Zoom Medicine: Evaluating Recent Changes to CMS Telemedicine Guidelines in Response to the COVID-19 Pandemic

By: Peter Hahn

Submitted in partial fulfillment of the requirements for the degree of:
Bachelor of Arts in Public Policy Studies at the University of Chicago

Preceptor: Kelsey Berryman
Second Reader: Sorcha Brophy, PhD

April 15, 2021

Acknowledgements

To Kelsey, thank you for your bright energy and insightful guidance throughout the year.

To Sorcha, thank you for sharing your expertise with me and inspiring a deep appreciation for policy during my time at the University of Chicago.

To my family and friends, for their good cheer, endless love, and steady support. I will be forever grateful.

Abstract:

This study examines the current state of telemedicine in the United States, with a focus on recent policy changes made in response to the COVID-19 pandemic. Between April and October of 2020, the federal government approved 147 additional telemedicine procedures for Medicare beneficiaries, greatly expanding their access to telemedicine. Analysis of data from the Centers for Medicare and Medicaid Services (CMS), as well as the New England Quality Care Alliance, show that: 1) the recent changes to the approved telemedicine procedures list led to a dramatic increase in both the number of procedures and the number of specialties approved for telemedicine, 2) the specialties represented on the list of approved telemedicine procedures signal a departure from the status quo, and 3) insurers differed in their approach to telemedicine during the pandemic, and also treated inpatient procedures differently than outpatient procedures. Additional findings are also discussed. In summary, this study demonstrates a need for clinical research to determine the efficacy of the newly-added telemedicine procedures and offers an argument in favor of expanding telemedicine access in the future.

Table of Contents

Introduction:

Telemedicine in the United States traces its history all the way back to 1959, before the advent of personal computers and audio/video technologies that are available to physicians and patients today. (Wittson & Benschoter, 1972) Despite the numerous technological advances that have been made since then, telemedicine never became a significant part of the healthcare system due to structural barriers such as legal concerns, reimbursement regulations and state licensure rules that prevented patients from seeking care from out-of-state physicians. (Granade, 1995; Dickens & Cook, 2006) There is evidence that these barriers are limiting the potential benefits of telemedicine. Previous research indicates that increasing telemedicine utilization will lead to improvements in the healthcare system, both in terms of healthcare costs and access. Multiple studies have shown that telemedicine could play a significant role in reducing the cost of healthcare for insurers and patients by reducing the amount of time and resources needed per appointment. (Yamamoto, 2014; Dullet et al., 2017) Additionally, patients that are unable to make in-person appointments with their physicians could benefit from telemedicine because they would be able to access physicians outside of their geographical vicinity. (Ekeland et al., 2010) Many rural communities are experiencing a physician shortage, and telemedicine could be a useful tool for increasing healthcare access in these communities. In other countries, telemedicine has been an effective tool for reducing waiting times for patients to see specialists. Figure 1 (below) shows how patients in the United Kingdom were able to receive dermatological care nearly 6 months earlier due to telemedicine. Facing a 35-week wait for an in-person appointment, these patients were able to see a dermatologist only 7 weeks after their referral. (Mort et al., 2003)

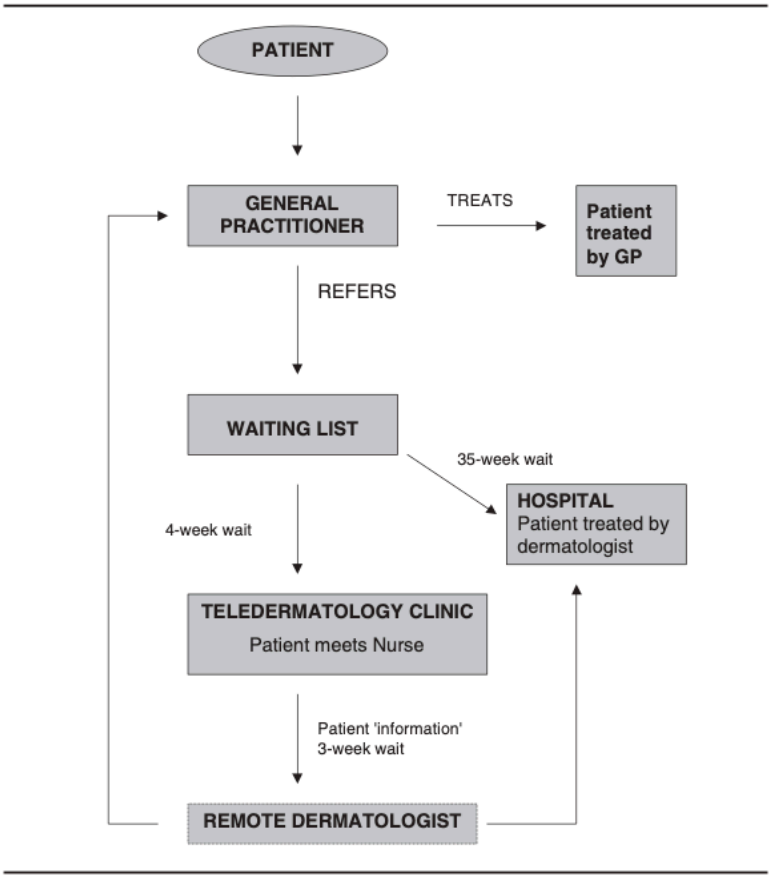

Figure 1: Waiting times for telemedicine vs. in-person appointment. Source: Mort et al. 2007

The potential benefits of telemedicine are numerous, but it was not until the outbreak of the COVID-19 pandemic in early 2020 that telemedicine was used in significant numbers in the United States. Telemedicine utilization rates dramatically increased as a result of the pandemic. The number of Medicare beneficiaries that utilized telemedicine skyrocketed, as did the total number of telemedicine appointments made per week. (Verma, 2020) One reason why telemedicine became more widely used was because of policy changes made at the federal level. Between March and October of 2020, the Centers for Medicare and Medicaid Services (CMS) approved 147 procedures to be delivered via telemedicine, adding to a list of 101 procedures that had previously been approved. (CMS, 2020) Because of these changes, physicians were able to

provide more telemedicine procedures to patients that would have otherwise needed to travel to a clinic or hospital to receive care.

These procedures were not limited to the outpatient setting, where telemedicine has been historically more widely-used. (CMS, 2020) Internal medicine and critical care physicians in the inpatient setting were approved to deliver many procedures via telemedicine. While telemedicine is often thought of as the real-time, video consultation between patient and physician, it actually includes a wide variety of procedures applicable to multiple specialties and settings. Telemedicine has been more generally defined as the use of communication technologies, including pre-recorded videos, still-images, and audio-only communication, to deliver healthcare across significant physical distances. (Breen and Matusitz, 2010; Mort et al., 2003) Furthermore, technological advances in health monitoring technology have allowed some physicians to monitor their patients' health remotely. This practice, known as telemonitoring, is especially common in certain specialties such as cardiology, endocrinology, and pulmonology.

Because several major changes to telemedicine reimbursement policy occurred within the past 12 months, little is known about the potential benefits and shortcomings of these changes. Previous studies of telemedicine have elucidated potential benefits, but there are many unknowns about the impact of telemedicine. For many specialties, little to no research has been done to determine the clinical efficacy of telemedicine. These are important gaps in the clinical literature, and the pandemic has increased the importance of answering some of these questions. At least 60 of the 147 newly-approved procedures have been permanently approved for coverage by CMS, suggesting that many of the changes that have occurred during the pandemic will remain after COVID-19 passes. (CMS, 2020) Therefore, it seems like an appropriate time to take a closer look at the state of telemedicine insurance coverage in the United States, with a special focus on the

inclusion and exclusion of certain specialties, the variety of procedures that are covered by insurance, and the reimbursement costs of telemedicine procedures.

The final dataset for this study was compiled by combining data from multiple CMS resources, and by manually adding a specialty designation to each procedure. CMS published an updated list of approved telehealth procedures in October of 2020, which included the full list of approved telemedicine procedures and indicated which ones had been added in response to the pandemic. This list, called the Medicare Telehealth Services list, contained a short description of each procedure. Using these descriptions, I matched each procedure with a medical specialty, and added this information to the Medicare Telehealth Services list. Furthermore, I used the Medicare Physician Fee Schedule (MPFS) lookup tool provided by CMS to gather reimbursement data for each telemedicine procedure. This data was also added to the Medicare Telehealth Services list. After making these additions, I consulted the clinical literature on telemedicine's effectiveness to gather information about the effectiveness of telemedicine in various specialties.

In this study, I aim to analyze the changes made to the insurance coverage of telemedicine in response to the COVID-19 pandemic. Additionally, I aim to analyze the state of telemedicine coverage prior to the pandemic and compare the state of telemedicine coverage today with the clinical evidence of what is known about the effectiveness of telemedicine.

Background:

Between March and October of 2020, CMS added 147 medical procedures to the list of approved telehealth procedures, called the Medicare Telehealth Services list. These procedures spanned across all specialties and medical settings, and included emergency department visits, initial inpatient visits, and nursing facility visits. (CMS, 2020) This policy change allowed Medicare beneficiaries to access telemedicine services at an unprecedented rate, and more people received health services via telemedicine than ever before. Medicare beneficiaries were not the only people that suddenly gained access to telemedicine as a result of the pandemic – similar policy changes occurred with several private insurers such as Aetna and Blue Cross Blue Shield. (NEQCA, 2020)

CMS data published in late-2020 revealed that the increase in telemedicine utilization was truly dramatic. While telemedicine procedures represented only a small fraction of medical consumption before the pandemic, more than 24.5 million out of 63 million Medicare beneficiaries received healthcare via telemedicine between March and October of 2020. (CMS, 2020) In the early weeks of the pandemic, the telemedicine utilization rate increased at an unprecendented rate. In early March, before the pandemic swept across the nation, about 13,000 patients received at least one telemedicine procedure per week in the entire country. By mid-April, on a few weeks later, more than 1.7 million patients were receiving at least one telemedicine procedure every week. (Verma, 2020)

This data shows that telemedicine became a vital method of healthcare delivery during the pandemic. Telemedicine procedures have a crucial advantage over their in-person counterparts because they present little to no risk of COVID transmission between patients and their providers. Given the rapid expansion of telemedicine during the pandemic, there are some reasons to believe

that it will remain prevalent even after the conclusion of the pandemic. One reason could be that people have become more accepting of technology in their healthcare; patients could be more willing to see their provider via telemedicine because they have become familiar with the process. From a policy standpoint, CMS has already committed to the permanent addition of 60 of the 147 new procedures to the Medicare Telehealth Services List. (CMS, 2020) It remains to be seen whether these permanent additions will improve the lives of patients or not. While telemedicine has clear advantages, medical researchers have attempted to define the benefits and drawback of telemedicine for a long time to no avail, with much of the research on telemedicine pre-dating the pandemic.

Researchers have studied telemedicine on a few different fronts, clinical benefits, gains in healthcare efficiency, and cost savings. Numerous studies have shown that telemedicine can have a positive clinical impact, and that it can cut down on healthcare costs by reducing health service use. (Ekeland et al., 2010) Telemedicine has many advocates as a result of these studies. But, it should also be acknowledged that the clinical efficacy of telemedicine procedures has often been undermined by inconclusive evidence. Ekeland et al. cite two bodies of research that are less optimistic about telemedicine. (2010) First, there is a group of researchers that have identified potential benefits of certain telemedicine procedures, but argue that more research is needed to conclusively prove their efficacy. Second, another group of researchers have been more critical. This last group of researchers argue that there "limited and inconsistent" data supporting the effectiveness of telemedicine. (Ekeland, 2010)

These contradictory findings led me to question the clinical efficacy of the procedures in the Medicare Telehealth Services list, and this seems like an especially important question in the face of the recent addition of telemedicine procedures to the list and the increased telemedicine

utilization across the country. The recent CMS policy changes ensure that Medicare beneficiaries will have access to telemedicine if they so desire, but the question of whether they *should* desire telemedicine remains unanswered. Patients, as well as their physicians, would benefit from knowing more about the approved telemedicine procedures available to Medicare patients, and this study aims to contribute to filling that gap in knowledge.

Telemedicine in the United States has a longer history than one might expect. The earliest cited case of telemedicine occurred in 1959 at the Nebraska Psychiatric Institute and Norfolk State Hospital, also in Nebraska. (Wittson and Benschoter, 1972) Even at this early stage, the program at the Nebraska Psychiatric Institute had many of the hallmarks of telemedicine that continues to define the field today. There are many parallels between this early program and the commonly-held views of telemedicine. For one, medical services were delivered in a rural setting, which is typical because telemedicine has often been used to overcome the shortage of healthcare providers in rural areas, a huge potential benefit that has thus far gone unrealized. (Preston et al., 1992; Mort et al., 2003; Cermack, 2006) For another, telemedicine was used to treat psychiatric conditions at the Nebraska Psychiatric Institute, establishing a link between telemedicine and psychiatry that has very much persisted to the current day. Telemedicine has consistently been linked with psychiatry more than any other specialty, and this continues to be the case as technological improvements transform telemedicine. (Nelson et al., 2006) Other than psychiatry, telemedicine has been most extensively approved for use in nephrology, as well as internal medicine in both the inpatient and outpatient settings. (CMS, 2020)

Since its inception in the mid-20th century, telemedicine became somewhat more widely adopted and niche-oriented as communications technology improved and more procedures were developed. Two factors were critical in the development of telemedicine: the rise of new

technologies and the precipitous decline in the cost of transferring data, which had previously been a threat to the economic viability of telemedicine. (Grigsby et al., 1995) Because technological advancements resulted in a huge diversity of available telemedicine procedures, telemedicine came to be classified in terms of the technology used to render the service. These included technologies such as videoconferencing, telephones, email services, and remote monitoring systems. (Mort et al., 2003; Matusitz and Breen, 2007; Cermack, 2006)

Telemedicine never gained widespread acceptance, and prior to the pandemic, it was primarily used to manage specific diseases and chronic conditions. (Matusitz and Breen, 2007; Turner et al., 2004) Routine check-ups and the vast majority of acute procedures were delivered in-person, even though the technology to deliver them through telemedicine came into existence. Therefore, while the healthcare system and technology sector developed the potential to bring telemedicine to all patients, this never actually materialized until the pandemic necessitated the widespread adoption of telemedicine to limit the transmission of COVID-19 between providers, their patients, and their wider communities.

Given telemedicine's long history, as well as the rapid technological developments that expanded the range of possible telemedicine procedures, it arguably should have been more widely adopted by the time the pandemic began in 2020. Researchers have identified several obstacles that hindered telemedicine's development in the United States and interfered with its widespread adoption. Entrenched powers, such as insurance companies as well as federal and state governments, prevented the proliferation of telemedicine despite its potential benefits.

There were several obstacles in the way of greater telemedicine utilization. Primary among the obstacles were numerous legal concerns regarding malpractice and patient confidentiality. For example, the issue of liability became problematic because hospitals could face costly legal

challenges for the misuse of telemedicine. Legal liabilities for medical malpractice via telemedicine were less clearly-defined than the liabilities of in-person practice, and therefore the potential costs of litigating these cases were extremely high. (Dickens & Cook, 2006) This understandably reduced the willingness of hospital executives, physicians, and patients to utilize telemedicine procedures. Another example of a legal barrier to telemedicine was the issue of patient confidentiality. Telemedicine necessarily includes the storage and transmission of private health data through the shared digital mediums, which raised concerns about potential data breaches that could threaten patient data. (Granade, 1995) Concerns about patient confidentiality transcended just hospital executives and legal experts, but was shared by physicians, hospital administrators, and patients as well. (Granade, 1995; Whitten et al., 2000) Between the lack of clarity on legal liability and the risks of compromised patient confidentiality, the legal barriers to telemedicine played a huge role in delaying its adoption.

Another barrier for telemedicine, one that is particularly relevant for this study, was the reluctance of insurance companies to cover telemedicine procedures. Insurance companies were "careful, reluctant, and almost skeptical to accept any untraditional methods of healthcare administration other than their comfortable, standard practices that have existed for generations." (Breen & Matusitz, 2011) Because insurance companies refused to cover telemedicine procedures, there was very little demand from physicians for new telemedicine services, even if they offered clear clinical benefits, reduced barriers to access, or proved to be cost-efficient. From the patient's perspective, the supply of telemedicine was insufficient, since physicians had no financial incentives to offer telemedicine in the absence of reimbursement mechanisms.

From the early days of telemedicine, researchers recognized its potential to connect physicians and patients across great distances. (Preston et al., 1992) Telemedicine could have been

used to alleviate the physician shortage in certain (mainly rural) parts of the country, but this potential benefit was almost never realized due to interstate licensing requirements, as well as institutional licensing requirements for physicians that also varied from state to state. (Dickens & Cook, 2006). Consequently, while there may have been a great demand for telemedicine in rural America, physicians from more populated areas of the country were not allowed to leverage telemedicine to provide care for these patients. The institutions that determine interstate practice authority, as well as state-specific licensing, could be seen as fulfilling a similar role as insurance companies by discouraging physicians from using telemedicine to address their patients' needs. These institutions minimized the disruption to the status quo by limiting the utilization of telemedicine.

Breen and Matusitz wrote that the lack of expertise in the field of telemedicine posed "probably the most crucial hindrance to the progressive evolution of telemedicine." (2007) In 2003, Turner noted that there was a "general lack of educated personnel who know how to use the equipment and technology that comprise telemedicine." The lack of expertise could be attributed to a couple of factors. First, it could be a reflection of the recent technological progress that gave rise to new and unfamiliar telemedicine procedures. Second, it could also be a product of the aforementioned barriers to telemedicine that limited the workforce's familiarity with telemedicine. Regardless, new technologies require users to navigate a learning curve, and healthcare technologies are no exception to that rule. One positive outcome from the high rates of telemedicine utilization during the pandemic could be an increased familiarity with telemedicine, both for providers and their patients. Furthermore, this familiarity could lead healthcare providers to adopt other forms of telemedicine as they become available in the future. Telemedicine in the United States has been plagued by stagnation and uncertainty, but the pandemic appears to have

caused a series of changes that could make telemedicine an important aspect of the healthcare system in the future.

Theoretical Framing:

The theoretical framing for this study is rooted in two separate theories, one regarding lobbying from the field of political science and another concerning technology acceptance from the field of information science. To understand the role of lobbying in the changes made to telemedicine policy, I apply the neo-pluralist theory of lobbying to analyze the opaque and intricate details of telemedicine reimbursement. I argue that the neo-pluralist view, that there are specific conditions under which lobbying becomes an effective force for policy change, is supported by the circumstances under which telemedicine policies changed. I also rely on the Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Viswanath Venkatesh and others, to analyze potential obstacles for the increased adoption of telemedicine. Under the UTAUT, both the characteristics of the user and the technology must be considered to evaluate the likelihood of technology acceptance from the end-user. With this in mind, I argue that telemedicine adoption will face a diverse set of challenges based on the environment in which new technology is deployed.

Much of the early literature in political science portrayed lobbying as a benign force. Specifically, the pluralist theory espoused by Robert Dahl and David Truman claimed that it was natural, and perhaps even desirable, for individuals to join forces when they agreed on specific policy outcomes. (Dahl, 1961; Truman, 1951) Beginning in the late 20th century, political scientists challenged this benign view and began to think of lobbying in transactional terms, which eventually led to another theory: the transactions, or profit-maximizing, theory of lobbying.

(Olson, 1982; Schattschneider, 1960; Crandall, 1983; Bartel & Thomas, 1987) Under this theory, "strong organizations lobby at the expense of the weak in efforts to secure private goods." (Lowery, 2007) In the context of the recent changes to telemedicine policies, the pluralist theory might predict that the recent changes by CMS are more likely to align with clinical data, while the transactions theory would predict that lobbying efforts lead to a misalignment of policy and clinical data due to prioritization of the interests of a few small groups.

A third theory of lobbying, known as the neo-pluralist theory, emerged during and after the 1990s. Neo-pluralism refuted the claims of the transaction theorists based on mounting empirical evidence that the effects of lobbying were unpredictable, and that lobbyists are certainly not able to consistently overpower the effects of public opinion. (Heinz et al., 1993; Kollman, 1998) Presumable, public opinion would capture the preferences of weaker members of society that these "strong organization" were attempting to overpower. Many studies "[highlighted] the difficulty of lobbying for narrow advantage in a manner consistent with the profit maximizing model in the face of an attentive public with strong preferences." (Lowery, 2007) It would be inaccurate, however, to claim that neo-pluralists view lobbying as generally ineffective. Rather, they believe that there are specific conditions that can augment or detract from the efforts of lobbyists in a given policy arena. Lowery writes that lobbying "is most likely to secure policy returns when few organizations are engaged on issues out of public sight." The complexities of healthcare reimbursement, along with the patient's indirect involvement in the payment process, makes this area a natural fit for effective lobbying.

Regarding technology acceptance, the end-user experience is an important consideration in telemedicine because the efficacy of a specific procedure can be undermined by poor acceptance among patients. This concern is especially salient for the elderly population of Medicare enrollees,

but also applies to certain ethnic groups that may be less familiar with the use of technology in medicine. Patient acceptance of technology is understood to be a precondition for its use, and the Technology Acceptance Model (TAM) defines use as being predicted by attitude towards the use, which in turn depends on both the perceived usefulness and perceived ease of using the technology. (Davis, 1989) In other words, patients are more likely to accept the technology if they perceive it to be: 1) useful and 2) easy to use. Since the development of the TAM, however, other scholars have argued that patient acceptance depends not only on the characteristics of the technology, but also the characteristics of the patient.

In a deviation from the TAM, proponents of the Normalization Process Theory postulated that technology use is not a dependent variable, but rather one among many interconnected variables that include group processes and organizational structures. (May and Finch, 2009) Under this view, patient likelihood of accepting technology depends not on their perception of technology, but rather on the overall acceptance of technology within their social networks. As other scholars built on this idea, it led to the development of the UTAUT, which encompasses not only the characteristics of the technology in question, its perceived usefulness, and its ease of use, but also the "organization and technological infrastructure in which the individual acceptance unit lives." (Harst et al., 2019; Venkatesh et al., 2003) Though the TAM continues to have lasting impacts on current studies of technology acceptance, the UTAUT is a more holistic model that accounts for both technological and personal considerations. (Riley et al., 2011; Harst et al., 2019) Telemedicine utilization will depend heavily on patient acceptance of a new treatment modality, and the UTAUT can be applied to understand which types of patients are most likely to accept telemedicine in the future. Already, there are some indications of heterogeneity in telemedicine usage across the country, as CMS data shows significant regional fluctuations in the rate of

telemedicine procedures rendered to Medicare beneficiaries. (Wuckland, 2020) The UTAUT could be a useful framework through which these fluctuations are analyzed.

Throughout the pandemic, telemedicine has received more attention from the federal government and healthcare providers than ever before. With CMS announcing the permanent addition of 60 telemedicine procedures to the list of approved services, it looks as if telemedicine is here to stay, even after the conclusion of the pandemic. While rapid technological advancements and the sharp decrease in the cost of sending electronic data had contributed to significant growth in the telemedicine field, the pandemic kick-started an unprecedented level of utilization. (Grigsby et al., 1995; Verma, 2020) Telemedicine advocates have long been lobbying for an expansion of telemedicine services, and the pandemic likely provided the perfect opportunity for their efforts to be effective. (Breen & Matusitz, 2011) The dangers of face-to-face healthcare deliver forced CMS to change regulations surrounding reimbursement for telemedicine services. Because this moment represents a potentially significant shift in how healthcare is delivered to thousands of patients around the nation, it is important to understand the forces behind these policy changes and analyze how patients will adopt to this new technology in the healthcare field.

Previous Research:

Telemedicine has been an established aspect of the American healthcare system for many decades, but researchers remain divided on its clinical efficacy. Though clinical efficacy is just one of many considerations when determining the merits of telemedicine, it is central to the discussion. A major challenge in this area of research is the wide range of medical services that can be offered via telemedicine. Telemedicine encompasses not only real-time video-calling but also audio-only formats, still image transmissions, and medical data transmissions. Therefore, it is

difficult to generalize about the clinical efficacy of telemedicine. At the same time, it would be useful from a policy perspective to know what types of telemedicine are beneficial to patients, as opposed to relying on a case-by-case evaluation of each novel telemedicine procedure.

Not only is there variety in the types of telemedicine procedures, but there is also a huge variety of pathologies that telemedicine procedures aim to address. The various combinations of procedures and pathologies is a major complicating factor for researchers. For example, continuous, real-time heart monitoring is a common example of telemedicine in the field of cardiology. However, this approach could be better for diagnosing certain heart conditions and worse for others. If this were the case, it would be inadequate to claim that heart monitoring is or is not effective. A great deal of nuance (perhaps an impractical amount for the purposes of policy-making) would be needed if examples like this involved not only one form of telemedicine and two pathologies, but rather several forms of telemedicine and multiple pathologies. Consequently, some level of generalization about the clinical efficacy of telemedicine is needed.

A final complicating factor is that telemedicine can be more or less effective based on the characteristics of the provider (or team of providers) that utilizes it. In a study of telemedicine in the critical care setting, Kahn et al. (2019) found that the following factors determined the efficacy of telemedicine in the intensive care unit (ICU): 1) Effective leadership 2) Perceived value among providers, and 3) Organizational characteristics, including staffing models and new hire orientation. These findings point to the importance of considering the specific context into which telemedicine is deployed when evaluating its efficacy, but these details are unlikely to be captured in individual studies. Even if they were, it would be difficult to create policies that account for the different organizational cultures that exist in the healthcare system.

Because of the many challenges to researching telemedicine's clinical efficacy, recent literature reviews have identified three separate outlooks on the state of telemedicine. One body of research identified clear, positive benefits of telemedicine. (Ekeland et al., 2010) The authors of these studies generally express optimism about the future of telemedicine and its positive effects on patients. A separate group of studies suggests that results are promising but more evidence is needed. These authors are generally cautious about telemedicine but leave the door open for more conclusive evidence of telemedicine's effectiveness. (Ekeland et al., 2010) Lastly, a third group of researchers claims that there is limited and inconsistent evidence of telemedicine's efficacy. (Ekeland et al., 2010) This group is skeptical about telemedicine and its ability to address the shortcomings of the healthcare system. Because previous research on telemedicine has failed to produce a consensus on its clinical efficacy, it is especially important to avoid biases that assume telemedicine is a positive force in healthcare. Although telemedicine utilization rates have dramatically increased since the beginning of the pandemic, and there are indications that telemedicine will continue to be an important aspect of the healthcare system after the pandemic, the recent changes made by CMS should be carefully evaluated.

The 248 procedures on the Medicare Telehealth Services list encompass a wide range of procedures across 16 different specialties. (CMS, 2020) It would not be possible to evaluate CMS's recent policy changes without a significant body of research on the efficacy of telemedicine in different contexts and specialties. While telemedicine began in the psychiatric setting, researchers have studied various applications of telemedicine in a wide range of specialties. In a retroactive study of hospitals that adopted telemedicine, Kahn et al. found that telemedicine adoption in the ICU was associated with a small reduction in the 90-day mortality rate. (2016) The authors also found, however, a wide variation in the statistical effect of telemedicine across the 132 adopting

hospitals. In fact, only 16 hospitals experienced statistically significant reductions in mortality. In a study of cognitive-behavioral therapy (CBT) for childhood depression, Nelson et al. discovered that all relevant CBT skills were implemented successfully in a telemedicine setting, and that the rate of remission from depression was similar between the telemedicine group and a group that received the same treatment in-person. (2007) Another study in the field of cardiology found evidence of telemedicine's effectiveness. A randomize control trial studying readmissions after episodes of heart failure found that home-based telemedicine (where patients are able to be seen without leaving their homes) led to a small reduction in readmissions at the 30-day and six-month timepoints compared to usual, in-person homecare. (Bowles et al., 2011) These studies highlight the potential benefits of telemedicine in a few different specialties, and suggest that telemedicine can have broad applicability across multiple specialties.

In addition to these studies that focused on a specific procedure or set of procedures, other researchers compiled the results of dozens of studies to draw more general conclusions about the clinical efficacy of telemedicine. Unfortunately, these reviews often revealed methodological flaws in research regarding telemedicine as well as an overall lack of detail that limited the usefulness of many studies. One systemic review found 11 articles that had "fair to good quality but with some limitations," as well as seven studies with only "limited validity," and four that were "unacceptable for decision makers." (Hailey et al., 2004) The authors of another review stated, "most of the available literature referred only to pilot projects and short-term outcomes, and most of the studies were of low quality." (Roine et al., 2001) It is not particularly surprising that many studies were based on pilot projects because the overall lack of reimbursements for telemedicine (prior to the pandemic) would have severely hindered the long-term financial viability of a telemedicine program.

The systematic review conducted by Roine et al. concluded that "relatively convincing evidence" of telemedicine's clinical efficacy was provided only for teleradiology, tele-neurosurgery, telepsychiatry, transmission of echocardiographic images, and video conferencing between primary care physicians and specialists. (2001) The inclusion of neurosurgery might be a sign that other surgical subspecialties could also benefit from telemedicine in the future, as more technologies are developed in the field of robotic surgery. Other surgical fields could have been excluded because applicable technologies were not yet developed at that time, or because convincing studies had not yet been published.

A lot can change in a short amount of time in the field of telemedicine. To this point, a follow-up study by the same authors found that new evidence of telemedicine's efficacy had emerged in the fields of geriatric care, intensive care, and home-based medical care just a few years later. (Hailey et al., 2004) Home-based care is an especially interesting case as it could transcend multiple specialties. Of course, if multiple specialties are able to make use of home-based telemedicine, there is no guarantee that telemedicine will prove to be effective in all cases. Rather, patient outcomes might vary from specialty to specialty. One lesson from the system reviews conducted thus far is that, as the list of potential uses for telemedicine grows, it will be important to document that varying levels of efficacy and acknowledge that the cost-benefit analysis of one telemedicine procedure will not necessarily be equivalent to another.

Previous research has identified several non-clinical benefits of telemedicine, and these are also important to consider when evaluating the overall impact of telemedicine on the healthcare system. Dullet et al. found that an outpatient telemedicine program in a university setting had positive impacts on patient travel time, patient travel costs, and environmental pollutants. (2017) Furthermore, the authors found that the time and cost savings were quite large, with the average

round-trip consultation saving over 250 miles in travel and slightly over four hours in time. Reducing environmental pollutants could have also had positive, albeit indirect, health benefits for those living in the vicinity of the outpatient clinics where these patients would have driven. Ekeland et al. generally noted that the benefits of telemedicine could be broken down into three categories: therapeutic effects, increased efficiencies in health services, and technical usability. (2010) While therapeutic effects are the most important, medically-speaking, the authors also pointed out that home-based telemedicine has been shown to be especially beneficial for reducing costs by preventing hospital visits and improving patient compliance. (Ekeland et al. 2010)

While previous research paints a somewhat unclear and incomplete picture of the clinical efficacy of medicine, it is far less ambiguous about the cost-savings that can be achieved when telemedicine procedures are utilized. Roine et al. noted several studies that demonstrated significant cost-savings in multiple specialties. Many examples were from the field of radiology: 1) Primary MRI interpretation of images generated at distant sites saved $470 per case at 2000 cases per year. 2) Converting a videotape review network to a telemedicine-based network saved between $7405 and $8585 per month. 3) Establishing a teleradiology network for neurologic surgery patients eliminated the requirement to transport many of these patients, saving $502,638 in total for 33 patients. (Roine et al., 2001) Another study found similar benefits for teleoncology. Providing teleoncology for patients in a medically underserved area cost $149 per patient, but a comparable service in-person would have cost over $800 per patient. (Roine et al., 2001) In pediatric primary care, a telemedicine consultation cost just two-thirds of an in-person consultation with a physician. (Muller et al., 1977) All of these studies reinforced the conclusion that telemedicine has significant economic benefits across several different specialties.

The existing body of research indicates that telemedicine's clinical efficacy is highly context-dependent, and that more research is needed in many cases. By contrast, researchers have demonstrated the numerous ways in which telemedicine could reduce healthcare costs. The cost-saving nature of telemedicine is significant because of the need to balance the trade-off between cost and clinical efficacy. An unfortunate reality is that high costs can be a barrier to healthcare access. Because telemedicine is often the cheaper option compared to in-person alternatives, it will be the more attractive option for healthcare providers, insurers, and patients as long as clinical outcomes are equal to, or better than, in-person outcomes. Proponents of telemedicine recognize that its value could ultimately lie in the economic realm, and not the medical one. In an article published by the National Coalition on Healthcare, the author lists broader access to providers and increased cost efficiency as the first two points in his argument for telemedicine, and lists quality of care as the third reason for supporting the expansion of telemedicine. Even then, he only writes the following about quality of care: "in some cases[…] more timely access to specialists through telehealth services can be crucial to positive health outcomes." (Bhat, 2016) This rather timid endorsement could be a reflection of the literature that currently suggests economic benefits could be a more compelling reason to support telemedicine than the clinical benefits it can bring to patients.

Methods:

This study primarily utilized quantitative methods to analyze CMS data, but some qualitative analysis was done to augment the quantitative findings. Primary data was provided by two organizations: the New England Quality Care Alliance (NEQCA) and CMS. Additional online-based research was conducted to add to this primary data and create an original dataset for the purposes of this study. Data was also compiled from a comprehensive review of the literature on the clinical efficacy of telemedicine. This data was then used as a point of comparison for the data provided by CMS and NEQCA. Below is a more detailed description of the data and the other methods used in this study.

The NEQCA is a network of over 1700 physicians in Massachusetts, and it published a report to assist physicians with the rapid proliferation of telemedicine during the pandemic. In the early days of the pandemic, telemedicine policy changes occurred at a very fast pace. The NEQCA report was an effort to centralize some of these policy changes to assist the transition to telemedicine for physicians in the New England region. This report outlined the various audio/video requirements for physicians to receive full reimbursements from private and public insurers for providing telehealth services. The private insurers included in the report were: Blue Cross Blue Shield of Massachusetts (BCBS), Fallon Health, Harvard Pilgrim, Tufts and Tufts Medicare Preferred, Cigna, and Allways. The two public health insurance providers, Masshealth (Medicaid) and Medicare were also included. The report was distributed to physicians in the NEQCA network, and contains the following information: 1) Healthcare Common Procedures Coding System (HCPCS) codes that qualify full reimbursement for telephone-only visits, broken down by payer, 2) Alternate codes that must be used for telemedicine reimbursement, broken down

by payer, 3) Modifier codes that must be included to receive full reimbursement, broken down by payer, and 4) Cost-sharing information for telemedicine services, broken down by payer.

Two CMS datasets were utilized for this study. One dataset was the Medicare Telehealth Services list. This list contains all of the currently-approved telemedicine procedures, which are assigned to unique HCPCS codes. Additionally, the list contains a short description of the each procedure, and has a status column that provides additional details if the code is a temporary addition to the list of approved telemedicine services, including the date that the addition went into effect. The list also includes data on which codes are approved for audio-only visits and which require both video and audio for full reimbursement. Finally, the list contains notes about any exceptions to the rule in terms of reimbursements. For example, there is a column that denotes specific HCPCS codes which will not be reimbursed by CMS. Unfortunately, there is no explanation of why certain procedures are not reimbursed by CMS and yet are included on the Medicare Telehealth Services list.

The other source of data from the CMS was the Medicare Physician Fee Schedule (MPFS) lookup tool. The MPFS tool is an interactive dataset which contains information about the physician fee associated with each procedure. If a physician performs a certain procedure, such as a physical exam, the MPFS lookup tool contains information about how much Medicare pays the physician for their services. The tool allows users to manually search for HCPCS codes and access payment data for the corresponding code. In the MPFS, there are multiple payments associated with each HCPSC code because CMS pays a different amount for the same procedure depending on the setting in which it was performed. Facility prices pertain to procedures carried out in a hospital setting, ambulatory care center, or skilled nursing facility. Non-facility prices pertain to

all other settings, such as outpatient clinics and patient homes. For this study, facility prices were used for all 248 telemedicine procedures for the sake of consistency.

To create the final dataset used for this study, I combined information from the MPFS to the Medicare Telehealth Services list, and also created a column to denote the medical specialty (e.g. cardiology, pulmonology, etc.) that corresponded to each procedure. Using the MPFS lookup tool, it was possible to ascertain the national average payment for each telemedicine procedure. I manually searched each of the 248 procedures on the Medicare Telehealth Service list, and added the payment amount to the final dataset. Then, I calculated the average payment amount for procedures by specialty, and added that information to the dataset as well.

I assigned each of the 248 telemedicine procedures to a medical specialty based on the short description. The majority of descriptions clearly matched one medical specialty. For example, if the short description included the term "psych," then it was marked as a psychiatric procedure in a separate column of the spreadsheet. One example of a straightforward description was "Critical care first hour," which was the description for HCPCS code 99291 and corresponded to the medical specialty of Critical Care. Not all of the descriptions were so straightforward, however, and many procedures required an online search to ascertain which medical specialty was the appropriate designation. For example, the description "Esrd serv 1 visit p mo 20+" is fairly incomprehensible unless one already knows that "esrd" stands for end-stage renal disease. This procedure required a quick online search, and afterwards, I was able to categorize it under the specialty of nephrology.

A small fraction of procedures were exceptional because they, 1) Did not fit with a single medical specialty, or 2) Did not have a national average payment amount associated with them. On the Medicare Telehealth Services list, 19 procedures were related to physical rehabilitation,

which is usually performed by physical therapists rather than physicians. I categorized these procedures under "Physical Therapy," even though that is not traditionally thought of as a medical specialty. Additionally, 17 procedures lacked a national average payment amount because they are "contractor priced," meaning that the amount CMS pays is variable based on individual contracts. Because there was a lack of information about these contracts, these procedures were omitted from the calculation of average payment amounts.

To gather data on the clinical efficacy of telemedicine, I consulted the literature on telemedicine and its clinical benefits. I reviewed standalone studies of telemedicine's clinical efficacy as well as systematic reviews conducted by other researchers. After this process, I compiled a list of telemedicine procedures that have been previously-shown to have clinical benefits, as well as the specialties associated with these procedures. Some studies concluded that telemedicine is effective in a broad field, such as psychiatry. In these cases, I noted that telemedicine shows clinical efficacy in the entire specialty. In summary, the literature review provided information for the creation of a dataset that contained a list of medical specialties in which telemedicine had previously been shown to be clinically effective, as well as a list of specific telemedicine procedures that had been shown to be effective in previous studies.

Analyzing the NEQCA data was a relatively straightforward process. I separated the private insurers from the public ones and noted the various restrictions that each insurer imposed on the delivery of telemedicine services.

Data analysis of the CMS data consisted of several discrete steps, the first of which was a big-picture snapshot of how telemedicine insurance coverage had changed between the pre-pandemic and post-pandemic eras. I calculated the total increase in the number of telemedicine

procedures approved by CMS in response to the pandemic, and also noted the inclusion of previously-excluded specialties from the list of approved telemedicine procedures.

The next step of data analysis was more in-depth and specialty-oriented. I separated the approved telemedicine procedures by specialty and by the date of their inclusion to the Medicare Telehealth Services list. I chose to distinguish between internal medicine procedures in the inpatient setting from those in the outpatient setting because of the myriad differences between seeing patients in a hospital vs. seeing them in a clinic. I then calculated the increase in the number of procedures per specialty. Additionally, I calculated the proportion of total telemedicine procedures that each specialty represented during both the pre and post-pandemic periods. Finally, I compared each of the procedures on the Medicare Telehealth Services list against the list of specialties and medical procedures that had previously shown clinical efficacy when delivered via telemedicine. For both the pre and post-pandemic periods, I calculated the proportion of approved telemedicine procedures that had shown clinical efficacy in previous research. In the data analysis, the concept of clinical efficacy was often phrased in terms of "positive clinical impact," which refers to improvements in patient outcomes. While some prior research directly compared telemedicine procedures with their in-person counterparts, many studies did not. For the purposes of this study, no assumption is made about the relative impact of a telemedicine procedure and its in-person counterpart.

Findings and Data Analysis:

Finding 1: Recent changes to the approved telemedicine procedures list led to a dramatic increase in both the number of procedures and the number of specialties approved for telemedicine. (See Figure 1 in the appendix)

Prior to April of 2020, there were 101 total telemedicine procedures that had been approved by CMS. There were only eight specialties represented by these 101 procedures, and these were: critical care (also known as intensive care), endocrinology, internal medicine (inpatient), internal medicine (outpatient), geriatric medicine, nephrology, oncology, and psychiatry.

As of October of 2020, the number of approved procedures had increased to 248, representing a 246 percent increase. Of the eight specialties that had been previously approved for telemedicine, seven of them were represented by the 147 new procedures, with endocrinology being the only exception. Importantly, eight new specialties were introduced to the Medicare Telehealth Services list, and these were: cardiology, emergency medicine, pulmonology, neurology, ophthalmology, otolaryngology, pediatric medicine, and physical therapy. As previously mentioned, physical therapy procedures were separated into their own category despite the fact that physical therapy is not traditionally designated as a medical specialty.

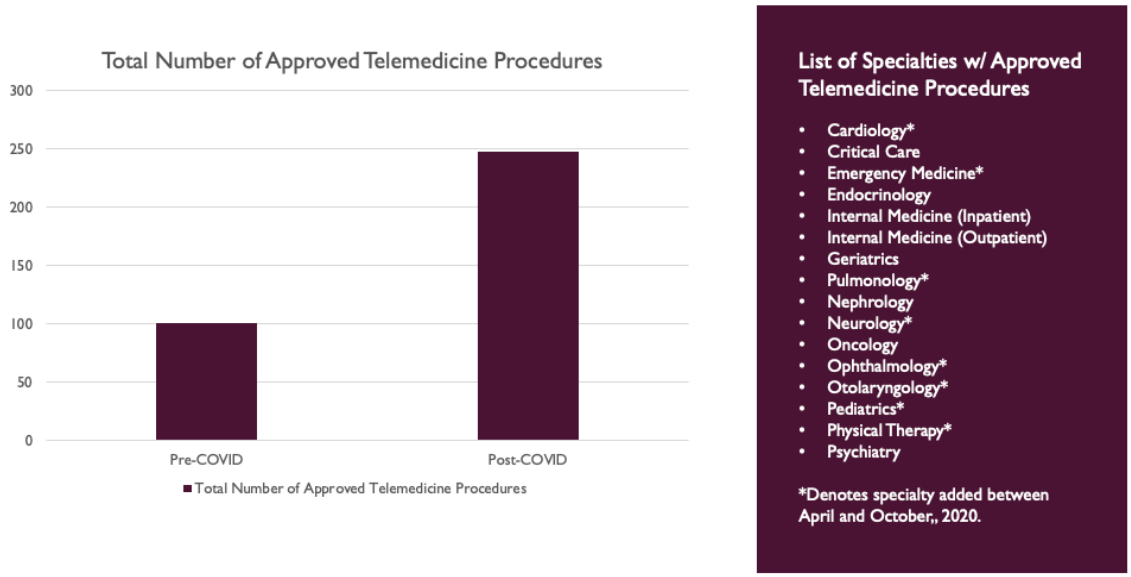

Figure 2: Comparison of the number of procedures and specialties on the Medicare Telehealth Services list.

Finding 2: Critical Care and Inpatient Internal Medicine procedures are heavily represented in the new list of approved telemedicine procedures.

Two specialties in particular gained approval for many telemedicine procedures, critical care and inpatient internal medicine. Critical care, which had only two approved telemedicine procedures before April of 2020, saw its total number of approved procedures jump to 19 by the year's end. Similarly, the number of approved inpatient internal medicine procedures increased from 12 to 27 during that time. As a result of these changes, critical care became the fifth most heavily represented specialty on the list of approved telemedicine procedures, out of sixteen specialties. Previously, it had been sixth out of eight. Inpatient internal medicine overtook nephrology to become the third most represented specialty, behind only psychiatry and outpatient internal medicine.

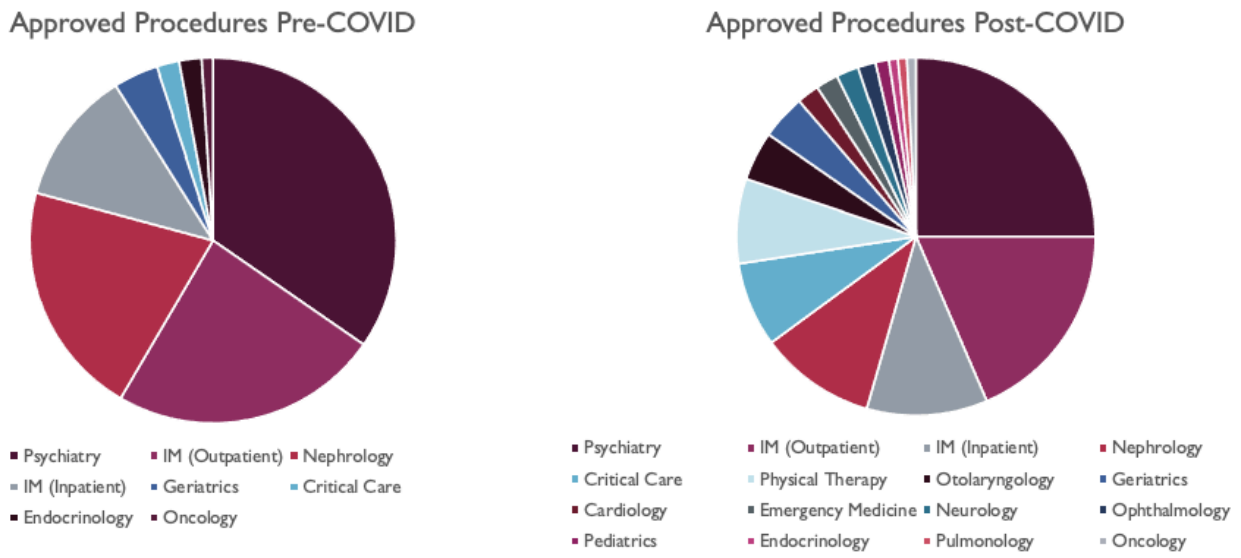

Figure 3: Procedures on the Medicare Telehealth Services list, broken down by specialty.

Finding 3: Proportionally, the number of psychiatry procedures decreased as a result of the changes made to the list of approved telemedicine procedures. (Refer to Figure 2)

After the recent additions to the Medicare Telehealth Services list, there is a greater diversity of specialties represented on the list. A byproduct of this diversity is that psychiatry no longer dominates the field of telemedicine. Psychiatric procedures represented over a third of all approved telemedicine procedures before the pandemic, making up 35 out of the 101 procedures. After the changes made by CMS in 2020, psychiatry comprises only a quarter of all approved telemedicine procedures (62 out of 248). Even so, psychiatry remains the most heavily represented specialty in telemedicine by a relatively wide margin. The second-most heavily represented specialty is outpatient internal medicine with 46 procedures.

Finding 4: The proportion of procedures that are associated with specialties known to have a positive clinical impact increased slightly after the recent changes made by CMS to the list of approved telemedicine procedures.

Both before and after the recent policy changes made by CMS, about 40 percent of the procedures on the Medicare Telehealth Services list are known to have a positive clinical impact (40.6 percent vs. 41.5 percent, respectively). Telemedicine has been shown to have a positive clinical impact in the following five specialties: psychiatry, critical care, radiology, geriatrics, and neurosurgery. In addition, procedures in pediatric primary care, cardiology, and home-based medicine were shown to have positive clinical impact. Of the approved telemedicine procedures in the pre-pandemic era, 40.6 percent of them were from one of those five specialties or matched one of the procedures known to have a positive clinical impact. After the recent changes made by CMS, 41.5 percent of telemedicine procedures came from specialties that are known to have a positive clinical impact. Even after 147 procedures were approved in response to the pandemic, only psychiatry, critical care, and geriatrics were included in the current list of approved telemedicine procedures. Furthermore, a small sublet of home-based outpatient internal medicine procedures were added to the approved list. Radiology and neurosurgery represent notable absences from the Medicare Telehealth Services list given the evidence of the efficacy of these telemedicine procedures in the literature.

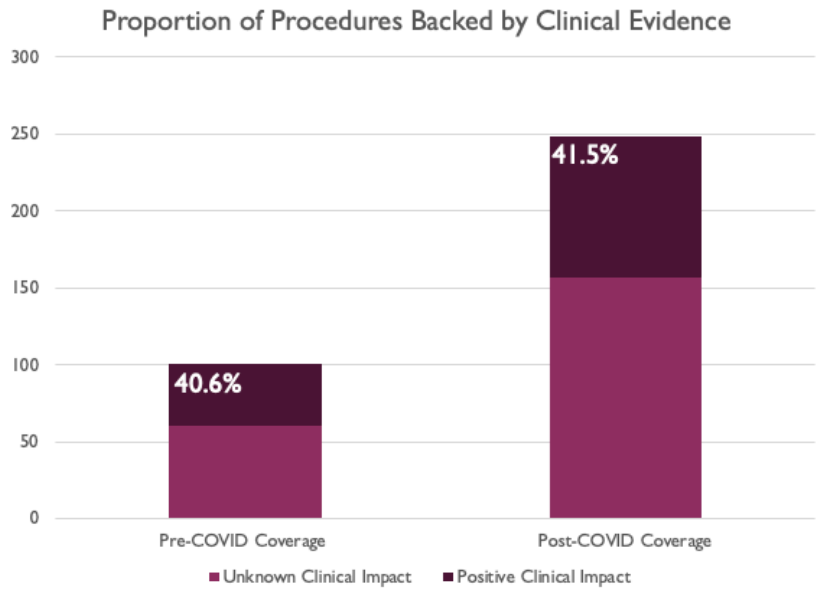

Figure 4: Proportion of procedures on the Medicare Telehealth Services list that are known to have positive clinical impacts.

Finding 5: Private insurers have fewer restrictions on audio-only appointments compared to public insurers (Medicare and Medicaid).

Analysis of the NEQCA report shows that CMS has instituted stricter two-way video requirements than the majority of private insurers in the Massachusetts. Of the eight private health insurers active in the state, seven of them did not require video to be used for outpatient office visits, and reimburse providers for audio-only appointments. Blue Cross Blue Shield of Massachusetts (BCBS) was the sole exception to this policy. Somewhat unexpectedly, MassHealth (Medicaid) did not place a two-way video requirement for outpatient office visits while Medicare did. Differences in federal and state-level policy could have led to this inconsistent approach between the two public health insurers.

Finding 6: Private insurers embraced telemedicine in the outpatient setting more willingly than in the inpatient one.

When the NEQCA report was initially published, all ten insurers had published guidelines on the use of telemedicine for outpatient office visits. At the same time, only four insurers had released guidelines on the use of telemedicine in the inpatient setting (BCBS, Harvard Pilgrim, Medicare, and Aetna). For an emergency department visit or an initial inpatient consultation, there were video requirements for three of the four insurers. Only Harvard Pilgrim allowed inpatient providers to utilize audio-only telemedicine services. Aetna, another private insurer that allowed outpatients to be seen via audio-only consultations, placed stricter guidelines on inpatients by requiring two-way video to be used. However, for subsequent consultations in the inpatient setting, the three private insurers dropped the video requirement. Only Medicare continued to require two-way video for subsequent inpatient consultations.

Finding 7: The average payment for a telemedicine procedure varied widely by specialty, with nephrology as the most costly at $302.25 per procedure and pulmonology the least costly at $19.85 per procedure.

A closer look at the procedure descriptions shows that the telemedicine procedures included on the Medicare Telehealth Services list are only a small subset of the procedures that are routinely practiced in the specialty. Nephrology does command the highest payments per procedure, but a significant portion of the approved telemedicine procedures are for treating patients with end-stage renal disease. Because of the severity of this condition, it makes sense that these patients would need a lot of care and that these procedures would have a high cost. Inversely, the pulmonary procedures on the list require less resources. One procedure is an evaluation of a

patient's use of inhalers, and the other procedure is pulmonary rehabilitation. Therefore, the lost costs of pulmonology procedures on the Medicare Telehealth Services list is not necessarily a reflection of the specialty as a whole.

Specialty	**National Average Payment**
Cardiology	$24.42
Critical Care	$293.69
Emergency Medicine	$86.61
Endocrinology	$36.45
Geriatrics	$102.25
Internal Medicine (Inpatient)	$111.21
Internal Medicine (Outpatient)	$101.98
Nephrology	$302.25
Neurology	$40.49
Oncology	$112.06
Ophthalmology	$68.39
Otolaryngology	$100.24
Pediatric Medicine	$95.46
Physical Therapy	$55.86
Psychiatry	$64.25
Pulmonology	$19.85

Table 1: The national average payment for each specialty, based on the procedures listed on the Medicare Telehealth Services list.

Discussion:

To reiterate, this study was aimed at evaluating the changes in insurance coverage of telemedicine procedures that were enacted by CMS in response to COVID-19. To do so, it was important to understand what the state of telemedicine coverage looked like before the pandemic began, and to gain some insights into the research on telemedicine's clinical efficacy as well as its other potential benefits. The insights from the NEQCA dataset provided an interesting comparative lens for discerning some of the differences between private and public insurers' approach to telemedicine procedures.

First and foremost, the data analysis shows that the changes made to the list of approved telemedicine procedures in response to the pandemic was a transformational expansion of telemedicine coverage. Prior to the pandemic, only 101 procedures had ever been approved by CMS. By adding 147 more procedures in a short span of time, CMS more than doubled the number of telemedicine procedures available to Medicare beneficiaries. Consequently, telemedicine can now be utilized in twice as many specialties as before the pandemic (the number of specialties increased from eight to 16). Furthermore, telemedicine can now be utilized more extensively in the specialties that had already been approved to practice telemedicine. For example, the number of psychiatric telemedicine procedures increased from 35 to 62, even as the total proportion of psychiatric procedures on the Medicare Telehealth Service list decreased.

Because of CMS's policy changes, it is difficult to identify the primary reason for the hyperutilization of telemedicine during the pandemic. As previously mentioned, the utilization rate of telemedicine dramatically increased this year, a statistic that could have been driven by fear of COVID transmission, but also could have been influenced by the policy changes that CMS enacted. Of course, it is very likely that both factors played a role in the increased utilization of

telemedicine. Yet, telemedicine's popularity could be a short-lived phenomenon if an overwhelming majority of patients return to in-person appointments after the pandemic. This would be a bit of a lost opportunity. Because many physicians and patients were exposed to telemedicine this year, it would be reasonable to assume that both parties overcame a learning curve and became more familiar with the process of conducting a virtual medical appointment. Consequently, telemedicine might be more effective in the post-pandemic era. In the future, both physicians and patients might be more willing to accept telemedicine as a standard method of care due to their experiences during the pandemic.

Regarding the state of telemedicine coverage before COVID-19, the data analysis shows that coverage was too limited before the pandemic despite telemedicine's potential benefits. One piece of evidence in favor of this view is that 27 additional psychiatric procedures were added between April and October of 2020, joining the 35 procedures that had already been approved in previous years. Because psychiatry is the specialty that is most closely-associated with telemedicine, the clinical benefits of telemedicine in psychiatry were well established in the literature. (Roine et al., 2001) Similarly, the number of geriatric procedures more than doubled, and the home-based telemedicine procedures for outpatient care were added in response to the pandemic. Continuing in this vein, there were only two critical care procedures that had been approved for telemedicine before the pandemic, with 17 additional procedures approved in response to COVID. In each one of these specialties, the pandemic appears to have jumpstarted a process that should have occurred years ago based on clinical evidence. Prior research had already revealed that telemedicine had clinical benefits in each of those specialties, and also that home-based telemedicine had positive clinical impacts. (Roine et al., 2001; Hailey et al., 2004; Bowles et al., 2011) Based on this research, CMS could have updated the Medicare Telehealth Services

list long before the pandemic, ensuring that Medicare beneficiaries have access to telemedicine that is known to be effective.

On the surface, CMS appears to have approved many telemedicine procedures without consideration for their clinical efficacy. Additionally, some procedures were likely excluded when they should have been included. Based on the research that has been done so far, CMS should include radiological and neurosurgical procedures to the list of approved telemedicine procedure, as these specialties have been shown to have a positive clinical impact when delivered via telemedicine. Additionally, one might be concerned that only 40.6 percent of telemedicine procedures approved by CMS were in specialties that have been found to have a positive clinical impact, and that this figure more or less remained unchanged (at 41.5 percent) after the changes made during the pandemic. It is important to keep in mind, however, that this does not suggest that nearly 60 percent of the telemedicine procedures are ineffective and produce no clinical benefits. Previous research on telemedicine often produced inconclusive results, and further research is needed to elucidate the impact of telemedicine. Therefore, this finding only reflects the reality that little is known about the clinical effectiveness of telemedicine in many areas of medicine. In some cases, one could reasonably infer that a procedure has clinical benefits, but no formal research has established that fact in the literature.

Two telemedicine procedures could share common traits, but because of the existing clinical evidence, only one of them could be considered to be clinically effective while the other would not. For example, one psychiatric procedure (HCPCS code 96127) is described as “Brief emotional/behave assessment,” and this procedure is considered to have a positive clinical impact because it is a psychiatric procedure, and telepsychiatry has been shown to be effective in general. By contrast, there is an outpatient internal medicine procedure described as “Depression screen

annual," which is (according to the literature) not known to have a positive clinical impact. Both procedures are aimed at addressing a potential mental health concern for the patient, and both rely on communication between the physician and patient. Without hearing the questions asked of the patient, it might be impossible for an observer to distinguish one procedure from the other. Therefore, it would not be a big stretch to say that, in this case, both the psychiatric and internal medicine procedures could be effectively delivered via telemedicine. But, the current state of research has yet to establish the clinical efficacy of the latter, while it has done so for the former.

The amount of unknowns in the field of telemedicine can be a bit daunting. From a policymaking perspective, it would be better to know more about the clinical impacts of telemedicine in the fields of cardiology, ophthalmology, and others. If these were known, policymakers could make an informed decision about reimbursing providers for administering these services. Yet, it should be acknowledged that telemedicine research has been stymied by the aforementioned barriers to its development. Additionally, the nature of telemedicine makes it difficult to conduct experiments that prove a causal relationship between the use of telemedicine and positive clinical outcomes, and it has only been possible for a small number of specialties. Difficulties arise because telemedicine research presents both significant logistical and ethical challenges that most areas of research do not. Telemedicine often requires specialized equipment, which can pose a challenge because of cost or lack of expertise with the equipment. Additionally, if an in-person procedure is already known to be effective, it is difficult to justify subjecting patients to an alternative form of treatment in which the clinical benefits are more dubious.

Though there are many questions to be answered regarding telemedicine, the recent changes made by CMS indicates that researchers will continue to develop a better understanding of telemedicine and its clinical efficacy. For two important reasons, the current gaps in clinical

knowledge should not be used as an excuse to halt or reverse the progress of telemedicine. First, the dramatic increase in telemedicine utilization during the pandemic will produce a huge volume of data. For example, CMS alone will compile millions of claims that could elucidate what types of telemedicine procedures were used most often during the pandemic. Therefore, the medical community could learn a lot about telemedicine in the aftermath of the pandemic. Second, continuing to allow more procedures to be conducted via telemedicine will produce the very data that is needed to clarify the questions surrounding its effectiveness. CMS appears to be supporting this approach by making at least 60 of the 147 newly-added procedures permanent additions to the Medicare Telehealth Services list.

The balance between inpatient and outpatient procedures shifted as a result of the changes that CMS enacted in response to the pandemic. Inpatient specialties, such as critical care and inpatient internal medicine, saw a large increase in the number of approved telemedicine procedures. Critical care saw an especially large increase with 17 new procedures added to the pre-existing list of only two procedures. This finding might come as a surprise to some observers, as it can be unclear why telemedicine is necessary in the inpatient setting. After all, patients should be within walking distance of their physicians at practically all times. One possible explanation for this finding is that this change in policy was intended to shield physicians from unnecessary risks of COVID transmission. Using real-time videoconferencing could have been a method of avoiding contact with COVID-positive patients when it could be avoided. Certainly, patients in the ICU with severe COVID complications would have been at high risk of transmitting the virus to their physicians, and therefore it makes sense that so many critical care procedures were added to the list of approved telehealth services. It should also be noted that critical care is one of the specialties identified by Hailey et al. that has demonstrated positive clinical impact when utilizing

telemedicine. (2004) Therefore, CMS could have justifiably added these procedures to the Medicare Telehealth Services list prior to the pandemic.

Despite the recent gains made by inpatient specialties, the fact remains that telemedicine has mostly been a tool in the outpatient setting. Before the pandemic, 80 percent of the approved telemedicine procedures were from specialties that practiced primarily in the outpatient setting. Even after the recent additions to the Medicare Telehealth Services list, the majority of procedures are for outpatients. It should be acknowledged that some of the newly-added outpatient procedures represented a departure from a norm in their own way. Specifically, many home-based telemedicine procedures were included in the Medicare Telehealth Services list, and their inclusion highlights the fact that the inpatient/outpatient dichotomy lacks some important nuances. For example, home-based care is a specific subset of outpatient procedures that takes place in a wide variety of settings which are less standardized than medical offices. Because of this, an argument could be made that home-based care is fundamentally different from other types of outpatient procedures.

A larger shift in the field of telemedicine was the increased utilization of telemedicine for inpatients. The inclusion of emergency medicine, critical care, and many inpatient internal medicine procedures indicates that CMS believes there is a role for telemedicine in the inpatient setting. Based on the literature which is filled with examples of telemedicine having a positive clinical impact in the inpatient setting, there is no reason why telemedicine cannot be practiced in the inpatient setting as well. Additionally, there are numerous examples of technologies that can be used for telemedicine in both the inpatient and outpatient settings. For example, a patient's vital signs can be recorded and transmitted to a physician in real-time, offering a level of constant monitoring that cannot be achieved without telemedicine. The diversity of technologies available

to physicians is another reminder that telemedicine encompasses more than a straightforward video call between a physician and patient, and incorporating the lesser known aspects of telemedicine (such as remote monitoring) could have numerous benefits for patients that have historically not been treated via telemedicine.

As previously noted, telemedicine has long been closely linked to psychiatry. Psychiatric procedures are the most common telemedicine procedure found on the Medicare Telehealth Services list today, but the link between psychiatry and telemedicine might not be as strong in the future as it has been in the past. This is because the inclusion of other specialties could lead to telemedicine becoming commonplace in multiple areas of medicine. Before the pandemic, psychiatric procedures represented a third of all approved telemedicine procedures. After the changes made by CMS, psychiatry now represents a quarter of telemedicine procedures. On one hand, this could be a cause for concern because evidence of telemedicine's clinical efficacy is more spotty in other specialties, while it is very well established in psychiatry. On the other hand, these shifting proportions could simply be a product of the fact that psychiatry was already very well represented in telemedicine when the pandemic broke out in early 2020. 35 psychiatric procedures had been approved before the pandemic, far outpacing other specialties. Given the many psychiatric procedures that had already been approved for telemedicine, it would be reasonable to assume that fewer psychiatric procedures needed to be approved in response to the pandemic. By contrast, other specialties needed to make up for years of exclusion from the list of approved telemedicine procedures.

The absence of radiology from the Medicare Telehealth Services list is surprising given the robust evidence of its benefits in the literature. Roine et al. found evidence of clinical efficacy in their systemic review conducted as far back as the late 20th century, and also found multiple studies

that demonstrated the economic benefits of using teleradiology. One possible explanation for why radiology procedures are missing from the list could be that CMS does not consider them to be telemedicine procedures. Rather, CMS might categorize radiology differently because radiologists often work without direct patient contact. If the assumption is that telemedicine procedures are an alternative version of in-person ones, then radiology would be excluded from the Medicare Telehealth Services list because there are no in-person alternatives to many radiology procedures. Another, simpler possible explanation is that CMS has overlooked an important specialty when considering the list of telemedicine procedures. Whatever the case may be, there is a strong argument to be made that radiology should be included on the list because many common radiology procedures have key features of telemedicine. For example, when a radiologist reads an x-ray or a CT scan, they rely on the digital transmission of data and are physically removed from the patient. Radiology remains one of the most prestigious specialties in medicine, secondary only to surgical fields and specialties that require extensive fellowships such as cardiology. (Norredam & Album, 2007) Therefore, categorizing common radiology procedures as telemedicine could be an important component of legitimizing telemedicine in the face of skepticism from insurers and other entrenched institutions that have thus far opposed its expansion.

Quite a few medical specialties were completely excluded from the Medicare Telehealth Services list, prompting the question of why certain specialties were included while others were not. One explanation could be that specialties were added based on the existing body of research on telemedicine, but this is not likely to be the case because nearly 60 percent of approved procedures have unknown clinical impacts. Another possible explanation for the selection of certain specialties over others is based on specialty prestige. Norredam and Album describe specialty prestige as being defined by the power and wealth associated with a particular medical

specialty. (2007) If the most prestigious specialties are the ones in which members have the most power and wealth, it would stand to reason that these specialties have more effective lobbying bodies to advocate on their behalf. A review of surveys regarding specialty prestige revealed that all surgical specialties and cardiology were consistently ranked near the top of the hierarchy. Meanwhile, psychiatry was ranked highly in some surveys and lowly in others. Specialties such as pediatrics and geriatrics were ranked lowly in nearly all cases. (Norredam and Album, 2007) The Medicare Telehealth Services list, after the recent updates, does include a lot of prestigious specialties that were added in response to the pandemic. A couple of surgical specialties (otolaryngology and ophthalmology), as well as cardiology, were included. Yet, the same could be same of critical care, internal medicine, and even psychiatry. Additionally, geriatric medicine is also included in the list of approved telemedicine procedures. Therefore, the overall picture remains unclear, and it is difficult to draw concrete conclusions about the effect of lobbying and specialty prestige on the development of the Medicare Telehealth Services list.

Though most of this study concerns the CMS and telemedicine policy on the federal level, some data regarding private insurers in Massachusetts was included. This data shows that, relative to private insurers, CMS had stricter regulations for telemedicine appointments, requiring both video and audio for the majority of outpatient visits in the primary care setting. Blue Cross Blue Shield of Massachusetts (BCBS) was the only private insurer out of eight that enacted a similar policy. On the public side, CMS-administered Medicare enacted a two-way video requirement while the state-run Medicaid program, known as MassHealth, allowed physicians to have audio-only telemedicine appointments with their patients. It is not particularly surprising that private insurers generally granted greater flexibility to their beneficiaries in terms of the types of telemedicine appointments that they could receive. However, the inclusion of BCBS along with

Medicare is puzzling, since it is a counterexample to the private vs. public explanation for this difference. One possible explanation is that, since BCBS is the largest insurer in the state, it leveraged its negotiating power to create a higher barrier for full reimbursement for providers using telemedicine. It is also possible that BCBS officials believe that video adds clinical value for their enrollees, and therefore refuses to reimburse audio-only appointments. In either case, BCBS is an anomaly in the Bay State in regards to telemedicine requirements. Overall, the pattern in the data clearly shows that private insurers and CMS took different approaches to handle the dramatically rising rates of telemedicine usage.

Analysis of the NEQCA data also revealed that insurers treated outpatient procedures differently from inpatient ones. For one, insurers were much faster to publish guidelines that governed the utilization of telemedicine in the outpatient setting. By the time that ten insurance companies had established guidelines for outpatient office visits, only four had taken the same steps for initial visits to the hospital or emergency room. (NEQCA, 2020) Furthermore, insurers generally enacted stricter requirements for inpatient procedures, as three of the four insurers required two-way videos for the initial visit, while two insurers out of ten imposed similar requirements in the outpatient setting. These disparities could be a reflection of the fact that telemedicine has been most often used for treating outpatients in the past, and therefore it is a paradigm shift to cover telemedicine procedures for inpatients. This paradigm shift, if it continues to hold in the future, could alter the way that healthcare is delivered in the hospital setting.

Study Limitations and Counterarguments:

When evaluating the clinical efficacy of telemedicine procedures, the sheer diversity of procedures and pathologies presented a significant challenge to researchers. Similarly, this study

falls short of fully accounting for the nuanced ways in which telemedicine procedures differ from and resemble one another. To that point, one limitation of this study is its reliance on specialties rather than specific procedures when discussing clinical efficacy or positive clinical impact. Throughout this study, telemedicine procedures are grouped together into medical specialties. However, this overlooks the diversity of procedures that exists within a specialty. Certain types of procedures in cardiology might be effective while others may not be, but for the purposes of this study, all telemedicine procedures in cardiology were categorized as having "unknown clinical benefit." However, some attempts were made to account for procedure-level details. For example, if one of the procedures on the Medicare Telehealth Services list matched a specific procedure that had shown clinical efficacy in prior research, it was categorized as having positive clinical benefits. This type of analysis became most important when evaluating the outpatient internal medicine procedures, which included several home-based telemedicine procedures. Consequently, some outpatient internal medicine procedures were categorized as having positive clinical benefits while others were not.

In some cases, it could have been reasonable to assume that all procedures of a specific specialty had positive clinical benefits. For example, psychiatry's long history with telemedicine and the robust body of research on it likely makes it reasonable to assume that all of the telemedicine procedures on the Medicare Telehealth Services list are effective. In such cases, specialties can serve as a reasonable proxy for multiple procedures. This approach is also what allowed some previous researchers to conclude that specific specialties are well-suited for telemedicine, so it is not an unprecedented approach. It should be acknowledged, however, that there are drawbacks to using a specialty as a proxy for all of the procedures under its umbrella. This study would have been stronger if the methodology included a detailed review of all of the

HCPCS codes in the Medicare Telehealth Services list. Without the medical expertise to recognize the context of each of these procedures, however, any analysis of differences and similarities between two procedures would have been prone to error, and might have actually harmed the quality of this study.

By simplifying the differences between telemedicine procedures, this study was limited in another way. By designating the clinical efficacy of procedures in a binary way ("positive" vs. "unknown"), this study implicitly assumes that telemedicine procedures roughly have the same amount of clinical benefits if they are effective. In other words, there is a lack of specificity around the term "positive clinical impact." This term generally captures the idea that telemedicine is beneficial to the patient, but fails to account for the scale of the benefit. Some procedures could lead to marginal benefits for the patient, while others might have more dramatic outcomes. Relatedly, some procedures could be aimed at long-term health management while others could address acute events. From the analysis provided in this study, it is impossible to make distinctions along these lines and evaluate telemedicine procedures on a more granular level. Similar to the first limitation, overcoming this drawback would require a procedure-by-procedure analysis of telemedicine's effectiveness.

While I advocate for further expansion of telemedicine and more research regarding its effectiveness, some might argue that telemedicine should remain limited in scope because it is inferior to in-person procedures that allow for direct contact with the patient. This perspective could be correct in some cases, and therefore I do not advocate for a *carte blanche* expansion of telemedicine. Rather, telemedicine should be treated as a promising but largely-untested treatment modality. More research will need to be conducted in order to overcome some of the resistance to telemedicine in the healthcare field, especially in the current context of limited technologies and

the stereotypical idea that telemedicine consists exclusively of real-time video calls. And it should not be overlooked that many studies have found inconclusive evidence for telemedicine's efficacy.

Despite these valid concerns, there are good reasons to continue investing in telemedicine. One reason is that technology will continue to improve, and creating a healthcare system that has already embraced the potential of telemedicine will make it easier to incorporate these new technologies into clinical settings. Another reason is that telemedicine could address some significant issues in the United States healthcare system. For example, telemedicine could alleviate primary care physician shortages in rural areas by allowing physicians in urban areas to see rural patients without the burden of relocating. Another example is that remote monitoring technology could be beneficial for many patients that suffer from chronic conditions, such as diabetes or chronic kidney diseases. And, all of these clinical benefits might ultimately be achieved in a more cost-efficient way as telemedicine has been shown to have both clinical and economic benefits. For all of these reasons, I firmly believe that it is worth continuing to invest in telemedicine, both in terms of research and real-world application.

Policy Recommendations:

Based on the data from this study, there are policy implications at both the federal and organizational levels. The first four recommendations are meant to inform policy at the federal level. Specifically, they are directed towards the National Institutes of Health (NIH) and CMS. Recommendations at the federal level are necessary for a few reasons. First, telemedicine utilization has interstate implications, and therefore the federal government should play a role in setting standards across the nation to reduce the prevalence of redundant and contradictory regulations at the state level. Second, Medicare is a federally-administered program, and changes to telemedicine coverage will have implications for Medicare beneficiaries across the entire nation. Third, the NIH already serves as a centralized network of researchers, and it can coordinate telemedicine research activities across multiple research centers in various states. Different medical institutions excel in different medical specialties, and the NIH could grant research funding appropriately to maximize the amount of high-quality research regarding telemedicine's clinical efficacy. The fifth recommendation is aimed at healthcare organizations such as hospitals and larger healthcare networks that include hospitals.

Recommendation 1: Dedicate NIH research funds to determine the clinical efficacy of the procedures on the Medicare Telehealth Services List.

To date, only 41.5 percent of the procedures approved by CMS come from specialties that are known to have positive clinical benefits when delivered via telemedicine. Consequently, the most pressing area of research on this topic is figuring out the clinical efficacy of the other 58.5 percent of procedures. It would be most thorough if each procedure were evaluated on its own merits, but that might not be the most efficient approach. A more efficient approach would be to

group procedures according to shared characteristics. For example, there are five different HCPCS codes related to seeing a new patient at home for the first time, and these only vary from each other in terms of timing. (CMS, 2020) Therefore, it could be reasonable to group them together when evaluating the clinical efficacy of these procedures.

The results of these studies will have direct policy implications. If a specific telemedicine procedure is shown to be effective in improving health outcomes, then CMS should grant it permanent approval for delivery via telemedicine. On the other hand, if a procedure that is currently approved is shown to be ineffective, CMS should remove that procedure from the list of approved services. Over time, this approach would yield a robust body of literature on the efficacy of telemedicine across multiple specialties, and physicians as well as patients could benefit from knowing that telemedicine is a viable treatment modality in many situations. Clinical benefits aside, increasing the number of telemedicine procedures available could have cost-savings that offset some of the costs of this research.

Prior research contains some warning signs about the difficulties of conducting telemedicine research. Hailey et al. showed that clinical research of telemedicine efficacy poses serious challenges. According to their data, only 57 percent of the 42 studies that they reviewed were judged to be of high quality. The rest were found to have serious flaws in study design, study performance, or both. (Hailey et al., 2004) Therefore, it will be important for CMS officials to consider the results of these studies carefully before making decisions about the procedures that are added or removed from the Medicare Telehealth Services list.

Recommendation 2: Include radiology procedures in the Medicare Telehealth Services list.

The total absence of radiology from the Medicare Telehealth Services list is puzzling. Not only does prior research suggest that teleradiology offers clinical benefits to patients, multiple economic studies have indicated that it can be cost-saving as well. (Roine et al., 2001) Given this existing clinical and economic data, radiology procedures should be approved for delivery via telemedicine and added to the Medicare Telehealth Services list.

It is possible that these procedures are not categorized under "telemedicine" because radiology procedures have long been conducted by a lone physician, consulting an image and later relaying the diagnosis back to the patient or other members of the patient's healthcare team. Despite their resemblance to telemedicine (because, definitionally-speaking this *is* telemedicine), these types of procedures might not have been grouped with the other telemedicine procedures because they are the norm within the specialty. Yet, these procedures involve a physician rendering a service across considerable distances using a digital medium. By all accounts in the literature, such procedures fall under the umbrella of telemedicine.

It is important to properly recognize radiology procedures as telemedicine because that will further normalize telemedicine, expanding its role in the healthcare system. Including radiology in the Medicare Telehealth Services list would highlight the fact that telemedicine has been central to the specialty for years, and perhaps cause certain actors in the field to expand their personal definition of what telemedicine can be.

Recommendation 3: Establish a routine review process for the Medicare Telehealth Services list.

There were several procedures and specialties that had been shown to have positive clinical impacts, but were excluded from the Medicare Telehealth Services list until the pandemic began.

Consequently, patients that could have benefitted from these procedures were not able to access them for many years. To avoid this in the future, CMS should institute a consistent review schedule to amend the Medicare Telehealth Services list and ensure it reflects the latest understanding of telemedicine's clinical efficacy.

Other than ensuring that Medicare beneficiaries have access to telemedicine, a review process could have the additional benefit of stimulating telemedicine research activities. Researchers could be reasonably certain that their findings will have concrete outcomes that affect the lives of patients and healthcare providers alike. Therefore, if the NIH were to make the investment towards telemedicine research, it would only make sense for CMS to take the results of that research and implement them on a regular basis.

Recommendation 4: Encourage the development of national or regional physician licensing institutions.[1]

One of telemedicine's chief advantages is that it allows physicians to see patients across great geographical distances. The potential for telemedicine to solve physician shortages in certain communities was apparent to policymakers very early on. (Preston et al., 1992) A primary reason why this potential has not yet been realized is because of the strict licensing requirements that prevent physicians from practicing outside of their state. (Dickens and Cook, 2006) State boards of medicine provide certificates for physicians to practice in specific states. For some states, this might not be a problem because physicians from urban centers are not barred from practicing telemedicine to see patients in more rural areas of their state. In states without a large concentration

[1] While this policy recommendation does not stem directly from the findings in this study, delving into the background of telemedicine convinced me that, as a proponent of more telemedicine in healthcare, I should advocate for this policy change.

of physicians in an urban center, however, there is no pool of physicians to draw from to meet the health needs of their rural population. Patients in these states would benefit greatly from being able to see out-of-state physicians.

Of course, there are some compelling reasons to institute state-level licensing requirements, primary among them being the diversity of patients that physicians treat based on their geographic location. Physicians from different parts of the country could become familiar with certain types of patients and pathologies while losing familiarity with others, especially if they have been practicing in one location for a long time. A physician in southern California, for example, might be adept at treating patients from a Hispanic/Latinx background in an urban setting, but their experience might make them less able to treat someone from rural Maine. Therefore, instead of abolishing state-level licensing entirely in favor of a national licensing system, a middle-ground approach might be best. Specifically, a regional approach in which physicians from similar states are able to practice medicine in multiple states could be the optimal approach. In 2017, eight states launched a cross-state licensing initiative that was aimed at addressing this exact issue. Rather than a patchwork of states, a federal agency could be better suited to drive this policy change that could impact multiple states if enacted.

Recommendation 5: Continue to find ways to implement telemedicine in the inpatient setting.

With specialties such as critical care and emergency medicine gaining approval to utilize telemedicine, there are many opportunities to implement telemedicine in the inpatient setting. Healthcare organizations should take this opportunity to build up telemedicine capabilities to deliver care to inpatients. Within a hospital, telemedicine might not be used to overcome geographical barriers, but other potential benefits exist. For example, reducing the transmission of

COVID-19 was definitely a benefit of using telemedicine in the hospital setting. Telemedicine could continue to cut down on the risk of disease transmission in hospitals going forward, which might be an especially important consideration for immunocompromised patients and patients that have an infectious disease.

Organizations that make effective use of telemedicine could also see economic benefits. Dullet et al. found that telemedicine could also have positive environmental impacts and reduce costs associated with transportation, while Roine et al. found multiple instances in which telemedicine cut down on the cost of providing care for patients. (2017; 2001) Consequently, embracing telemedicine could be an important step in cutting down on the rising costs of healthcare and improving a struggling hospital's financial viability.

Further Research Directions and Conclusion:

Overall, this study highlights the fact that this is a transformational time in the area of telemedicine, and that the potential for telemedicine to improve the lives of patients and providers is immense. In response to the pandemic, CMS dramatically expanded access to telemedicine and committed to increased telemedicine utilization in the inpatient setting, representing a departure from the status quo. At the same time, this study showed that more research is needed to establish how telemedicine could be best used to improve patient outcomes, since nearly 60 percent of procedures that are currently approved for telemedicine have an unknown clinical impact.

In the policy recommendation section, I elaborated on the need for more clinical research to continue developing the Medicare Telehealth Services list in an informed manner. Relatedly, there is also a need to analyze the empirical data on the utilization of telemedicine procedures during the pandemic. CMS claims data should be consulted to examine which procedures were used most often, what types of patients relied most heavily on telemedicine, and which parts of the country used telemedicine the most. Not only would this data be useful for future policymaking, but it could also be used to project the estimated costs of reimbursing telemedicine procedures. While this study focused mainly on the clinical impact of telemedicine, economic considerations remain important as well. Finally, the distinction between audio-only appointments and two-way video appointments should be researched, since that has become a relevant distinction for insurers. This research could be especially relevant during cases when a video connection cannot be established between the patient and the provider, which might occur more often for Medicare beneficiaries.

Gaining a firm understanding of telemedicine has never been so important. With increased utilization during the pandemic and permanent expansion of telemedicine reimbursements coming

in the future, enacting well-informed policies will benefit millions of patients and providers across the country. Telemedicine has become a more popular way for Americans to access healthcare during the COVID-19 pandemic, and it will be important to make sure that policy regulating telemedicine access incorporates the body of evidence that currently informs our understanding of how healthcare can be effectively delivered from a distance.

Bibliography

Bhat, Nisha. “Lifting Barriers to Telehealth.” *NCHC*, 19 Feb. 2016, https://nchc.org/lifting-barriers-to-telehealth/.

Bowles, Kathryn H., et al. “Clinical Effectiveness, Access to, and Satisfaction with Care Using a Telehomecare Substitution Intervention: A Randomized Controlled Trial.” *International Journal of Telemedicine and Applications*, 1 Dec. 2011, doi:https://doi.org/10.1155/2011/540138.

Breen, Gerald-Mark, and Jonathan Matusitz. “An Evolutionary Examination of Telemedicine: A Health and Computer-Mediated Communication Perspective.” *Social Work in Public Health*, vol. 25, no. 1, Jan. 2010, pp. 59–71, doi:10.1080/19371910902911206.

Centers for Medicare and Medicaid Services. *MEDICARE TELEMEDICINE HEALTH CARE PROVIDER FACT SHEET | CMS*. https://www.cms.gov/newsroom/fact-sheets/medicare-telemedicine-health-care-provider-fact-sheet. Accessed 23 Nov. 2020.

---. *Overview of the Medicare Physician Fee Schedule Search*. https://www.cms.gov/apps/physician-fee-schedule/overview.aspx. Accessed 23 Nov. 2020.

---. *Telehealth Insurance Coverage*. https://www.medicare.gov/coverage/telehealth. Accessed 23 Nov. 2020.

---. *Trump Administration Finalizes Permanent Expansion of Medicare Telehealth Services and Improved Payment for Time Doctors Spend with Patients | CMS*. https://www.cms.gov/newsroom/press-releases/trump-administration-finalizes-permanent-expansion-medicare-telehealth-services-and-improved-payment. Accessed 9 Dec. 2020.

Cermack, M. “Monitoring and Telemedicine Support in Remote Environments and in Human Space Flight.” *British Journal of Anaesthesia*, vol. 97, no. 1, July 2006, pp. 107–14, doi:10.1093/bja/ael132.

Davis, Fred D. “Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology.” *MIS Quarterly*, vol. 13, no. 3, 1989, pp. 319–40, doi:10.2307/249008.

Dickens, B. M., and R. J. Cook. “Legal and Ethical Issues in Telemedicine and Robotics.” *International Journal of Gynaecology and Obstetrics: The Official Organ of the International Federation of Gynaecology and Obstetrics*, vol. 94, no. 1, July 2006, pp. 73–78, doi:10.1016/j.ijgo.2006.04.023.

Dullet, Navjit W., et al. “Impact of a University-Based Outpatient Telemedicine Program on Time Savings, Travel Costs, and Environmental Pollutants.” *Value in Health: The Journal of the International Society for Pharmacoeconomics and Outcomes Research*, vol. 20, no. 4, Apr. 2017, pp. 542–46, doi:10.1016/j.jval.2017.01.014.

Ekeland, Anne G., et al. "Effectiveness of Telemedicine: A Systematic Review of Reviews." *International Journal of Medical Informatics*, vol. 79, no. 11, Nov. 2010, pp. 736–71, doi:10.1016/j.ijmedinf.2010.08.006.

Granade, P. F. "Malpractice Issues in the Practice of Telemedicine." *Telemedicine Journal: The Official Journal of the American Telemedicine Association*, vol. 1, no. 2, 1995, pp. 87–89, doi:10.1089/tmj.1.1995.1.87.

Grigsby, Jim, et al. "Effects and Effectiveness of Telemedicine." *Health Care Financing Review*, vol. 17, no. 1, 1995, pp. 115–31, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4193577/.

Hailey, David, et al. "Study Quality and Evidence of Benefit in Recent Assessments of Telemedicine." *Journal of Telemedicine and Telecare*, vol. 10, no. 6, Dec. 2004, pp. 318–24, doi:10.1258/1357633042602053.

Harst, Lorenz, et al. "Theories Predicting End-User Acceptance of Telemedicine Use: Systematic Review." *Journal of Medical Internet Research*, vol. 21, no. 5, 2019, p. e13117, doi:10.2196/13117.

Kahn, Jeremy M., et al. "Determinants of Intensive Care Unit Telemedicine Effectiveness. An Ethnographic Study." *American Journal of Respiratory and Critical Care Medicine*, vol. 199, no. 8, Apr. 2019, pp. 970–79, doi:10.1164/rccm.201802-0259OC.

Kahn, Jeremy M, et al. "ICU Telemedicine and Critical Care Mortality: A National Effectiveness Study." *Medical Care*, vol. 54, no. 3, Mar. 2016, pp. 319–25, doi:10.1097/MLR.0000000000000485.

LaPointe, Jacqueline. "CMS to Assess Telehealth Reimbursement Rates Post-Pandemic." *RevCycleIntelligence*, 21 July 2020, https://revcycleintelligence.com/news/cms-to-assess-telehealth-reimbursement-rates-post-pandemic.

Matusitz, Jonathan, and Gerald-Mark Breen. "E-Health: A New Kind of Telemedicine." *Social Work in Public Health*, vol. 23, no. 1, Feb. 2007, pp. 95–113, doi:10.1300/J523v23n01_06.

May, Carl, and Tracy Finch. "Implementing, Embedding, and Integrating Practices: An Outline of Normalization Process Theory." *Sociology*, vol. 43, no. 3, June 2009, pp. 535–54, doi:10.1177/0038038509103208.

Mort, Maggie, et al. "Remote Doctors and Absent Patients: Acting at a Distance in Telemedicine?" *Science, Technology, & Human Values*, vol. 28, no. 2, Apr. 2003, pp. 274–95, doi:10.1177/0162243902250907.

Muller, C., et al. "Cost Factors in Urban Telemedicine." *Medical Care*, vol. 15, no. 3, Mar. 1977, pp. 251–59, doi:10.1097/00005650-197703000-00006.

Nelson, Eve-Lynn, et al. “Feasibility of Telemedicine Intervention for Childhood Depression.” *Counselling and Psychotherapy Research*, vol. 6, no. 3, 2006, pp. 191–95, doi:https://doi.org/10.1080/14733140600862303.

Norredam, Marie, and Dag Album. “Review Article: Prestige and Its Significance for Medical Specialties and Diseases.” *Scandinavian Journal of Public Health*, vol. 35, no. 6, Dec. 2007, pp. 655–61, doi:10.1080/14034940701362137.

Preston, J., et al. “Using Telemedicine to Improve Health Care in Distant Areas.” *Hospital & Community Psychiatry*, vol. 43, no. 1, Jan. 1992, pp. 25–32, doi:10.1176/ps.43.1.25.

Riley, William T., et al. “Health Behavior Models in the Age of Mobile Interventions: Are Our Theories up to the Task?” *Translational Behavioral Medicine*, vol. 1, no. 1, Mar. 2011, pp. 53–71, doi:10.1007/s13142-011-0021-7.

Roine, Risto, et al. “Assessing Telemedicine: A Systematic Review of the Literature.” *Canadian Medical Association Journal*, vol. 165, no. 6, Sept. 2001, pp. 765–71.

Turner, Jeanine Warisse, et al. “Willingness to Try a New Communication Technology: Perceptual Factors and Task Situations in a Health Care Context.” *The Journal of Business Communication (1973)*, vol. 41, no. 1, Jan. 2004, pp. 5–26, doi:10.1177/0021943603259584.

Venkatesh, Viswanath, et al. “User Acceptance of Information Technology: Toward a Unified View.” *MIS Quarterly*, vol. 27, no. 3, 2003, pp. 425–78, doi:10.2307/30036540.

Verma, Seema. *Early Impact Of CMS Expansion Of Medicare Telehealth During COVID-19 | Health Affairs Blog*. 15 July 2020, /do/10.1377/hblog20200715.454789/full.

Whitten, Pamela, et al. “Transcending the Technology of Telemedicine: An Analysis of Telemedicine in North Carolina.” *Health Communication*, vol. 12, no. 2, Apr. 2000, pp. 109–35, doi:10.1207/S15327027HC1202_1.

Wittson, Cecil L., and Reba Benschoter. “Two-Way Television: Helping the Medical Center Reach Out.” *American Journal of Psychiatry*, vol. 129, no. 5, Nov. 1972, pp. 624–27, doi:10.1176/ajp.129.5.624.

Wuckland, Eric. “CMS: 9 Million Used Telehealth During Early Days of COVID-19.” *MHealthIntelligence*, 16 July 2020, https://mhealthintelligence.com/news/cms-9-million-used-telehealth-during-early-days-of-covid-19.

Yamamoto, Dale. *Assessment of the Feasibility and Cost of Replacing In-Person Care with Acute Care Telehealth Services*. Red Quill Consulting Inc., Dec. 2014.