2022).

Surgeons must also consider finances. There is the potential for a surgeon to receive personal gains when suggesting one procedure over another – whether in a clinical trial or otherwise (Gunaratnam & Bernstein, 2018). Such consideration may influence a surgeon's recommendation if they know it could provide data or financially benefit them, despite potentially hurting the patient or insurance companies.

Geography accessibility

Geographic accessibility refers to the inability to receive desired or necessary care based on the physical location of the patient or provider. Patients will heavily consider the location of the physician in conjunction with the procedure and associated recovery process. Just as geography impacts the quality of care received, the location with which a patient resides can influence the coverage they receive. Regardless of individual health, rankings regarding state-health impact the rate provided by insurance companies; state statistics regarding tobacco usage, obesity, chronic illness, and poverty levels contribute to the insurance plan provided (Pollitz et al., 2019).

Severity of Ailment or Condition

This refers to the specific issue or ailment about which the patient is seeking medical attention. Defining the severity is difficult as a patient, providor, and insurance company may classify it differently based on difference of opinions, expertise level, and the classification of a patient's condition.

Desired Outcomes & Rehabilitation

The desired outcome is an agreed-upon final result following the procedure and rehab. Typically dictated by the patient, it defines their end goal often referred to as 'Return To Normal.' Rehabilitation refers to the timeline and protocol following a procedure before the patient achieves RTN. The rehabilitation process includes follow-up appointments, additional devices or therapy sessions, as well as protocol for recovery. During a patient-doctor consultation appointment, the patient will address areas of pain, where they hope to see improvement, and describe what their 'return-to-normal' would be following recovery (Kroh et al., 2021). A doctor will typically present the recovery timeline and protocol, aligning it to the patient's desires. Timelines can vary based on the procedure, location of ailment, commitment of patient, and the surgeon's previous experience.

Specialization or experience level

Specialization most simply indicates the experience level of the physician. This refers to both their concentration area (i.e.: podiatry) as well as the specificity of surgical experience. This can be dictated by the doctor's educational background, previous surgical experience, as well as resident hospital (i.e. HSS).

DISCUSSION

Internal-Network Specific Analysis

Influences Involved in the Patient Network

Patients typically seek surgical advice or information when they have exhausted other non-surgical options and believe their daily life is hindered too much to continue with such ailment. Evidence suggests that patients seeking elective surgery have prior knowledge and considered alternative options yet have concluded on surgery as a solution (Bernal-Delgado et al., 2016). In this position, they have already classified their ailment as a serious condition warranting surgery and are now focused on determining the right surgeon and procedure. The increasing number of publicly accessible medical reviews and content enables patients to inform themselves of the condition and options without surgeon consultations (Shinkunas et al., 2020). This is evident as patients will typically generate a list of desirables to confront their medical providers with and seek answers regarding surgical interventions (See Appendix B).

Patients will tend to seek second or third opinions from different surgeons, heavily considering each surgeon's previous experience to determine the right surgical route (*Can a Second Opinion Make a Difference?*, n.d.). This mindset may work against the patient as each doctor may be partial to different surgical methods based on their individual expertise. This is an important consideration for the patient because one doctor may present a longer, more tedious rehabilitation protocol than the other which may sway the patient's decision. This issue goes hand in hand with geographical hindrances. Surgeons tend to be populated in similar locations or facilities based on their specialty – as evident with HSS – making geographic location a key

consideration for the patient. The interviewee affirms this factor as she chose to remain in New York for the procedure due to the specialization of the surgeons available and feasibility of recovery (See Appendix B).

The concept of accessibility continues to be the leading consideration for patients as they consider feasibility of rehabilitation and financial considerations. Patients are heavily weighing finances associated with the procedure including insurance coverage, cost of appointment or operation, as well as extra costs for rehabilitation. For example, insurance companies typically cover generic products for rehabilitation making it difficult to obtain high-quality products; the addition of physical therapy further complicates the decision process as it requires an additional provider and cost. In the interviewee's case, she was presented with two surgeons of equal caliber but one had better bedside manners and shorter recovery timeline (*What Do Patients Look For In A Surgical Doctor*, 2019). Further, the two surgeons exist within the same insurance-network and coverage plan yet one provides a more cost-effective postoperative process. In this case, the decision was driven by financial and personal considerations as geographical location was not an issue in her situation (See Appendix B).

Influences Surrounding Provider Network

Providers hold a high level of influence due to their situational and expert position over patients. When confronted with an ailment, providers are able to utilize their experience and educational background to assess the patient. The act of interpreting clinical data and recognizing patterns through prior experiences refers to the CDM process as a surgeon utilizes both subconscious and analytical tactics to determine a diagnosis (Crebbin et al., 2013). While a recommendation based solely on the ailment is ideal, surgeons allow factors within his/her

personal network – education level, socioeconomic status and background, cultural beliefs etc. – to influence the decision or recommendation (Gunaratnam & Bernstein, 2018). According to studies, the location in which a surgeon was trained has a great impact on the type of surgeon they become. Surgeons in academic hospitals will base decisions off evidence-based medicine where others with limited background or experience may be uncomfortable recommending new techniques or advanced procedures due to lack of exposure (Gunaratnam & Bernstein, 2018). These claims emphasize the influence of a surgeon's specialty or experience level during SDM, highlighting the value in patients seeking experts and multiple opinions (Shinkunas et al., 2020).

While a recommendation based solely on the ailment is ideal, studies prove that doctors consider patients personal and socioeconomic factors when providing a recommendation. Using the example of age, certain surgical procedures may need to be performed at a later stage in the condition once the patient has matured for better surgical outcomes (Gunaratnam & Bernstein, 2018). In the case of age and bunionectomies, patients are typically between 40-65 as bunions are typically fully formed around that time. The interviewee's age fell well below that prompting her to question the feasibility and potential success of the procedure. In her case, the surgeon referenced previous experience with patients of the same age range, X-ray and CT scans of the foot, and her pain scale to provide a sound recommendation. Due to the severity and passion of the patient, the surgeon and his colleagues believed surgery was a promising option (Appendix B). The thought process utilized in this case aligns with the CDM model depicted in Appendix A as the surgeon exercised each end of the cognitive continuum to arrive at a diagnosis and clinical plan of the patient.

Influences Surrounding Insurer Network

As previously mentioned, there are numerous companies, plans, and methods for accessing health insurance as a patient. Unfortunately, there is no universal healthcare across America and insurance companies provide customizable coverage to their clients. This coverage, in exchange for an annual fee, protects patients against certain health events – but their coverage is not inclusive. A ceiling of financial coverage does exist which can be determined by the initial plan, or intended procedure. Insurance companies set their premiums based on five individual factors: location, age, tobacco use, plan category, and dependants (*Can Location Impact Healthcare Costs?*, n.d.). Hawaii, being one of the more healthy states, has the lowest premium ($863), whereas Maine has the highest ($2,305) (*Can Location Impact Healthcare Costs?*, n.d.). It is evident that geographic factors can influence the level of coverage a patient can receive. Their level of influence extends further than patients as Medicare limits which hospitals can perform specific procedures. While meant to enhance the quality of clinics and hospitals, this can impact surgical accessibility for patients. Further, specialists are also often concentrated in certain geographic areas or hospitals – as is the case at HSS, which may make it geographically inaccessible for a patient to receive high levels of care.

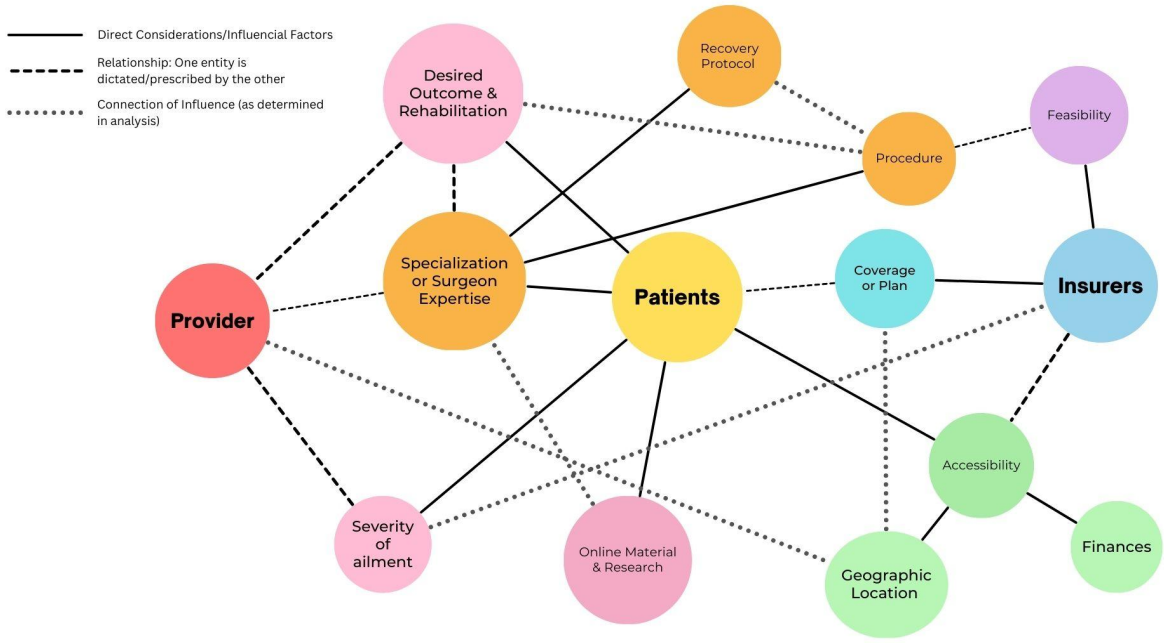
Insurance companies' use of health codes and systems for classifying procedures, injuries, and devices adds another layer of influence. For a procedure to be covered by insurance, it must be deemed medically necessary or impact a patient's way of life; unless the doctor agrees and classifies the procedure as medically necessary, an insurance company may not provide funding to cover the procedure. Insurance providers therefore influence the patient's surgical decision as financial feasibility can hinder a patient from receiving a specific procedure. For example, plastic

surgery is one of the largest growing elective procedures but is not universally covered and often paid for out of pocket (Research, 2022).

Their influence also extends to surgeons because insurance companies tend to cover physicians up to a certain level. Most insurance companies provide a list of providers within their 'network' that will be covered under the individual's plan. Unfortunately, this resource further exacerbates the inequality in care because those with a more expensive plan, and therefore higher coverage, have access to more medical professionals (Pollitz et al., 2019). Additionally, if the suggested procedure is technically advanced, it may require a highly-specialized surgeon who may be out of network (Dey & Bach, 2019). Situations of confusion may arise when the procedure is deemed medically necessary but the surgeon is not covered within the insurance network. In this scenario, insurance policies are influencing the patient as they must weigh financial considerations, as well as the expertise and preference of surgeon and procedure.

Assessment of Surgical - Network Relations

All three entities – patients, providers, and insurance companies, have different relationships with one another. This generates smaller networks within the overall system of surgery yet influences are apparent throughout. The network of influences included below exemplifies the connections and relationships between different stakeholders.



It is clear that the relationship between surgeon and patient greatly influences the final surgical decision. Patients directly consider the desired outcome and rehabilitation, surgeon's expertise, the severity of their issue, online research, and the accessibility of finances and geographic location in their surgical decision process. In connection with providers, patients heavily weigh his/her expertise, the desired outcome or necessary rehabilitation, and accessibility to the surgeon when determining the right provider for the procedure. Online resources allow patients to research expert surgeons in the industry and develop personal opinions regarding the procedure and their ailment prior to consultations. Patients are therefore more involved in the decision making process and ultimately influence the surgeons recommendation. This also perpetuates variation because the surgeon is no longer driving the decision. While the provider's level of expertise previously entitled them to dictate the recommended procedure and recovery protocol, the shift towards a patient-centric decision process forces surgeons to allow patient opinions and desired outcomes to influence their recommendation. This is evident as the majority

of patients prefer a shared decision making process since it primarily caters towards the patient's needs (Gunaratnam & Bernstein, 2018).

The variation across U.S. surgeries is evident when considering access to surgeons and specialists and primarily due to geographic or financial considerations. Specifically, specialists are heavily concentrated in different geographic locations and primarily require a higher level of compensation. Nevertheless, there is minimal variation in the actual procedural approach which can be attributed to cross-talk between surgeons and shared academic experience(Birkmeyer et al., 2013). Thinking broadly, geographic location and financial burden go hand in hand and are directly dictated or influenced by insurance companies. Insurance providers directly influence the feasibility of procedures, and coverage or plan provided to patients; subsequently hindering patients from accessing specific procedures or surgeons, as well as categorizing patients based on their demographics and socioeconomic status.

Looking broadly, while patient stakeholders hold the primary power, variation most specifically stems from the surgeon's experiences and resources. Surgeon's specialization can influence the recovery protocol, procedural plans and surgical outcome as well as analysis of ailment. Additionally, patients are more likely to seek expert advice in preliminary research, second opinions from specialists, and travel to credible hospitals to access quality procedures and information. Therefore, while the shift to joint decision making is evident, patients tend to allow expert opinions to shape their outlook and influence the final surgical decision.

CONCLUSION

It is evident that there is no clear line of influence between the three entities – patients, providers, and insurance companies – involved as it pertains to surgery. Utilizing ANT as a lens of analysis enabled each factor to be evaluated equally disregarding the inequities and bias typically depicted in healthcare. While this qualitative discussion regarding surgical variability and the decision making process identified key influences within the network, quantitative studies would be useful to best demonstrate the level of impact. The actors and metrics outlined in this paper are only a glimpse into the possible influences. Considering the continual growth in healthcare and medical innovation, as well as the increase in SDM, I believe variation in surgical diagnosis will only increase.

Appendix

Appendix A: Map of Clinical Decision Making Process Including Pattern Recognition and Data Interpretation Tactics

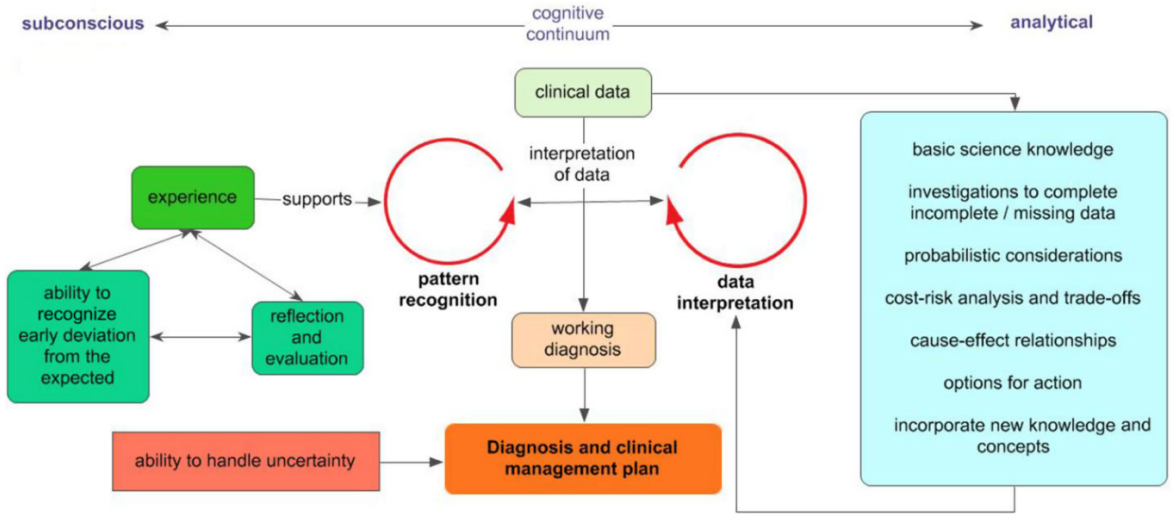


Fig. 1. A model of the CDM processes of experts while diagnosing and managing a patient.

Appendix B: Primary Source – Transcript/Response from Interviewee Regarding Bunionectomy and Surgical Decision Process

Goal/Intent of Interview: Gain an insider perspective into the decision making processes from the point of view of the patient.

Background of Interviewee: A 23 year old recent college graduate has suffered from bunions (hallux abducto valgus) for as long as she can remember. This foot deformity occurs from years of pressure to the big toe joint (metatarsophalangeal or MTP joint) causing misalignment of the big toe joint and the formation of a bony bump at the interior of the foot. Her bunion has always been a point of conflict during daily activities: she was an avid ballet dancer and the compression of shoes only perpetuated the issues. Originally from New York, she had just accepted a job in California and intended to move at the end of the summer; this meant she had the summer months free – a perfect time to recover from bunion surgery. As the bunion would only get worse as she got older, she began research into potential procedures, surgeons, hospitals, and financial coverage options.

Question – Can you explain your ailment/situation prior to surgery?

I have lived with bunions for as long as I can remember. My grandmother has severe bunions and recently her toes began to cross over making it impossible for her to wear 'normal' shoes. From a young age I envisioned myself getting bunion surgery but assumed I would need to wait until I was much older. Before I began researching the condition and procedure, I had preliminary knowledge on the length of recovery and severity of the procedure. I figured I would need to wait because bunions continue to grow with age. Mine specifically has grown a lot since I first noticed it – the pain it brought me also increased significantly as I got older. I became aware of the pain and the hindrances it put on my day-to-day life. For instance, I love to walk but would find myself taking frequent breaks to stop and realign the bone for comfort purposes; I had to buy my shoes in a wider-size, and could only wear select heels.

Question – What made you consider seeking a surgeon/consultation at this time of your life?

The deciding factor for surgery was realizing the pain was only going to increase, and it was already negatively impacting my life and I was only 20. I also had a window of time between graduation and starting work that I was able to adequately recover as my mother and father would be able to care for me. Additionally, I have bought and tried all the options and contraptions they sell online to remedy or fix/aid the pain of bunions – none of which worked. Because it had become a hindrance to my daily life, and the embarrassment of bunions was increasing as I was being limited by my shoe choices, I felt that looking into procedures was the best step.

Question – What was your thought process and considerations when scheduling consultations or seeking doctors?

First, because I am so young and like to be involved in my medical affairs, I did a lot of research into procedure types, surgeons/specialists, rehabilitation needs and timelines, as well as side/adverse effects and situations that could arise post-surgery. Further, I needed to consider my personal body/ligament issues that could impact the surgical outcome as well as feasibility. I have knee problems which attribute to my balance and stance issues, as well as very loose ligaments throughout my body. The problem of ligaments is an important consideration because bunionectomies can lead to laxity in ligaments because there is less pressure from the bone formation. If my ligaments are already loose, and there is potential for the bone to assume its original position/deviate from the position set by surgery, I was concerned the bunion would come back. Additionally, I have very flat feet which already impacts my instability and pain when overusing my feet. This can also impact the outcome of a procedure, in conjunction with loose ligaments, because my foot wants to remain in a lax positioning and the procedure tightens/shifts the natural anatomy of the foot.

My last consideration was to ensure the procedure would be covered financially either by my insurance provider or parent (with which I am considered a dependant). Because I was fortunate to be supported by my mother, it was less of a "top-of-mind" consideration for me personally. Thankfully, because the bunions impact my way of life, and because doctors have diagnosed me with them at a previous check-up, I have medical clearance for the procedure. For that reason,

and because I am in NY and have access to numerous surgeons, I sought out surgeons that are in my network and have expertise in bunions/orthopedic procedures and ailments.

Before going into each consultation, I formulated a question that addressed those concerns. I wanted to make sure the surgeon knew how involved and invested I was in the procedure and how important it was to me that he knew of my additional feet issues when devising a surgical plan.

Question – What preliminary research did you do before scheduling your first consultation?

I wanted to understand the different types of procedures possible based on the different severities of bunions. I first set out to determine what level of bunion I had: I pinpointed pain points and specific activities that perpetuated the pain. I learned that there are a few different types of procedures: Lapiplasty 3D bunion correction, Minimally invasive surgery: Metatarsal osteotomy or bunionectomy, and the Lapidus and Akin procedure. I gathered intel on the differences and what would be required of the injury to undergo each. I also collected specific surgeons (in the US) that specialized in these procedures. I was able to narrow down 2 surgeons in HSS - both of which were published in foot deformity research articles proving their expertise in this area. One surgeon outside of insurance but had experience with this procedure on celebrity athletes. I also found a surgeon in California who had conducted multiple of these procedures.

I was able to make some decisions and narrow down my search: Firstly, I decided to only look at surgeons covered by my insurance to minimize any additional costs. Second, I assumed the procedure would take place in NY – considering I have a support system here and access to many top-tier surgeons and facilities for recuperation. Thirdly, because I did not know the key impact/differences between each procedure, I decided to include targeted questions about what the procedure would entail and how it would manifest into the recovery timeline and needs.

Question – What were the main questions you wanted answered going into the consultation?

The list of questions – which changed based on new information or sessions – to address with the surgeon.

1. What procedure do you suggest and what will be done to my foot specifically?
    a. CONT.: I understand that I am not a candidate for minimally invasive surgery due to the severity of the bunion – can I have a duel foot surgery/do the procedure on both feet at the same time? If not, what is the timeline for doing the second foot?
    b. CONT.: What incisions or implants are necessary (fusion, shaving of bone, incorporation of bone marrow, plates, sutures etc.)
2. I have loose ligaments throughout my body, how if at all will you address that so the bunion does not reform? Additionally, I have an extra bone within the center of my foot, does this need to be addressed and how will it be addressed?
    a. CONT.: I am 23 and have the potential to grow more. I also understand that loose ligaments can cause the bunion to reform due to its desired position: do you

foresee that happening and what steps in the procedure will address potential bunion regrowth?

3. What is the recovery timeline/protocol and what measurements of return to normal are used as benchmarks?
    a. CONT.: Considering I intend to exit the state, how do you typically organize post-op visitation? When am I able to return to normal?
4. Is there anyway to do both feet at once; or what is the timeline you suggest for doing both in a set time period (minimum time required by your policies to wait between operations)
    a. CONT.: I do need to move to California by August 15th, how feasible is this and when would I need to have the procedure to properly travel and move if I intend to drive across the country?
5. We have United Healthcare Choice Plus - is this covered?
6. What is the probability the bunion will grow back/I will need additional surgeries later in life?
    a. CONT.: I understand that this procedure can lead to laxity in ligaments because there is less pressure from the bone formation: how are you going to address this in the procedure and if not why?

Question – After your consultation, what were your initial thoughts?

In my first appointment I learned and decided on a few things. First, I was not a candidate for the minimally invasive procedure as I had hoped and could not have both feet operated on simultaneously. Second, I had an extra bone in both feet which needed to be further evaluated for surgical complications. Third, while the left foot was the more painful of the two, it made logistical sense to operate on the right foot as I knew I was being cared for and would not need to drive.

I did however decide that surgery was the right step. This was the perfect time for me, both feasibly and financially considering my family's support and proximity to top-surgeons and facilities. I was only concerned with the return to normal/recovery considering my plans to move. This was a major concern because the first surgeon I spoke to gave me a ten-week timeline before I could start light-activities (low-impact). The second surgeon provided the same surgical plan but with a six-week rehab protocol. The second surgeon also went more into depth with his surgical agenda making me feel more confident in his tactics and experience.

Question – What did you primarily consider when choosing a surgeon?

Because geographic and financial constraints were not a factor (surgeons I chose from were both in network/covered, and both worked a block from one another with equally equipped facilities), I focused primarily on the recovery timeline and personality/bedside manner of the surgeon. After reading each surgeon’s report on the surgical plan, I realized that they were the same, one just provided a more concrete explanation – a quality I appreciated. A third party who I received advice from said to choose the man who provides a shorter recovery because “those who claim a longer timeline typically high-ball to prove their efficiency when you recover faster”. Further, I felt more secure with the second surgeon's procedure and recovery protocol.

Bibliography:

About STS - stswiki. (2018, May 8). https://web.archive.org/web/20180508081439/http://www.stswiki.org/index.php?title=About_STS

Actor-network theory (ANT)—Stswiki. (2016, May 11). https://web.archive.org/web/20160511003951/http://www.stswiki.org/index.php?title=Actor-network_theory_(ANT)

ANT Vocabulary – Table | Actor Network Theory. (n.d.). Retrieved March 15, 2023, from https://actornetwork.wordpress.com/2009/08/21/ant-vocablulary-table/

Bernal-Delgado, E., Ridao-López, M., & Garcia-Armesto, S. (2016). Medical Practice Variations in Elective Surgery. In A. Johnson & T. Stukel (Eds.), *Medical Practice Variations* (pp. 1–29). Springer US. https://doi.org/10.1007/978-1-4899-7573-7_71-1

Birkmeyer, J. D., Reames, B. N., McCulloch, P., Carr, A. J., Campbell, W. B., & Wennberg, J. E. (2013). Understanding regional variation in the use of surgery. *Lancet*, *382*(9898), 1121–1129. https://doi.org/10.1016/S0140-6736(13)61215-5

Can a Second Opinion Make a Difference? (n.d.). Yale Medicine. Retrieved March 17, 2023, from https://www.yalemedicine.org/news/second-opinions

Can Location Impact Healthcare Costs? (n.d.). Retrieved March 16, 2023, from https://www.innovu.com/post/can-location-impact-healthcare-costs

Crebbin, W., Beasley, S. W., & Watters, D. A. K. (2013). Clinical decision making: How surgeons do it: Clinical decision making in surgery. *ANZ Journal of Surgery*, *83*(6), 422–428. https://doi.org/10.1111/ans.12180

Cresswell, K. M., Worth, A., & Sheikh, A. (2010). Actor-Network Theory and its role in

understanding the implementation of information technology developments in healthcare. *BMC Medical Informatics and Decision Making*, *10*(1), 67. https://doi.org/10.1186/1472-6947-10-67

Data Reveal the Details about the Surgeon Workforce Shortage. (2022, February 4). The Bulletin. https://bulletin.facs.org/2022/02/data-reveal-the-details-about-the-surgeon-workforce-shortage/

de Mik, S. M. L., Stubenrouch, F. E., Balm, R., & Ubbink, D. T. (2018). Systematic review of shared decision-making in surgery. *The British Journal of Surgery*, *105*(13), 1721–1730. https://doi.org/10.1002/bjs.11009

Decision-Making About Elective Surgery | National Poll on Healthy Aging. (2022, March 9). https://www.healthyagingpoll.org/reports-more/report/decision-making-about-elective-surgery

Dey, P., & Bach, P. B. (2019). The 6 Functions of Health Insurance. *JAMA*, *321*(13), 1242–1243. https://doi.org/10.1001/jama.2019.2320

Elective surgery. (n.d.). Retrieved March 16, 2023, from https://www.healthywa.wa.gov.au/Articles/A_E/Elective-surgery

Elective vs. Nonelective Surgery: Uses, Benefits & More. (n.d.). Verywell Health. Retrieved March 15, 2023, from https://www.verywellhealth.com/elective-vs-nonelective-surgery-5409504

Gunaratnam, C., & Bernstein, M. (2018). Factors Affecting Surgical Decision-making—A Qualitative Study. *Rambam Maimonides Medical Journal*, *9*(1), e0003. https://doi.org/10.5041/RMMJ.10324

Health Equity—Inequitable Access to Healthcare's Racist Roots | RTI. (2022, March 8).

https://healthcare.rti.org/insights/health-equity-racism-and-proximity-to-hospitals

How an Air Pocket Can Cause Concha Bullosa. (n.d.). Verywell Health. Retrieved April 12, 2023, from https://www.verywellhealth.com/what-is-concha-bullosa-1191864

How U.S. Health Insurance Works | Vaden Health Services. (n.d.). Retrieved March 15, 2023, from https://vaden.stanford.edu/insurance-referral-office/health-insurance-overview/how-us-health-insurance-works

ISPOR - US Healthcare System Overview-Backgound. (n.d.). Retrieved March 15, 2023, from https://www.ispor.org/heor-resources/more-heor-resources/us-healthcare-system-overview/us-healthcare-system-overview-background-page-1

Jones, O. (2009). Nature-Culture. In R. Kitchin & N. Thrift (Eds.), *International Encyclopedia of Human Geography* (pp. 309–323). Elsevier. https://doi.org/10.1016/B978-008044910-4.00716-1

Kroh, M., Prager, G., Rubino, F., Marinari, G. M., Torres, A. J., Somers, S., Akın, F., & Haskins, O. (2021). Returning to Surgery—Experience, Discussions and Consensus. *Obesity Surgery*, *31*(3), 1336–1338. https://doi.org/10.1007/s11695-020-04989-0

Meara, J. G., Leather, A. J. M., Hagander, L., Alkire, B. C., Alonso, N., Ameh, E. A., Bickler, S. W., Conteh, L., Dare, A. J., Davies, J., Mérisier, E. D., El-Halabi, S., Farmer, P. E., Gawande, A., Gillies, R., Greenberg, S. L. M., Grimes, C. E., Gruen, R. L., Ismail, E. A., … Yip, W. (2015). Global Surgery 2030: Evidence and solutions for achieving health, welfare, and economic development. *The Lancet*, *386*(9993), 569–624. https://doi.org/10.1016/S0140-6736(15)60160-X

PITTORE, B., AL SAFI, W., & JARVIS, S. J. (2011). Concha bullosa of the inferior turbinate: An unusual cause of nasal obstruction. *Acta Otorhinolaryngologica Italica*, *31*(1), 47–49.

Pollitz, K., Tolbert, J., Claxton, G., & 2019. (2019, July 30). What's The Role of Private Health Insurance Today and Under Medicare-for-all and Other Public Option Proposals? *KFF*. https://www.kff.org/health-reform/issue-brief/whats-the-role-of-private-health-insurance-today-and-under-medicare-for-all-and-other-public-option-proposals/

Reasons to Choose HSS | #1 in Orthopedics #3 in Rheumatology. (n.d.). Hospital for Special Surgery. Retrieved March 16, 2023, from https://www.hss.edu/reasons-to-choose-hss.asp

Research, P. (2022, August 31). *Cosmetic Surgery Market Size to Worth Around USD 205.1 Bn by 2030*. GlobeNewswire News Room. https://www.globenewswire.com/en/news-release/2022/08/31/2507760/0/en/Cosmetic-Surgery-Market-Size-to-Worth-Around-USD-205-1-Bn-by-2030.html

Shinkunas, L. A., Klipowicz, C. J., & Carlisle, E. M. (2020). Shared decision making in surgery: A scoping review of patient and surgeon preferences. *BMC Medical Informatics and Decision Making*, *20*(1), 190. https://doi.org/10.1186/s12911-020-01211-0

Ward, M. M., Ullrich, F., Matthews, K., Rushton, G., Tracy, R., Bajorin, D. F., Goldstein, M. A., Kosty, M. P., Bruinooge, S. S., Hanley, A., & Lynch, C. F. (2014). Access to Chemotherapy Services by Availability of Local and Visiting Oncologists. *Journal of Oncology Practice*, *10*(1), 26–31. https://doi.org/10.1200/JOP.2013.001217

What Do Patients Look For In A Surgical Doctor. (2019, November 28). Surgimate. https://www.surgimate.com/blog/how-patients-choose-a-surgeon/