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**An Analysis on Advanced Practice Providers
Delivering Primary Care Services
Through Telehealth**

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AN ANALYSIS ON ADVANCED PRACTICE PROVIDERS DELIVERING PRIMARY CARE SERVICES THROUGH TELEHEALTH.

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Abbreviations

AACN – American Association of Colleges of Nursing

AANP – American Academy of Nurse Practitioners

AHRQ – The Agency for Healthcare Research and Quality

AMA – American Medical Association

ATA – American Telehealth Association

CAH – Critical Access Hospital

CCHP – Center for Connected Health Policy

CEA – Cost-effectiveness Analysis

CHIP – Children’s Health Insurance Program

CMHC – Community Mental Health Center

CMMI – Centers for Medicare and Medicaid Innovation

CMS – Centers for Medicare and Medicaid Services

CNM – Certified Nurse Midwife

CNS – Clinical Nurse Specialist

CRNA – Certified Registered Physician Assistant

CRNP – Certified Registered Nurse Practitioner

CUA – Cost-utility Analysis

FQHC – Federally Qualified Health Center

GDP – Gross Domestic Product

HHS – U.S. Department of Health and Human Services

HRSA – U.S. Health Resources and Services Administration

MA – Medicare Advantage

MIPS – Merit-based Incentive Payment System

NLC – Nurse Licensure Compact

NP – Nurse Practitioners

NPP – Non-physician Practitioner

ONC – Office of the National Coordinator for Health Information Technology

OTA – Office of Technology Assessment

P2P – Physician-to-Physician

PA – Physician Assistants

PCP – Primary Care Providers

RHC – Rural Health Clinic

SNF – Skilled Nursing Facility

SOP – Scope of Practice

VHA – Veterans Health Administration

Abstract

Health care is a rapidly evolving industry with new technologies constantly entering the marketplace. Supply for quality care has to continuously catch up to demand. The United States' primary care system is at a crossroads, as patients rightly demand the best in health care costs, access, and quality. How will the industry continue to deliver high quality of care with our nation's increasing demands? What technologies can be best utilized when caring for our aging population?

This thesis is built around key sections that address our country's impending physician shortage and how our health care system can combat growing demand with better processes and technologies.

First, this thesis will examine physician shortages in America and what opportunities are available to address the problem. Existing health care research has found that advanced practice providers improve the costs, access, and quality of care as a solution to the impending shortage. This review will also assess the effectiveness of advanced care providers and health systems using telehealth, and how technology can alleviate the primary care physician shortage. An analysis was also conducted to document the United States' current ratio of physician to patients in each state, which shows that adding advanced primary care providers and telehealth services can narrow the gap between supply and demand in most states.

Second, this thesis will analyze the impact of telehealth in the U.S. health care system. A literature review of telehealth's definition and history will give a foundation of how the technology has already changed how Americans access care, especially in rural areas.

This thesis is proposing that advance practice providers can deliver primary care services using telehealth. Through the review of studies and literature, in addition to interviews with industry experts, it is suggested that there is a lack of concrete evidence with which to fully assess the economic impact of telehealth. Two of the most common economic evaluation methods are cost-utility analysis (CUA) and cost-effectiveness analysis (CEA). The main

objective of CUA, which is used especially in health technology assessment, is to estimate the ratio between the cost of a health-related intervention and the benefit it produces in terms of the number of years lived in full health by the users. In health technology assessments, the benefits are usually expressed in quality adjusted life years.¹

Thesis Readers:

Ricardo Sarmento Costa

¹ Devlin N, Parkin D. Does NICE have a cost-effectiveness threshold and what other factors influence its decisions? A binary choice analysis. *Health Econ* 2004; 13:437–452.

Introduction

The cost of health care represents approximately 18 percent of the U.S. Gross Domestic Product (GDP), according to the Council of Economic Advisors, and this percentage is growing.² Today the health care industry has ever-increasing obligations to reduce costs, provide access, and increase quality, while confronting a national crisis with an impending physician shortage. Health care institutions around the country are also faced with the challenge of adapting to innovative technologies that are centered on cost-effective deliveries. The primary purpose of this study is to establish a critical analysis of how to combat health care's physician shortage challenge and present solutions through advanced practice providers delivering primary care services using telehealth.

This thesis will demonstrate how advanced primary care providers, if utilized to their optimal potential, could play a vital role in answering the impending physician crisis and growing demand for primary care. Health care systems operating at their full potential want providers who are practicing to the level of their licensure. Major inefficiencies surrounding effective and efficient health care practices are creating issues including access, quality, and costs in America's health system. It is crucial that the health care industry adopts new technologies to combat an increase in demands and expectations, as most other industries have already done. Our health care system also needs to increase its use in existing technologies such as computers and sensors. There is a gradual increase in job responsibility that results with technology-assisted services. For example, certain health technologies would be able to accomplish duties with which mid-level providers are currently tasked. By implementing these technologies, mid-level providers would then be able to perform the duties that physicians are currently handling. This would subsequently allow physicians to focus on more back end things that have been neglected but must be improved in order to advance the nation's health care system.

The review and analysis of advanced practice providers delivering primary care services using telehealth will be discussed throughout the thesis. The main focal points will be the

² Council of Economic Advisors. The Economic Case for Healthcare Reform. Presidential Report, Executive Office of the President. Washington, DC, 2009.

cost-effectiveness of utilizing advanced primary care providers and telehealth in the U.S. health system. The analysis of this paper will evaluate MedStar Health, a regional health system based in the Washington, D.C. metro area, as well as find gaps in health care that can be made up in areas with better efficiencies.

Objective

I will analyze and answer the questions that created the foundation for this thesis. Telehealth has been revolutionizing the healthcare industry for decades now, but has only really found its place in the industry within the last ten years. In knowing how effective the technology is, I wanted to ask the question of, what problem can telehealth really focus on and solve? This question led me to narrow in on health care's impending physician shortage problem. This problem will inevitably affect areas in health care such as cost, access, and quality. The objective to this first question then led me to ask another question of why do we have an impending physician shortage that is looming over the health care industry? Through extensive research and analysis of America's current health system, I discuss reasons to this question such as, the growing demand for care due to older more chronic diseased patients referred to our Baby Boomer generation (Born between 1945 -1965). Also, 20 million new entrants due to the Affordable Care Act have flooded into the health care system that weren't using the system 5 years ago. Lastly, the medical field, especially for medical doctors has the highest burnout rate in any industry in America. The balance and expectations of work-life have changed since the early decades of medicine. New physicians don't see the benefits of working long hours for the expenses of education and salary coming into the primary care field.

Once I answered my first two questions, I then asked the final question of, who will be best able and qualified to implement telehealth services in primary care settings? The answer is advanced primary care providers. I go into further detail throughout the thesis and discuss how advanced practice providers can be an alternative for primary care physicians through the use of telehealth services. In the current health care climate, where 52 percent of all

hospitals are using some form of telehealth³, this thesis will exam to what extent telehealth is providing an effective solution in addressing the rise of a physician shortage, and moreover, if advanced practice providers are a cost-effective alternative to implementing telehealth solutions.

The cost of telehealth has not been fully comprehended but data has revealed decreasing health care costs for both the consumer and provider.⁴ This study will further exam the role of telehealth in the primary care setting and assess the effectiveness of implementing alternatives to answering solutions to the impending physician shortages.

Advanced practice providers, which consist of physician assistants and nurse practitioners, are considered to be in a “career flexibility” position.⁵ This allows them to change clinical specialties throughout their careers because of having a core generalist education. Advanced practice providers who can quickly adapt to new opportunities could help alleviate medical workforce shortages in primary care. This thesis will further explore alternatives to traditional roles primary care physicians have and how advanced practice providers can be managed in teams to better handle the growing demands of health care access and quality.

³ AHA Annual Survey, Health Information Technology Supplement (2013).

⁴ Jennett, P.A., et al., The socio-economic impact of telehealth: a systematic review. J Telemed Telecare, 2003. 9(6): p. 311-20.

⁵ Hooker RS, Cawley JF, Asprey DP. Physician assistants: policy and practice. Philadelphia (PA): FA Davis: 2010

Methodology

The thesis will conduct a literature review and analysis in the following areas of health care:

1. Primary care physician shortages in the U.S. health care system;
2. Advanced practice providers' role in alleviating the primary care physician shortage and an analysis of cost, access, and quality;
3. The role of telemedicine as a cost-effective approach for primary care solutions.

The systematic reviews for all the researched areas will focus on methodologies from health-policy analysts, authors in the health care industry, financial reviews associated with primary care policy and procedures, methodological recommendations, quantitative analysis on the U.S. healthcare system, future ratios comparing health provider to patient demands in accessibility, comparative data to cost versus quality, and qualitative analysis of the present primary care and telehealth industries through personal interviews.

The research involved in the health care and telehealth fields allowed for opportunities to access industry leaders in the Washington, D.C. area through personal interviews. The interviews were conducted in-person with David Brennan, Director of Telehealth Initiatives for the MedStar Institute for Innovation and Dr. Sachin Nagrani, Physician and Director of Health IT for MedStar Institute for Innovation. Both interviews allowed me to dive right into exploring where telehealth is in the field of primary care and how the future outlook is for physician shortages. I was able to get access to these industry leaders because of the current work I do with Georgetown University's Lombardi Cancer Center, which partners with MedStar Health in the D.C. metro area. Dr. Nagrani provided a current analysis of where MedStar Health is with telehealth and how the technology affects the health system's patient population. Mr. Brennan has been in the telehealth industry for over 15 years. The insights and wealth of knowledge in the telehealth industry provided the groundwork for this thesis in determining how technology works with the primary care field.

The conclusion made through the systematic review of this thesis and the interviews from industry experts have been constructed to confirm my considerations for advanced primary care providers to deliver primary care services through telehealth technologies.

Literature searches were performed using ProQuest through the Georgetown University Library. Key search terms included: primary care (also general practice, family medicine), physician shortage, telehealth, patient accessibility, telemedicine, quality health outcomes, advanced practice providers (also nurse practitioners and physician assistants), cost-effectiveness, and health equity.

Literature Review

I. Physician Shortages and Health Care's Opportunity

Physician shortages are expected to impend over the United States in the next ten years, as the nation's population grows and age demographics and insurance coverage expands as a result to the Affordable Care Act.⁶ Research from Cooper et al. (2002) estimates that by 2025, the U.S. will experience a shortage of 35,000 to 44,000 adult primary care physicians.

The United States health care system will experience an enormous transition in the next decade with regards to how Americans access their health providers. America's health care system is at a crossroads with the not-so-simple-problem of a supply and demand crisis. The supply of physicians is projected to increase modestly between 2016 and 2025, but it will not be enough for the country's growing demand. By 2025, demand for physicians will exceed supply by a range of 61,700 to 94,700 (Abraham, 2011).

II. Background on Primary Care Providers

Primary care teams normally consist of primary care physicians who work with other skilled staff to deliver services needed by a particular patient subgroup. The strategic vision to improve value is geared towards these primary care teams that define patient subgroups and develop teams that focus on patient care integration. The team leader does not always fall on the responsibility of the primary care physician. Health systems across the country are developing new practice models that, in some cases, involve non-physicians having the primary responsibilities for preventative care for healthy patients and for patients with stable chronic diseases. A tool that allows these non-physicians to effectively lead primary care teams is telehealth. The introduction of advanced primary care providers such as nurse practitioners and physician assistants has the potential to disrupt the status quo.⁷

⁶ Hofer AN, Abraham JM, Moscovice I. Expansion of coverage under the Patient Protection and Affordable Care Act and primary care utilization. *Milbank Q.* 2011; 89(1):69-89.

⁷ Contandriopoulos, Damien, Astrid Brousselle, Mylaine Breton, Esther Sangster-Gormley, Kelley Kilpatrick, Carl-Ardy Dubois, Isabelle Brault, and Mélanie Perroux. "Nurse Practitioners, Canaries in the Mine of Primary Care Reform." *Health Policy* 120.6 (2016): 682-89. Web.

Primary care providers (PCP) are general non-emergency health care providers. The role of a primary care provider is to: deliver preventative care and impart healthy lifestyle choices; identify and treat common medical conditions; assess the urgency of medical problems; and direct patients to the best place for care such as a medical specialist. Primary care is usually provided in an outpatient setting.⁸ Patients can choose from a variety of PCPs that range from family practitioners, who are physicians who have completed a family medicine residency and are board certified, to pediatricians or geriatricians, who are both board certified and completed residencies in pediatrics or internal medicine. Nurse practitioners (NP) and physician assistants (PA) also fall under primary care, but go through a different training and certification process than doctors. They will be a patient's key contact in most practices. Primary care sees more than 55% of all health care visits.⁹

III. Access to Health Care

The business of primary care is in need of a complete overhaul. American consumers live in a society where immediate access to everything is a priority. The days of waiting long hours, days, or even months to see your doctor are over. Primary care providers have new competition like Minute Clinics provided through a neighborhood CVS, or flu shots offered at the airport; these businesses understand the demand for immediate access and are championing the process. Health care industry leaders have been studying the effects of increased demand and access to the primary care industry, and want to find new innovative ways to bridge the gap of supply and demand, while focusing on maintaining overall quality.

The primary drivers for increased demand of physicians are population growth and the increased percentages of Americans becoming aged 65 and older. By 2025, the U.S. population under age 18 is projected to grow by only five percent, while the population aged 65 and above is projected to grow by 41%.¹⁰ Every day there is an influx by the thousands of Baby

⁸ Peikes D, Zutshi A, Genevro J, Smith K, Parchman M, Meyers D. Early evidence on the Patient-Centered Medical Home. AHRQ Publication No. 12-0020-EF. Rockville, MD: Agency for Healthcare Research and Quality. February 2012.

⁹ Visit rates are based on the July 1, 2010 set of estimates of the civilian non-institutional population of the United States as developed by the Population Division, U.S. Census Bureau

¹⁰ "Physician Supply and Demand." Hospitalist Recruitment and Retention (2016): 1-22. AMC, Apr. 2016. Web

Boomers turning 65 and entering into the Medicare program. Baby Boomers will double the number of older Americans by 2040.¹¹ The supply of doctors must increase to keep up with the demand, especially from the growing senior population, which will require the greatest health care needs.

Health analysts have identified access to care as one of the most important dimensions of health care quality. An important relation to consider when evaluating access to care is the current ratio of one physician for every 2,500 patients.¹² These estimates attempt to compare the average daily patient demand with the supply of physician appointment capacity. In 2008, the Office of Management and Budget (OMB) estimated the average duration of a face-to-face visit with a primary care physician was 19.01 minutes. The average health consultation equates to 28 slots per day for a primary care provider to see patients while working a 40-hour workweek. To put this into perspective, by 2025, there will be a decreased number of 321,200,000 appointments per year for a patient to have access to a primary care provider. This is based on a single provider having 7,300 slots per year, multiplied by a shortage of 44,000 primary care providers.

IV. Reason for Physician Shortage

The interest in medicine as a career is higher than ever in the U.S., with reports showing record numbers of students applying to and attending medical school. Medical schools have been increasing their enrollments in order to respond to the impending physician shortage. Despite the rising number of medical school graduates, there hasn't been the same growth in the number of federally supported residency training positions that are required for new medical doctors. Graduate medical education (GME) is the supervised hands-on training after medical school that all physicians must complete to be licensed and practice independently. This hands-on training varies in length, but generally lasts between three to five years for initial specialty training and increases in length going as long as 11 years for some

¹¹ Congressional Budget Office. The 2015 Long-Term Budget Outlook. Figure 2-3. <https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/50250-LongTermBudgetOutlook-4.pdf>.

¹² Mitka M. Looming shortage of physicians raises concerns about access to care. JAMA. 2007;297(10): 1045-6.

subspecialties after graduating medical school.¹³ The required training is coordinated and funded by teaching hospitals and other clinical settings.

In 2002, there were 125 U.S. medical schools; today, the number of schools has increased to 141. About one third of the recent growth in enrollment comes from new medical schools.¹⁴ Two decades ago, Congress imposed a payment cap on Medicare's funding of advanced training in the Balanced Budget Act of 1997. Medicare is the primary supporter of GME programs, contributing \$9.5 billion, which funds a share of the costs for 100,000 positions in teaching hospitals (Iglehart, 2013). Immense efforts have been made by the Association of American Medical Colleges (AAMC) and its allies to convince Congress that Medicare GME support is vital to alleviating the country's impending physician shortage. The request for funding and an additional 15,000 positions were turned down during the debate over the Affordable Care Act (ACA). Without the increase in Medicare GME support, there will be even more medical students like the 606 students who did not match with a residency program in 2015 (Graduate Medical Education, unknown date).

In order for the medical community to introduce new primary care physicians to the field to contribute to the country's growing demands, the federal and state governments need to continue its planning and budgeting for medical education, which will be determined on the attitudes towards the current health care environment. Experts in the late 1990s anticipated an excess of physicians so they controlled the supply by limiting the number of people admitted to medical schools and the number of positions available for postgraduate training.¹⁵ These initial estimates did not take into account the rapidly growing population in the United States or the aging and life expectancy of the existing population, both of which are putting enormous demands on the health care system. Additionally, these estimates do not include new patients who will and have received insurance under the new healthcare mandate. The gradual number of physicians exiting the industry, combined with the low number of medical

¹³ "Graduate Medical Education (GME) - Government Affairs - AAMC." Graduate Medical Education (GME) - Government Affairs - AAMC. N.p., n.d. Web.

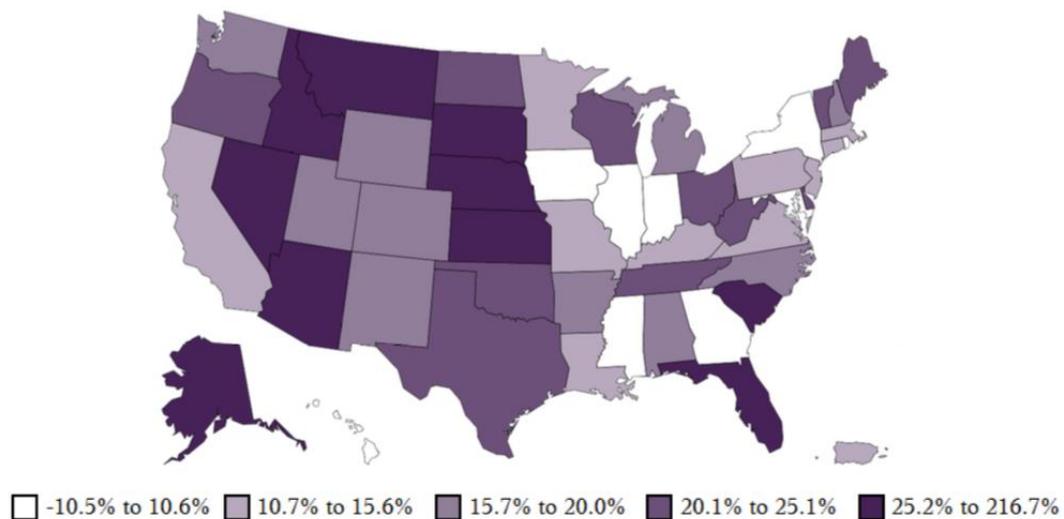
¹⁴ Iglehart, John K. "The Residency Mismatch." *New England Journal of Medicine* N Engl J Med 369.4 (2013): 297-99. Web.

¹⁵ Kane GC, Grever MR, Kennedy JI, Kuzma MA, Saltzman AR, Wiernik PH, Baptista NV. The anticipated physician shortage: meeting the nation's need for physician services. *American Journal of Medicine* 122(12), 1156-62, Dec 2009.

graduates each year will not be sufficient in providing care to the U.S. population.

The current-day field of general medicine in the United States is seeing an increased trend of moving away from medicine. Today’s medical school graduates report feeling that general medicine is neither financially nor personally satisfying as a career choice.¹⁶ Societal norms have shifted from where they once were in American history, to a greater emphasis on work-life balance. A new wave of medicine is seeing high numbers of older physicians retiring and new physicians entering into medicine not wanting to work the same number of hours that earlier generations once practiced.¹⁷ There is a large transition being seen in primary care physicians moving to roles like consulting and administration, due to increased frustrations. Others are closing their private practices and joining hospital groups, or becoming “concierge” providers who offer individualized care to families who pay a premium for health services.¹⁸

Map 3.5.2. Percentage Change in Residents and Fellows in ACGME-Accredited Programs, 2004–2014



Source: 2004 and 2014 AAMC/AMA National GME Census (data extracted in August 2015).

Table 1.1

¹⁶ Hauer KE, Dorning SJ, Kernan WN, and others. Factors associated with medical students’ career choices regarding internal medicine. *JAMA* 300(10):1154-64, Sep 10, 2008.

¹⁷ Salsburg E, Grover A. Physician workforce shortages: Implications and issues for academic health centers and policymakers. *Academic Medicine*, 81(9):782-7, Sep 2006.

¹⁸ Steinbrook R. Easing the shortage in adult primary care – Is it all about money? *New England Journal of Medicine* 360(26), 2696-9, Jun 26, 2009.

V. Impact of Telehealth on the Health Care System

Telehealth has been transformative to the health care system in the way it has changed the speed of care and eliminated barriers to access. The technology has impacted health care on many levels from regular checkups to ICU care. Telehealth has already improved patient health outcomes and continues to improve the industry with tremendous promise in future technologies.

The terminology used for “telehealth” and “telemedicine” has been used almost interchangeably across federally funded health programs. Each of the term’s definition results in varying problems associated with data collection, evaluation, and payment. There are ranges of descriptions that current laws and policies use for telehealth and the related term of telemedicine. For example, the Office of the National Coordinator for Health Information Technology (ONC) differentiates telemedicine as being a function of interactions that involve clinical decision-making. The Agency for Healthcare Research and Quality (AHRQ) focuses on the technologies used that support telehealth, stating that the technologies are meant for delivering health care in different arrangements, such as remote patient monitoring, video conferencing, Internet applications, and devices. The Veterans Health Administration (VHA), is similar to AHRQ in the way it believes telehealth technologies include either single or combined uses of: videoconferencing, mobile technologies, store-and-forward technology (or asynchronous communication). The Centers for Medicare and Medicaid Services (CMS), under its Medicare Advantage (MA) program utilizes its health services by conducting telephone, Internet, or telemonitoring for selected Medicare beneficiaries. Under the Medicaid program, the terms “telemedicine” or “telehealth” are used interchangeably. These and other distinctions are important, not merely for semantic reasons, but because they have implications for federal policies that impact access, cost and/or quality.¹⁹

¹⁹ Telehealth and Telemedicine: Description and Issues

VI. Brief History and Background of Telehealth

The concept of telehealth dates back as far as 1879, when the world's leading medical journal, *The Lancet*, published an article that discussed the use of telephone communication with a physician. In 1925, the magazine "Science and Invention" had an article on physicians using the radio.²⁰ However, it wasn't until the late 1960s that telehealth took to action with the U.S. Military and Space programs using its technologies. The National Aeronautics and Space Administration (NASA) developed technologies that monitored the vital signs of astronauts as part of its Mercury space program.²¹ The first medical institute to start implementing the videoconferencing technology was a psychiatric institute, where specialists were able to videoconference non-specialized staff at a mental hospital.^{22 23}

Telehealth services incorporate three traditional components including: real-time videoconferencing, store-and-forward, and remote patient monitoring. Real-time allows live interaction between the patient and the health care provider using audiovisual technology. This form of telehealth is used mainly for consultations, diagnosis, and treatment options for patients. Store-and-forward technology involves asynchronous transmission of health records through a secure electronic communications system. This technology has innovated immensely in the past decade with prerecorded videos, digital images such as x-rays and photos, and patient vitals via smartphone application platforms that are connected directly to health care providers.²⁴ This form of telehealth renders a service outside of a real-time interaction. The advantage of store-and-forward gives multiple access points to patient data at a centralized location and is especially beneficial to patients who require specialty care when local providers are not available. Patients outside of the United States have also been able to utilize the benefits of specialized physician care. The last of the three traditional components of telehealth is remote patient monitoring, which involves the collection of personal health and medical data through electronic communication technologies. The data is transmitted

²⁰ Institute of Medicine, *The Role of Telehealth in an Evolving Health Care Environment: Workshop Summary* (Washington, DC: The National Academies Press, 2012), 11-12.

²¹ Institute of Medicine, *The Role of Telehealth in an Evolving Health Care Environment*, 11-12.

²² Kay, Santos, and Takane, *Telemedicine*, 9.

²³ Reba Ann Benschoter, Merril T. Eaton, and Pringle Smith, "Use of Videotape to Provide Individual Instruction in Techniques of Psychotherapy," *Academic Medicine* 40, no. 12 (December 1965): 1159-61.

²⁴ Tucker, D. H. (2015). The promise of telehealth. *Trustee*, 68(3), 27-30.

from the patient to the provider who then uses it to track progress, usually after the patient has been released to go home or to another care facility. These traditional modalities are growing in numbers for mobile health use. In addition, the market for wearable devices has increased from \$1.5 billion in 2014 to \$6 billion by 2016.²⁵ For example, wearable technologies have moved into the electrocardiogram monitoring health device space, which deliver EKG readings to a patient's provider.

VII. Cost, Access, and Quality of Telehealth

One of the most important benefits of telehealth is the lowering of costs associated with reductions in hospitalizations, readmissions, length of stays, monitoring vitals, and generalized care—all from the convenience of one's home or workplace. The systems that are built around telehealth enable real-time communication between healthcare providers and their patients. As technology revolutionizes the health care sector, patients will see improvements to various technologies through the capacities of videoconferencing; the storing and forwarding of clinical data through smartphones; and remote monitoring of patients' chronic conditions via sensors and monitoring equipment. All of these capacities associated with innovative technologies will continue to enter into mainstream health care. Telehealth technologies are evolving into new markets that focus on preventative care through wearable devices that track everything from calories burned to the amount of sleep a person receives. Health data will become more accessible for both the patient and provider through centralized platforms. Innovative technologies continue to build upon preventative care through components that track an individual's lifestyle trends and become just a click away through mobile applications on a smartphone.

For the past decade health care policy analysts have been collecting data on the cost-effectiveness and potential telemedicine has on the healthcare industry. The most recent data from 2013, found that 52 percent of hospitals utilized telehealth, and another 10 percent were beginning the process of implementing telehealth services.²⁶ A survey conducted by the American Health Association (AHA) found health consumers' interest, acceptance, and

²⁵ mHealth App Developer Economics 2014; research2guidance, May 6, 2014.

²⁶ AHA Annual Survey, Health Information Technology Supplement (2013).

confidence are rising in this area of health care. Recent studies on the use of telehealth services have shown that:²⁷

- 74 percent of U.S. consumers would use telehealth services;
- 76 percent of patients prioritize access to care over the need for human interactions with their health care providers;
- 70 percent of patients are comfortable communicating with their health care providers via text, email, or video, in lieu of seeing them in person;
- 30 percent of patients already use computers or mobile devices to check for medical or diagnostic information.

There is a strategic movement that is beginning to focus on the benefits of telehealth technologies. A significant trend through consumerism is driving health care providers and government agencies to adopt telehealth technologies that are improving patient health, lowering costs, and reducing readmissions. Major health plans, the federal government, national pharmacy chains, large behavioral health systems, and enormous employer groups are starting to leverage telehealth to advance their strategic goals.

There are various applications in telehealth technologies that are filling the need for critical health care services in a variety of specialty areas across diverse patient populations. Traditional telehealth applications have been developed to service patients who seek care for the most common symptoms such as sinusitis, cold and flu, and skin problems. Traditional applications are most important in rural communities that have limited health care access.

Approximately 62 million Americans live in rural and frontier areas where access to primary care or a health care specialist is limited.²⁸ Only about 10 percent of physicians practice in rural America, despite the fact that nearly one-fifth of the population lives in these areas. Equipped in many ways to serve rural health needs, telehealth allows patients, providers, and state governments to leverage existing provider networks and potentially improve rural health outcomes.

²⁷ PricewaterhouseCoopers Health Research Institute. *New Health Economy* (2014).

²⁸ *Rural Healthy People 2010—“Healthy People 2010: A Companion Document for Rural Areas,”* Federal Office of Rural Health Policy.

The fundamental aim for telehealth is to increase access to health care in areas where it is otherwise not available. The original beneficiaries and early adopters of telehealth were the U.S. military, prisons, and rural populations. Access to the Internet has changed the way telehealth is used and who benefits from the technology. The U.S. Senate Committee on Finance recently stated, “Traditionally, telehealth has been viewed as a tool to improve access to services, but interest is growing to see if telehealth has the potential to reduce health care costs” (Ray and Topol, 2016).

The U.S. health care system and the use of telehealth are seeing major trends that are defining the future landscape for patient value. The design and development of telehealth originated with addressing acute care conditions. With the expansion of telehealth, we will see it addressing not only acute care conditions, but also episodic and chronic conditions (Ray and Topol, 2016). In an interview with MedStar’s Director of Health IT, Dr. Sachin Nagrani stated, “Acute care prevention is slowly moving towards chronic care prevention. Looking at the statistics of chronic care, it not only costs a lot of money, but also costs a lot of lives. Seven out of ten used to be acute problems; now seven out of ten are chronic issues. It has been a full reversal. We used to invest heavily in hospitals and we still are, but we’re now also looking at how can we manage these problems longitudinally and prevent people from getting these chronic diseases because that’s where all of the money is being spent.”

Chronic conditions affect approximately 140 million citizens in the United States and account for 80% of health care expenditures. In the past, chronic conditions were limited to general asynchronous monitoring (e.g. text messages or telephone support). The present-day technologies and future models of telehealth will include rich data transfers from remote monitoring (use of wearable sensors and mobile diagnostic systems, such as electrocardiograms), patient education, and regular virtual visits from physicians, advanced primary care providers, and social workers (Ray and Topol, 2016).

“When we talk about chronic disease management, it’s more about frequency of touch points. If, for example, you have diabetes, you would need to go into the office for many touch points, with many doctors. The burden of going in all of these times is what makes patients reluctant

to take care of their health—because of having to go in all of the time. Now if it was something as simple as picking up the phone, you might be more engaged as a patient with your own health, and what we would want to see from that is better control, lower high-cost visits, and lower complication visits, like frequency of heart attacks. You start to see that and the attention and communication from providers is paying off” (Nagrani, 2016).

The third trend being seen in telehealth care is the transition from hospitals and satellite clinics to patient homes and their mobile devices. Institutions including hospitals and satellite clinics were the initial adopters of telehealth applications. The technological systems and onsite clinical support that went into these institutions were very expensive. Telehealth innovation has since recommended moving these portable technologies to homes and devices such as smartphones. The patient-centered medical homes that are increasingly becoming popular are providing efficient and effective care to the two million elderly American citizens with chronic conditions (Ray and Topol, 2016). The exploitation of technologies including video conferencing has moved even acute conditions like pneumonia from the ER, to a patient’s front door. As stated in the *New England Journal of Medicine*, “Providing health care to persons in retail clinics or homes and over the telephone mirrors the trend in banking, in which automated teller machines and the Internet moved services from the bank lobby to mobile devices.” (Ray and Topol, 2016).

“Some of the near-term returns on investments for telehealth that are being looked at heavily in the industry are divergent from ER care. For instance, an ER visit averages a little over \$1,400 a visit, and urgent care, the national average is in the vicinity of \$200, and an online visit, the industry standard is about \$50. So you have a very concrete platform for where someone looks to go for care and how much it costs” (Nagrani, 2016).

There are limitations to telehealth that prove to be inferior to in-person medical consultations. The quality has limitations, especially when there is the absence of physical touch, which allows the provider to make a clinical assessment. Technology innovation in the areas of peripheral devices (mobile blood pressure monitor) have increased the quality of the telehealth examinations, but the success of these assessments also are contingent on whether

trained medical personnel are assisting, which has become less common with the use of home and mobile telehealth devices (Ray and Topol, 2016).

There is an even larger limitation to the adoption of telehealth, and that's the social aspect that divides Americans and how they want to receive their health care. This limitation is called the "digital divide," which is based on social factors and where Americans receive health care services in the country. Geography plays a very large role in who receives telehealth services and how. David Brennan states, "I think all the assessments around virtual visits are grossly over stated. I think people's willingness to do a virtual visit far out paces their readiness to do a virtual visit. I know, with the shifting demographics as people get older, that will eventually happen but right now, Millennials don't cost us a cent" (Brennan, 2016).

Americans who are older and live in rural areas, with lower incomes, less education, or more chronic conditions are less likely to have access to the Internet. We see the opposite divide through American youth, who are more likely to live in urban areas and have higher incomes and more education, but don't have chronic conditions in which they could utilize telehealth's technology. The social divide gap is apparently wider with older Americans. Only 58% of the elderly, 65 and older use the Internet, one of the lowest percentages of any single group. This percentage of America's elderly and the digital divide greatly undercuts telehealth's aim to increase access to healthcare to those in the greatest need.

There have been numerous studies published on the quality of telehealth and the services provided from its activities under the federal Medicare program, but few studies have been published on state Medicaid programs. Medicaid is a joint federal-state program that finances the delivery of primary and acute medical services. These services for Medicaid beneficiaries, which are used by more than 65 million Americans, also include long-term services and support. In 2014, the total payments funded by Medicaid services amounted to \$494 billion, with the federal government paying about 60%—or \$299 billion.

Analysis

I. Effects of the Physician Shortage

Physicians are counted as primary care physicians if their self-designated primary specialty is one of the following: adolescent medicine (pediatrics), family medicine, general practice, geriatric medicine (family practice and internal medicine), or internal medicine. In 2014, there were 265.5 active physicians per 100,000 patients in the United States. The state of Massachusetts averaged the highest in the country with 432.4 per 100,000, while Mississippi was the lowest at 184.7.²⁹ By comparison, there were only 91.1 active primary care physicians per 100,000 patients in the same year. Nationally, more than one-fourth (29.4%) of active physicians were aged 60 or older (The State Physician Workforce Data Book, 2015). The demand for health access by the U.S. population can be put into perspective with these numbers. In 2014, one primary care physician would see 1,097 patients on average. Now consider the statistic stated before, that 606 medical students were not matched in 2015. This is a lost potential of 664,782 patients being seen by a physician in the future. The numbers are alarming just given the statistic we already know from 2014. A decade from now is unpredictable, but we know it will multiply by leaps and bounds.

²⁹ "The State Physician Workforce Data Book." Publications - AAMC. Association of American Medical Colleges, Nov. 2015. Web.

Table 1.1. Active Physicians per 100,000 Population by Degree Type, 2014

	Total Population	Total Active Physicians*			Active M.D.s		Active D.O.s	
		Number	Rate per 100,000	Rank	Number	Rate per 100,000	Number	Rate per 100,000
United States	318,857,056	846,686	265.5	N.R.	783,982	245.9	62,644	19.6
Alabama	4,849,377	9,992	206.0	44	9,505	196.0	487	10.0
Alaska	736,732	1,883	255.6	24	1,683	228.4	200	27.1
Arizona	6,731,484	15,754	234.0	32	13,929	206.9	1,822	27.1
Arkansas	2,966,369	5,877	198.1	46	5,599	188.7	278	9.4
California	38,802,500	101,859	262.5	20	97,294	250.7	4,563	11.8
Colorado	5,355,866	14,631	273.2	15	13,430	250.8	1,201	22.4
Connecticut	3,596,677	12,148	337.8	5	11,698	325.2	450	12.5
Delaware	935,614	2,496	266.8	19	2,205	235.7	290	31.0
District of Columbia	658,893	5,596	849.3	N.R.	5,476	831.1	120	18.2
Florida	19,893,297	51,160	257.2	22	46,685	234.7	4,469	22.5
Georgia	10,097,343	22,303	220.9	39	21,335	211.3	967	9.6
Hawaii	1,419,561	4,209	296.5	10	3,993	281.3	216	15.2
Idaho	1,634,464	3,099	189.6	49	2,739	167.6	360	22.0
Illinois	12,880,580	34,970	271.5	17	32,617	253.2	2,350	18.2
Indiana	6,596,855	14,686	222.6	38	13,689	207.5	997	15.1
Iowa	3,107,126	6,557	211.0	42	5,338	171.8	1,218	39.2
Kansas	2,904,021	6,220	214.2	40	5,531	190.5	689	23.7
Kentucky	4,413,457	9,936	225.1	36	9,345	211.7	590	13.4
Louisiana	4,649,676	11,199	240.9	29	11,037	237.4	162	3.5
Maine	1,330,089	4,174	313.8	7	3,481	261.7	692	52.0
Maryland	5,976,407	22,148	370.6	2	21,406	358.2	742	12.4
Massachusetts	6,745,408	29,166	432.4	1	28,384	420.8	775	11.5
Michigan	9,909,877	26,948	271.9	16	22,283	224.9	4,660	47.0
Minnesota	5,457,173	15,438	282.9	13	14,803	271.3	635	11.6
Mississippi	2,994,079	5,530	184.7	50	5,178	172.9	352	11.8
Missouri	6,063,589	15,791	260.4	21	13,715	226.2	2,074	34.2
Montana	1,023,579	2,349	229.5	34	2,166	211.6	183	17.9
Nebraska	1,881,503	4,252	226.0	35	4,055	215.5	196	10.4
Nevada	2,839,099	5,604	197.4	47	4,999	176.1	605	21.3
New Hampshire	1,326,813	3,985	300.3	9	3,660	275.8	325	24.5
New Jersey	8,938,175	25,930	290.1	12	23,169	259.2	2,761	30.9
New Mexico	2,085,572	4,908	235.3	31	4,637	222.3	271	13.0
New York	19,746,227	69,861	353.8	3	66,344	336.0	3,507	17.8
North Carolina	9,943,964	24,267	244.0	28	23,142	232.7	1,125	11.3
North Dakota	739,482	1,759	237.9	30	1,670	225.8	89	12.0
Ohio	11,594,163	32,438	279.8	14	28,352	244.5	4,081	35.2
Oklahoma	3,878,051	7,826	201.8	45	6,194	159.7	1,632	42.1
Oregon	3,970,239	11,567	291.3	11	10,730	270.3	837	21.1
Pennsylvania	12,787,209	39,176	306.4	8	33,720	263.7	5,453	42.6
Puerto Rico	3,548,397	9,839	277.3	N.R.	9,838	277.3	1	0.0
Rhode Island	1,055,173	3,656	346.5	4	3,420	324.1	235	22.3
South Carolina	4,832,482	10,781	223.1	37	10,209	211.3	572	11.8
South Dakota	853,175	1,974	231.4	33	1,835	215.1	139	16.3
Tennessee	6,549,352	16,184	247.1	26	15,477	236.3	707	10.8
Texas	26,956,958	57,502	213.3	41	53,400	198.1	4,098	15.2
Utah	2,942,902	6,107	207.5	43	5,668	192.6	438	14.9
Vermont	626,562	2,116	337.7	6	2,043	326.1	73	11.7
Virginia	8,326,289	21,309	255.9	23	20,211	242.7	1,098	13.2
Washington	7,061,530	18,975	268.7	18	17,897	253.4	1,077	15.3
West Virginia	1,850,326	4,564	246.7	27	3,818	206.3	746	40.3
Wisconsin	5,757,564	14,677	254.9	25	13,756	238.9	920	16.0
Wyoming	584,153	1,149	196.7	48	1,032	176.7	117	20.0

Sources: July 1, 2014, population estimates are from the U.S. Census Bureau (Release date: December 2014). Physician data are from the 2015 AMA Physician Masterfile (December 31, 2014).

N.R. = Not Ranked

* Physicians whose school type was unavailable (n=58) are included in the total.

Table 1.2

II. Advanced Practice Providers – Cost, Access, and Quality

Across the country, physicians are looking to scale their practices with cost-effective approaches, which results in tough decisions on whom to hire. They have the decision to bring on other physicians or bring in advance practitioners such as physician assistants, nurse practitioners, or registered nurses. The impending physician shortage has changed the old model of physician practices. However, there are many misconceptions that exist with nurse practitioners and physician assistants. The most common is that nurse practitioners and physician assistants are unable to practice at the same level as physicians. Through decades of studies, numbers have shown that, when permitted to practice at the full extent of their training, advanced primary care providers can perform a majority of the tasks that physicians do while providing the same quality of care.

There have also been studies that evaluate patient volumes and how those volumes correlate with practices with advanced practice providers. One study found that adding a nurse practitioner could virtually double the typical patient panel and result in a yearly revenue increase of \$1.65 million per 100,000 enrollees.³⁰ This is not conclusive to all practices that employ advance practitioners and may vary depending on different areas of the country. Physician practices and health care systems also analyze liability risk costs associated with the legal environment to which all health care systems must handle. The liability risk cost for nurse practitioners and physician assistants has been found to be one-third of a primary care physician's liability rate. Advanced providers have remarkably lower rates of malpractice claims and lower costs per claim.

The Office of Technology Assessment (OTA) conducted a study of 26 capitated primary care practices with approximately two million visits by 206 providers, determined that the practitioner labor costs and total labor costs per visit were both lower in practices where nurse practitioners and physician assistants were used to a greater extent.³¹ Based on a systematic review of 37 studies, Newhouse et al (2011) found consistent evidence that cost-

³⁰ Coddington, J. & Sands, L. (2008). Cost of health care and quality of care at nurse-managed clinics. *Nursing Economics*, 26(2) 75-94.

³¹ Roblin, OW., Howard, D.H., Becker E.R., Adams, E., & Roberts, M.H. (2004). Use of midlevel practitioners to achieve labor cost savings in the primary care practice of an MCO. *Health Services Research*, 39, 607-26.

related outcomes such as length of stay, emergency visits, and hospitalizations for NP care are equivalent to those of physicians.³²

The American Association of Colleges of Nursing (AACN) has long reported that NP preparation costs 20-25% that of physicians. Nurse practitioners and physician assistants perform many of the same services as a physician in the primary care setting with comparable outcomes, yet the cost of educating them is much lower. Studies have shown that the total tuition cost for a nurse practitioner's preparation was less than one year of tuition for medical (MD or DO) preparation.³³ On average, nurse practitioner programs for one-year resident tuition in a public university range between \$8,671 and \$11,077, based on the type of program (AACN, 2015). The number of nurse practitioners (NPs) licensed in the United States has nearly doubled over the past ten years, rising from approximately 106,000 in 2004 to more than 205,000 in 2014. In addition, roughly 17,000 men and women graduated from NP programs during the 2013–2014 academic year.³⁴ These statistics indicate that advanced primary care providers are a cost-effective solution to the health care workforce shortage.

III. Telehealth – Cost-Effective Opportunities

Telehealth is transitioning from its adolescence and quickly gaining the attention of major players in the health care industry. For many patients, telehealth has provided almost instant opportunities that offer better access to providers. And for payers, it has been an effective way to monitor and offer early intervention. The benefit for providers has been that telehealth is an easy way to connect with patients more often. There has been particular success for telehealth in regards to how it has changed the way patients with chronic conditions manage their health. About 26% of physician visits each year are due to hypertension, and replacing just one of those visits per patient could save about \$300 million annually, according to an Accenture report titled, “Virtual Health: The Untapped Opportunity to Get the Most out of

³² Larkin, H. (2003). The case for nurse practitioners. *Hospitals and Health Networks*, (2003, Aug.), 54-59

³³ American Association of Colleges of Nursing (nd). *Nurse Practitioners: The Growing Solution in Health Care Delivery*. Retrieved February 7, 2013, from <http://www.aacn.nche.edu/media-relations/fact-sheets/nurse-practitioners>

³⁴ American Association of Nurse Practitioners (AANP). (2015b). *2013–14 National Nurse Practitioner Practice Site Census*. Retrieved from <http://www.aanp.org/images/documents/research/2013-14nationalnpcensusreport.pdf>

Health Care.” Using a combination of services—perhaps an annual in-person visit with a primary care provider (PCP) and ongoing maintenance care throughout the rest of the year via electronic visits—could potentially save \$2 billion in health care spending; that’s equivalent to 24,000 PCPs, or 11% of the primary care physician workforce.³⁵

Proponents of telehealth and its benefits, including cost-effectiveness, argue that the technology can help contain costs by providing specialty care at local health facilities by remote video monitoring. One major advantage that can be evaluated is the cost savings in patient transportation. This can be beneficial for patients who need to be transported from one health care facility to another, as well as patients who have to travel to primary care providers and specialists. The Department of Veterans Affairs (VA) health care system provides beneficiary travel reimbursement (“travel pay”) to qualifying patients who must travel to appointments. Travel pay is a large expense for the VA and subsequently the U.S. government, costing nearly \$1 billion in 2015.³⁶ A pilot program conducted at the VA hospital in White River Junction, Vermont, studied the cost-effectiveness of using a telehealth program to reduce its travel expenses. The study resulted in the findings of average travel savings of 145 miles and a time savings of 142 minutes per visit. This led to an average travel payment savings of \$18,555 per year. Telemedicine volume grew significantly over the study period such that by the final year, the travel-pay savings had increased to \$63,804, or about 3.5% of the total travel-pay disbursement for that year.³⁷

³⁵ Managed Healthcare Executive;Feb2016, Vol. 26 Issue 2, p17.

³⁶ Department of Veterans Affairs. FY 2014 funding and FY 2015 advance appropriations request. Available at www.va.gov/budget/docs/summary/Fy2015-VolumeII-MedicalProgramsAndInformationTechnology.pdf (last accessed November 12, 2014).

³⁷ Wootton R, Bahaadinbeigy K, Hailey D. Estimating travel reduction associated with the use of telemedicine by patients and healthcare professionals: Proposal for quantitative synthesis in a systematic review. *BMC Health Serv Res* 2011;11:185.

IV. Data Analysis of Telehealth Programs – MedStar Health & the U.S. Department of Veterans Affairs

MedStar Health is the largest health care provider in Maryland and the Washington D.C. metro area. The ten medical centers within the MedStar Health system are regionally and nationally recognized. David Brennan, Director of Telehealth Initiatives at MedStar Health, explained the current outlook of telehealth services. “The current footprint at MedStar is wide but shallow in the division of primary care. MedStar is not doing anything remotely. MedStar currently contracts with the e-visit American Well platform right now that is used purely for urgent care. American Well offers software, services, and access to clinical services—everything a health system such as MedStar needs in telehealth services. It is essentially a front door to a prompt care office. MedStar prompt care is equivalent, but far superior to, a CVS Minute Clinic, like onsite imaging. But it doesn’t connect you with your known physician. We have a small pilot where our endocrinologists through the MedStar diabetes pathway are doing diabetes education sessions with known patients. That’s an encounter that’s a time-based 60- or 90-day pilot. We are trying to offset the traditional office visit with video-based appointments and replace the phone with video and see where there’s value. That’s as close to a care management path MedStar has,” according to Brennan.

In 2015, the Department of Veterans Affairs (VA) was the largest telehealth provider in the federal government, providing 2.1 million telehealth consultations to roughly 677,000 veterans (Zimlich, 2016). The VA has taken steps to utilize cost sharing as a mechanism to incentivize its telehealth services by lowering, and in some cases, waiving copayments for certain programs. There are more than 20 federal agencies, including the VA, that have initiated increased access to telehealth services.

The VA is a division of the United States government and its core mission is to take care of military veterans and their families through medical care. In the interview, Brennan shared the differences in telehealth services that MedStar provides compared to what the VA offers. He stated, “The cost effectiveness for telehealth as a whole is unprovable. We have to get more granular than that. The VA has massive data and huge results on things like remote patient monitoring and care navigation, where you can measure patients by exception across large

populations. In telehealth, you can do pilots all you want, but you don't show any impact clinically or financially until you're really running its scale. The VA has two things going for it: A) its size in terms of patient population; and B) its ability to mine data all on one single record. The most significant part of this is that they are a payer provider, which means it's their money to be seen. Congress says you have "x" amount of people this year with your billions or trillions of dollars to spend. You're more efficient, so they look at that. It's a clear budget line. For a group like MedStar it becomes increasingly challenging."

Brennan continued with saying, "Now, MedStar is beginning to push more into the active payer space with programs like Medicaid plans, medical ACO plans, employee health plans, etc. As we go at risk with a larger number of patients, that's where we can start to reap some of the benefits. Where the VA is really showing money is, for example, a known diabetic patient that costs "x" number of thousands of dollars per week, per month, per year. We know that an emergency department visit, an inpatient visit, and outpatient visit, costs us "x-y-z" dollars. If we can keep them at home longer; if we can triage them effectively by phone instead of the emergency department; if we can prevent those, it's really a nice case control across two groups. So that's where you'll see the most amount of cost-effectiveness."

Analysis of the Results

This thesis reviewed and analyzed a broad range of subjects, from an impending physician shortage in the United States to solutions in increasing advanced primary care providers' responsibilities in delivering primary care services through telehealth. The shortage of physicians was analyzed through a state-by-state breakdown of physicians per patient population; in addition to examining the access, benefits, and costs of utilizing advanced care providers.

The role of a primary care provider is to: deliver preventative care and impart healthy lifestyle choices; identify and treat common medical conditions; assess the urgency of medical problems; and direct patients to the best place for care, such as medical specialists. Advanced primary care providers can perform a majority of the tasks that physicians do while providing the same quality of care. One study, described in the thesis, found that adding a nurse

practitioner could virtually double the typical patient panel and result in a yearly revenue increase of \$1.65 million per 100,000 enrollees. The findings in the analysis section of this thesis outlined the benefits in cost savings, increased patient access, and equal quality of care through utilizing advanced care providers.

A major effort needs to be enforced to remove access barriers to health care. It has been found that roughly 80% of patients lacking primary care access have insurance, so it's a matter of removing barriers to care on the provider side. In analyzing strategies for extending primary care access, health care needs to target services, supplement its workforce, and open access to documentation.

When analyzing reasons for the physician shortages in the America, this thesis found areas in reduced funding for federal aid to GME programs. In addition to these programs not receiving more funding, the thesis also identified the health care industry as being one of the highest percentages for provider burn-out rates. As any industry changes with the times, so has health care and how future physicians view the work-life balance.

It was also identified through an interview with Dr. Nagrani who explains that health care currently works on a concrete platform when it comes to consumer behavior spending. Dr. Nagrani states, "the varying cost of care is substantial—on average, a visit to the ER is \$1400, urgent care is \$200, and a telehealth session is \$49. This cost model is easy for how we will see patients, and in this case a health care consumer views the benefits to lower costs for the same quality of care."

Overview of the Main Results

The main results and findings of this thesis that I found through the review and analysis outline two areas for future change in health care: 1) advanced care providers increased involvement in primary care, and 2) telehealth's continued involvement in benefiting overall cost, access, and quality. Health care systems across the country are developing new practice models that involve non-physicians leading primary responsibilities for preventative care.

The overall benefits in terms of costs as a whole are unprovable. Telehealth continues to gain traction, but is still in too early of a stage to use effective data to analyze and compare its benefits to current health care models.

Another result identified is the need to remove access barriers. The strategies identified as the key outcomes for removing access barriers include: target services by ensuring people have routine and ongoing source of care; supplement the workforce by adding advanced care providers from physician teams to diagnose illnesses; and lastly, open up documentation by developing electronic networks between health care systems.

Through multiple studies associated with telehealth, a comprehensive cost-benefit analysis of its effectiveness still remains elusive. The biggest reason for this is the diverse range of health care systems in which telehealth programs exist. It has been argued that an economic analysis of telehealth in a collective approach is futile and that each health system's program needs to be evaluated individually in its specific setting.

Discussion of the Results

I was able to conclude my original considerations by confirmations made through literature reviews and interviews with industry experts. The gap between the supply of primary care providers and the demand for primary care continues to grow. Through my findings, it has been identified that physician practices need to find a way to increase total patient capacity without sacrificing the quality of health care. In order to effectively adhere to these growing health demands, the role of the primary care physician will need to transition from seeing every patient, to overseeing a team of health care providers. Primary care providers are faced with a difficult situation as they try to meet and exceed overall health care expectations. One solution to overcoming these challenges is to have today's practices concentrate on providing prompt access while maximizing a patient's experience and minimizing the total health care cost. Another solution is to make the field of primary care more attractive through better pay and work-life balance, while also employing better practices of provider teams.

The findings outlined throughout this thesis highlight the need for the health care industry to

utilize the skills of advanced primary care providers and concentrate on value-based cost efficiencies that can be implemented for best practices. The starting point for health care's primary care providers is to organize around subgroups of patients who have similar needs. By grouping patients according to similarities in their needs, primary care providers would then have the ability to develop multiple "needs-based" delivery systems designed to measure and improve what the health care industry truly needs—value. As discussed in the literature review section, the industry's preventative care model is moving from acute care to chronic disease care. The concept of dividing patients into subgroups enables primary care providers to better meet patient needs and enables increased anticipation for appropriate preventative care.

In this thesis' analysis of the impact of telehealth to the health care system, we better understand the history of both telehealth and health care. As Dr. Nagrani mentioned, health care has its rigid structure for a reason—mainly because it's always worked. When considering everything from costs to quality, we start to realize "one size does not fit all" in terms of a solution to growing demand and lessening supply.

The analysis of the two health care systems, MedStar Health and the Veterans Affairs Administration, evaluated the cost-effectiveness and benefits to providing telehealth services. Many factors come into play when deciding on a partner like American Well, and also deciding when it's viable to develop a proprietary telehealth service. The VA is much more advanced in the use of telehealth and has a different situation in terms of regulations providing services across state lines.

As telehealth continues to gain traction and interest from both patients and providers; it will also come upon many limits. Procedures that require physical inspection or other direct contact with a physician, for example, are unlikely to be developed as quickly as procedures like telemental health. As we transition health care needs from acute care to increased chronic cases, preventative care through telehealth will be essential to how we handle cost, access, and quality of care.

Conclusions

The conclusions drawn from this thesis highlight the ability for health care systems to adapt to increased patient access, and quality of service to be validated through decreasing delays and wasted capacity, and increasing patient and physician satisfaction. A solution to the impending physician shortage in the United States can be through e-health applications, such as telehealth. Telehealth represents an efficient and cost-effective means for a continuously shifting health care industry that demands improvement towards patient satisfaction. This is directly correlated to the time and attention that a health care professional can spend with a patient, and to the strength of the patient and provider relationship.

The extensive reduction in physicians cannot be overcome simply by producing more physicians. Through literature review and my own analysis, I have proposed using advanced practice providers such as physician assistants and nurse practitioners to bridge this gap. This thesis has further explored the cost-effective benefits for utilizing advanced practice providers in the primary care field to implement telehealth services.

The health care industry can only speculate on the future of telehealth, but as technological advances close the social divide gap, so will the avenues in how we access global health. We can conclude that as technology advances, so will the way health systems practice better ways in delivering care. Practices will no longer individually identify visits as; phone visits, or video visits, or ER visits. It will all be labeled as global care. Patients would be able to utilize whichever of those tools (video, phone, email, in-person), is the most effective and convenient. Studies show that by 2020, 90% of the world will own a smartphone. The high percentage of smartphone owners defines that the future of how sophisticated sensors and the growing number of peripheral assessments will enable smartphones to monitor a person's health passively, facilitate diagnosis, and connect patients to clinicians when needed.

It has been suggested through my findings that establishing cost-effectiveness through telehealth as a whole is unprovable because the use of these technologies in the health care industry is too early with little data. Health care systems will utilize telehealth to work in

areas to better triage medical conditions that are more cost-effective for both the patient and health care provider. My findings have also brought me to the conclusion that utilizing advanced care providers in primary care services that would typically be accomplished by a physician can, in fact, be done by practitioners in order to improve cost efficiencies.

Recommendations

As policies continue to be updated that better reflect the nation's health care needs, all parties involved will see a general shift on how we use telehealth. The health care systems in America will one day treat both an in-person and a virtual visit the same. There is a need to further analyze the use of telehealth data to better make decisions on its benefits to cost, access, and quality.

An approach to incentivize providers to use telehealth will allow for less spending and better quality of care, which will be carried on to the patient. A huge hurdle outside of new policies and regulations is the marketing of preventative care through telehealth. Our health care environment is built around seeking care when you're sick. This model needs to change if policies in Washington, DC are going to reflect the ACA's mandate to initiate preventative care. The largest dollars are going to chronic care cases, which as explained earlier is costing our system billions of dollars each year. The most important recommendation for this thesis is to continue the positive traction in providing patients better access and quality through telehealth, and disrupt health care's old model of diagnostic care in favor of preventative care that focuses on keeping people healthy.

Appendix A

Interview by Author with David Brennan

Director of Telehealth Initiatives for the MedStar Institute for Innovation (MI2)

Interviewed in Washington, DC on August 16, 2016

Gushti Davidson: What do you think about advanced primary care providers delivering primary care services?

David Brennan: Everything I tell people about the future of healthcare and technology is that we need the right people doing the right things. And that increasingly will be computers and sensors doing things that mid-levels do and then mid-levels doing what doctors are doing, and on the back end have physicians doing what they need to be doing but aren't doing now. So everything's going to shift down-stream. I think there are a lot of things that can be done with non-providers, most of the people doing online urgent care and increasing online primary care are NPs and PAs. It's the same reason doctors are hiring scribes because they don't want to do EHR entry. I'm confident in the not so distant future, probably 5-10 years we'll start to see provider types that have certain credentials that even known yet, showing path ways that are completely different of having care coordinators and navigators doing more of the triage services that go up the ladder.

Davidson: In what areas has MedStar initiated their programs tackle the impending physician shortage?

Brennan: The physician shortage certainly isn't going to be fixed by adding more providers, but with more different kinds of providers. The current footprint of things at MedStar, are wide but shallow in the division of primary care, MedStar is not doing anything remotely. We are through the e-visit American Well platform right now that is purely urgent care. It is essentially a front door to a prompt care office. MedStar prompt care is equivalent but far superior to a CVS minute-clinic, like on-site imaging. So the same thing that you would call your doctor for same day care, you would go to with their prompt care office. But it doesn't connect you with your known physician. We have a small pilot where our endocrinologists

through the MedStar diabetes pathway are doing diabetes education sessions with known patients. That's an encounter, that's a time based 60 or 90 day pilot. We are trying to offset the traditional office visit with video based appointments and replace the phone with video and see where there's value. That's as close to a care management path MedStar has started to initiate.

Davidson: Does this matter because a large percentage of patients don't really care who they see, they just want to be seen?

Brennan: This is really uncharted waters, my opinion is that all the market assessments of virtual visits in which a patient is directly interacting with a provider, also called a teleconsultation, would be provider to provider so that could be the B2B or the B2C or D2C. I think all the assessments around virtual visits are grossly over stated. I think peoples willingness to do a virtual visit far out paces their readiness to do a virtual visit. I know with the shifting demographics as people get older that will eventually happen but right now frankly the millennials don't cost us a cent. These are the people who are unintentionally causing spiraling costs to the healthcare system because the health care system can't get their act together. The providers and the patients right now are not necessarily the demographic we care about. Some of the things we're doing with known patients, where we know we have established relationships.

Davidson: Can you evaluate the cost-effectiveness for telehealth?

Brennan: Cost effectiveness for telehealth as a whole is unprovable. We have to get more granular than that. The VA has massive data and huge results on things like remote patient monitoring and care navigation where you can measure patients by exception across large populations. I say all the time in telehealth, you can do pilots all you want but you don't show any impact clinically or financially until you're really running its scale. And the bigger your scale, you know when your margins are small you have to amplify them with volume. So the VA has two things going for it, A) its size in terms of patient population B) its ability to mine data all on one single record and the most significant part of this is that they are a payer provider. This means, it's the VA's money as they see fit. Congress says you have x amount of

people this year with your billions or trillions of dollars to spend. You're more efficient, so they look at that. It's a clear budget line. For a group like MedStar, it becomes increasingly challenging. MedStar is beginning to push more into the active payer space with programs like Medicaid plan, medical ACO plan, employee health plan, etc. We go at risk with a larger number of patients, that's where I think we can start to reap some of the benefits. Where the VA's really showing money is for example, a known diabetic patient that costs modeled down x number of thousands of dollars per week, per month, per year, if we can keep them at home longer, if we can triage them effectively by phone instead of them coming to an emergency department, we know that an emergency department visit, an inpatient visit, and outpatient visit, cost us xyz, if we can prevent those it's really a nice case control across two groups. So that's where I think you'll see the most amount of cost effectiveness.

Davidson: How do you see telehealth benefiting health care systems?

Brennan: When we are looking at the benefits of telemedicine and it's always access, quality, and cost. Access allows you to overcome geographic disparities to people. We always said if you had a stroke and lived in a four-story walk up in South East DC, you might as well be living on a rural farm because you're not getting to a hospital center easily. Putting money around access isn't so clear. Medicare will pay for travel, along with some other payers will pay for travel, but if they don't have access, costs are born on the patient. If you can remove the access barrier, then you might reduce missed appointments, which impacts clinical efficiency, which there's a dollar on that, which impacts clinical quality, which has a dollar on that. Now up until recently there was no pay for value, there was pay for volume. So if your patients missed an appointment you cared because you weren't generating that charge. Now if your patients miss an appointment, your quality scores will go down. Large health systems that are doing direct to consumer are measuring how the ROI will span. It's a lot of marketing push, public perception, media value, things like that. It's new patient volume, trying to keep your specialist referrals in network, so if a patient goes to a walkup clinic or a Minute Clinic, there's no soft handoff, and they're also looking at emergency department divergence. Trying to steer people to the appropriate point of care for the most appropriate cost for you.

Davidson: How is MedStar utilizing telehealth services to its patients?

Brennan: None of our hospitals at MedStar are rural, so we can't bill Medicare for anything. We can technically bill third party payers for a chunk of stuff because of parity laws in DC, Maryland, and Virginia, but we don't really do it.

Davidson: Why don't you bill?

Brennan: Frankly it's too much work. They know they can't bill Medicare unless you have someone in your office who can filter out your billing. They haven't necessarily communicated with all the payers saying we're now a telemedicine provider. They're not registered with the state of Maryland as a telemedicine provider, so they can't bill Medicaid. We can keep patients where they are instead of unnecessary transfers. In regards to cost-effectiveness, it depends on what your definition of effectiveness. There's operational expenses for the equipment, there's staffing for building clinical capacity for being there to service the patients, and then there's operations support for the program. You certainly have operational costs and clinical costs.

The issues surrounding level-5 consults, which is new to MedStar right now. Even if Medicare opened up to MedStar, would we even want to bill for this? However if we have the ability to sell this as a service beyond MedStar, then it becomes a more sustainable business line, but as far as service to the system, it's going to be about internal efficiencies. They were giving away these consults years ago by phone. Say for example, you're a small rural hospital and you have no neuro specialists on staff, and I approach my CEO and I'm the emergency department director and I say, look we're getting killed with these patients. Example, Medstar neurology wants to bill us 15K a month, for online 24 hours access to their neurologists, should we do it? So it's the cost-effectiveness of his 15K buy. There's enough businesses out there that are making huge amounts of revenue over providing this specialists staffing like, neuro call, psychology, infectious disease, etc. You look at a system for where you have gaps in care and long delays and if you can push volume more appropriately to handle the volume you have, you can move your clinical needles the way you need to and you can handle volume better.

You can make up your efficiency on the back end, and keep your margins pretty low. Then it makes sense to do that.

I know there are huge things lacking in cost-effectiveness but if it becomes an operational part of doing business then it really doesn't get questioned. For example, how many people ask if electronic health records are effective? Or new safety measures for hand washing is cost-effective? They're making a positive improvement. At some point hospital administrators have to make the leap and say this is the way we're going to do it in order to stay efficient and to stay competitive. If you're a small regional hospital and you're not getting any inbound calls because the ambulances keep driving by because they know you don't have access to a level-1 neuro, well now if you do virtually, you can now take the business. And it keep it local.

Davidson: Where does MedStar's competition stand in regards to providing its patients with telehealth services?

Brennan: John Hopkins has a very dispersed approach to telemedicine. They have a big international footprint. They own and manage some hospitals in the Middle East, so they were doing live video as part of their very large contracts with those providers. Hopkins has a lot of political stuff going on. University of Maryland has an advanced e-ICU project, so they monitor ICU beds virtually, which has been around for 20 years. They monitor the beds at St. Mary's believe it or not. They've tried to bolt on the telestroke to that. Inova is doing some interesting things in behavioral health. They're trying to take behavioral health into primary care.

Davidson: What are some things MedStar is doing to differentiate from their competitors?

Brennan: The number of lab orders that aren't filled by patients is astronomical. MedStar's doing a pilot with a company called Igbo, which is essentially Uber for phlebotomy. For example, when the patient leaves the appointment and is ready to check out, the nurse at the desk says we need your lab work done, here's all of your blood work locations such as LabCorp near you or if you want, we're doing something with this company called Igbo and they'll come to your office. The benefit with that is that they'll do the lab draw and bring the

blood back the MedStar. MedStar will then do the assay. MedStar makes the money on the assay. Currently at a place like Labcorp, you don't get anything, just the results, but now Medstar get the results and makes a little bit of money. Models like that are being implemented. If you look at referrals that aren't met across the system, such as primary care office, which is a huge one. Behavioral health is a marketed need across the whole system. If we can get those services delivered in the emergency room or in the primary care office, that'll get us a couple steps ahead of where we want to be.

Davidson: Where do you see the future of telehealth?

Brennan: I see telehealth being a part of everyday care. I still think the market is really young. The challenge in health care is that everything in digital health is contingent on people thinking differently on the where, when, who, and why in accessing health care. It's still only that you see a doctor when you're not well. The way our medical model works today. You're not incentivized to stay healthy. No one cares about you when you're healthy. It's out of sight out of mind. And most patients are healthy. The people who aren't are the ones who need the most acute care. You either target the high utilizers, these are sort of your worried well. Or there are these other people you don't care about. Health care systems are going to need tools to let them be involved and engaged in people's lives at all moments. This is where we start talking about home-based sensors. This will allow getting feedback loops whether you're healthy or not. It's not just you're tracking whether you've walked 10,000 steps and you get a buzz on your wrist. It's more engagement with the provider. There's also the question whether models will shift to concierge subscription based care, I don't know yet. I don't know how well people are going to take that. It's attractive because you have income coming in. It's an insurance model. You make money on the healthy and lose money on the sick and hopefully you balance out.

Appendix B

Interview by Author with Dr. Sachin Nagrani

Physician and Director of Health IT for the MedStar Institute for Innovation (MI2)

Interviewed in Washington, DC on July 21, 2016

Gusztai Davidson: What's your definition of telehealth and how is it being used at the hospital?

Dr. Sachin Nagrani: Telehealth is a broad term. If you we're talking about the broadest definition, it would be delivering care remotely. In regard to video conferencing, electronic health records (EHR) had asynchronous for viewing of labs, secure communications, so that has existed longer than EHR has. The hot ticket item now is asynchronous video. So like a Skype, Face-time videoconference. And the reason that's so hot right now is because it's reimbursable. There's been a domino effect of state legislature that has sort of made it mandatory. Over 40 states now reimburse. I think the reason behind this now, is it's the closest to an in person visit as far as using the Internet to take care of people. This is the most mirroring of an in-person visit.

Davidson: How involved is MedStar and what telehealth company do you use?

Nagrani: In regards to what we have [MedStar] as a system, it's a partner with American Well, one of the larger vendors in telehealth. One of the advantages with partnering with American Well is that it comes with 24/7 provider support. So when the physicians on the MedStar side are not available, they have their own physicians available. They of course pick up the payment for that, but it gives patients another option. Eventually the goal would be to have MedStar delivering all of the telehealth services.

Davidson: Where do you see physician shortages effecting healthcare access in the next 10 years?

Nagrani: We don't only have enough physicians; we're not equitably distributed, for the care that is needed to be delivered. For example the cluster on the coasts, compounding the issue of not having enough physicians, is the fact that the map distribution is poor in regards to the population centers on the coasts but the degree of physician distribution is even higher skewed in that direction.

The lead time to train physicians is incredibly long and very expensive as well. You have your four-year college, four-year medical school, and then three to five year residency, and when you're talking about primary care it's going to be three years, you're talking about 11 years post high school. Outside of the personal burden of time and finances, you also have the GME costs that are funded by Medicare, of training all of these physicians.

You have NP's and PA's licensed and available coming in to fill a need, but at the same time, they're following the same patterns physicians' follow, which is inequitable distribution. We're talking about a NP graduating from school is still going to be making more money doing cardiology or orthopedics, then they are primary care. And so a fellowship in that is more desirable. And so living on the coasts is where the tendency tends to skew, so we still end up with pockets of disparities. The need for care without any provider availability and the brute force of just more advanced practice providers doesn't solve that problem. Telehealth has been one of the avenues through which they've looked at how to deliver care to areas that weren't receiving as much care, but now telehealth become more bending the cost curve, like how do we deliver care more efficiently, regardless of where you are.

Davidson: What are the largest areas the health care system needs to concentrate on?

Nagrani: One of the largest areas that has yet to be addressed, is Medicare reimbursement reform, like payment structure reform. Pay for value, not for care delivery. We all have a feeling it's going in that direction and there are the naysayers that say there were HMO's that came before that just came and went. The dollars that will really skew care in the right direction – there's a lot we can do outside of that but ultimately, money influences behavior. We're not going to look at it like or that was a phone visit or that was a video visit or that was an ER visit, we'll just look at it as global care. And you would just utilize whichever of those tools (video, phone, email, in-person).

MedStar has about 42,000 dependents. They've used their own associates so far that use only acute care. They have through the years scaled up from a small pilot program to a larger more diverse system that covers more. Essentially increased the pilot size. When we talk about cost associated with telehealth, there are a few phases that are going on, so we can narrow it down to video telehealth. There's not a costs improvement impact that has looked into studying the cost effectiveness of telehealth seeing more patients than in-person visits would. Telehealth so far has been effective for increasing patient numbers with concepts of bringing patients in and having them getting into the routines of preventative care through all of the services provided at the hospital/care centers. The acute care prevention is slowly moving towards chronic care prevention. Looking at the statistics of chronic care, it not only cost a lot of money but also cost a lot of lives. 7 out of 10 used to be acute problems; now 7 out of 10 are chronic issues. It has been a full reversal. We used to invest heavily in hospitals and we still are but were now also looking at how can we manage these problems longitudinally and prevent people from getting these chronic diseases because that's where all of the money is being spent.

Davidson: In general, where do you see the future of primary care?

Nagrani: The future will swing towards primary care. Just like general surgery being an example of that just prior to that, at the inception of Medicare in the 1950's, almost all of the board members of the AMA were primarily general surgeons because that was where the power was for acute intervention. And then subsequently, cardiologists, gastroenterologists started developing these tools of catheterization and endoscopy, and now these are high paying specialties, because they greatly impact humanity and mortality. When you look at the problems that face our people in terms of health. I'm not saying or advocating that we should start paying primary care doctors more, but what I think will start happening going forward is you're going to see the healthcare system shift to the needs of people, which is the way it should be.

Davidson: How do you see telehealth and mobile health applications playing a role in health prevention and how primary care providers utilize these technologies?

Nagrani: If you look at everything that goes into a patient going to the physician's office, think about everything from them having to take off of work, leave work, travel there, wait and sit in the waiting room with people who are sick even if they're not sick. They could just be in for something minor like a blood pressure medication refill and they then walk out of the physician's office with that and the flu. They have to fill out paper work. It's sort of a rigid structure for a reason, it's worked well. But it's not a one size fits all solution. All a patient now may need to do is give a few blood pressure readings and a quick chat, and maybe that can fill the gap before you have to see your primary care doctor and go through everything that needs to be done.

Davidson: What is the lowest level medical care provider that can provide these standard requests?

Nagrani: In regards to NPs and PAs that are out there, there are some really good ones out there that can provide what's needed on telemedicine platforms. We want people practicing to the level of their licensure. It's inefficient for a physician to be seeing a bunch of people with pinkeye, while people are out there with complex problems like diabetes are going untreated or uncared for.

Davidson: What are some of the investments being put into telehealth?

Nagrani: Some of the near term returns on investments for telehealth that are being looked at heavily in the industry are, divergent from ER care. So for instance, an ER visit averages a little over \$1,400 a visit, and urgent care, I'm not sure the national average is but I'm guessing in the vicinity of \$200, and an online visit, the industry standard is about \$50. So you have a very concrete platform for where someone looks to go for care and how much it costs. A lot of decisions are skewed by out of pocket costs. If you look at in terms of incentive structures – so if you have a \$0 co-pay to go to the doctor's office, versus these online visits which at the time, don't do real-time authorization and charge your credit card – first it requires you

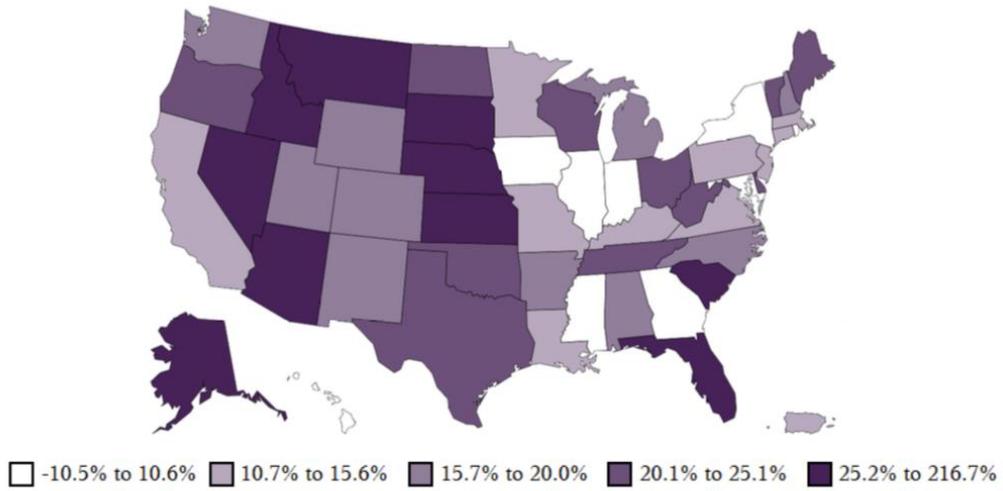
having a credit card, and then it's going to bill you \$50 and then you're going to have to reimburse or submit that to your insurance and go through that phone tag game, versus you going to an office and you've got no out-of-pocket expense upfront, and they deal with the rest. The cost structure will skew towards the office visits. Plus you have the inertia of people's behavior. You know consumers aren't rational, that's the reason behavioral economics exists because if we were just perfectly rational humans there wouldn't be such a thing.

Davidson: What state and national regulations changed since implementing telemedicine and where do you see it in the next 10 years?

Nagrani: Practicing across borders, right now telehealth requires you to have a license in the state where the patient lives, so the physician or care provider doesn't have to be there, just licensed there. There is this compact between states that's being worked out and there is somewhere between the teens of states that have been working together on telehealth. In regards to where telehealth is going, I see retail facing sort of use-it to try and capture early adopters and start building momentum. There is evidence that suggests that's already occurring with regards to American Well individually on their platform. Their total usage this quarter equals their total all of last year. And last year equaled their entire 8 years total prior. You'll get to the point that telehealth will skyrocket and everyone will get in on it and at that point when the competition starts getting broader you'll see the deeper dive into building out into chronic management. Some systems have already done this and primarily these systems received federal grants that were provided. These systems tended to be rural systems were a lot of systems were built to build out telehealth. When we talk about chronic disease management, it's more frequency of touch points. If for example you have diabetes, you would need to go into the office for many touch points, with many doctors. The burden of going in all of these times is what all human would feel; you would be reluctant to go in all the time. Now if it was something as simple as picking up the phone, you might be more engaged as a patient in your own health, longitudinally and what we would want to see from that is better control, lower high-cost visits and lower complication visits, like frequency of heart attacks. You start to see that and the attention and communication from providers is paying off.

Appendix C

Map 3.5.2. Percentage Change in Residents and Fellows in ACGME-Accredited Programs, 2004–2014



Source: 2004 and 2014 AAMC/AMA National GME Census (data extracted in August 2015).

Appendix D

Table I.1. Active Physicians per 100,000 Population by Degree Type, 2014

	Total Population	Total Active Physicians*			Active M.D.s		Active D.O.s	
		Number	Rate per 100,000	Rank	Number	Rate per 100,000	Number	Rate per 100,000
United States	318,857,056	846,686	265.5	N.R.	783,982	245.9	62,644	19.6
Alabama	4,849,377	9,992	206.0	44	9,505	196.0	487	10.0
Alaska	736,732	1,883	255.6	24	1,683	228.4	200	27.1
Arizona	6,731,484	15,754	234.0	32	13,929	206.9	1,822	27.1
Arkansas	2,966,369	5,877	198.1	46	5,599	188.7	278	9.4
California	38,802,500	101,859	262.5	20	97,294	250.7	4,563	11.8
Colorado	5,355,866	14,631	273.2	15	13,430	250.8	1,201	22.4
Connecticut	3,596,677	12,148	337.8	5	11,698	325.2	450	12.5
Delaware	935,614	2,496	266.8	19	2,205	235.7	290	31.0
District of Columbia	658,893	5,596	849.3	N.R.	5,476	831.1	120	18.2
Florida	19,893,297	51,160	257.2	22	46,685	234.7	4,469	22.5
Georgia	10,097,343	22,303	220.9	39	21,335	211.3	967	9.6
Hawaii	1,419,561	4,209	296.5	10	3,993	281.3	216	15.2
Idaho	1,634,464	3,099	189.6	49	2,739	167.6	360	22.0
Illinois	12,880,580	34,970	271.5	17	32,617	253.2	2,350	18.2
Indiana	6,596,855	14,686	222.6	38	13,689	207.5	997	15.1
Iowa	3,107,126	6,557	211.0	42	5,338	171.8	1,218	39.2
Kansas	2,904,021	6,220	214.2	40	5,531	190.5	689	23.7
Kentucky	4,413,457	9,936	225.1	36	9,345	211.7	590	13.4
Louisiana	4,649,676	11,199	240.9	29	11,037	237.4	162	3.5
Maine	1,330,089	4,174	313.8	7	3,481	261.7	692	52.0
Maryland	5,976,407	22,148	370.6	2	21,406	358.2	742	12.4
Massachusetts	6,745,408	29,166	432.4	1	28,384	420.8	775	11.5
Michigan	9,909,877	26,948	271.9	16	22,283	224.9	4,660	47.0
Minnesota	5,457,173	15,438	282.9	13	14,803	271.3	635	11.6
Mississippi	2,994,079	5,530	184.7	50	5,178	172.9	352	11.8
Missouri	6,063,589	15,791	260.4	21	13,715	226.2	2,074	34.2
Montana	1,023,579	2,349	229.5	34	2,166	211.6	183	17.9
Nebraska	1,881,503	4,252	226.0	35	4,055	215.5	196	10.4
Nevada	2,839,099	5,604	197.4	47	4,999	176.1	605	21.3
New Hampshire	1,326,813	3,985	300.3	9	3,660	275.8	325	24.5
New Jersey	8,938,175	25,930	290.1	12	23,169	259.2	2,761	30.9
New Mexico	2,085,572	4,908	235.3	31	4,637	222.3	271	13.0
New York	19,746,227	69,861	353.8	3	66,344	336.0	3,507	17.8
North Carolina	9,943,964	24,267	244.0	28	23,142	232.7	1,125	11.3
North Dakota	739,482	1,759	237.9	30	1,670	225.8	89	12.0
Ohio	11,594,163	32,438	279.8	14	28,352	244.5	4,081	35.2
Oklahoma	3,878,051	7,826	201.8	45	6,194	159.7	1,632	42.1
Oregon	3,970,239	11,567	291.3	11	10,730	270.3	837	21.1
Pennsylvania	12,787,209	39,176	306.4	8	33,720	263.7	5,453	42.6
Puerto Rico	3,548,397	9,839	277.3	N.R.	9,838	277.3	1	0.0
Rhode Island	1,055,173	3,656	346.5	4	3,420	324.1	235	22.3
South Carolina	4,832,482	10,781	223.1	37	10,209	211.3	572	11.8
South Dakota	853,175	1,974	231.4	33	1,835	215.1	139	16.3
Tennessee	6,549,352	16,184	247.1	26	15,477	236.3	707	10.8
Texas	26,956,958	57,502	213.3	41	53,400	198.1	4,098	15.2
Utah	2,942,902	6,107	207.5	43	5,668	192.6	438	14.9
Vermont	626,562	2,116	337.7	6	2,043	326.1	73	11.7
Virginia	8,326,289	21,309	255.9	23	20,211	242.7	1,098	13.2
Washington	7,061,530	18,975	268.7	18	17,897	253.4	1,077	15.3
West Virginia	1,850,326	4,564	246.7	27	3,818	206.3	746	40.3
Wisconsin	5,757,564	14,677	254.9	25	13,756	238.9	920	16.0
Wyoming	584,153	1,149	196.7	48	1,032	176.7	117	20.0

Sources: July 1, 2014, population estimates are from the U.S. Census Bureau (Release date: December 2014). Physician data are from the 2015 AMA Physician Masterfile (December 31, 2014).

N.R. = Not Ranked

* Physicians whose school type was unavailable (n=58) are included in the total.

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