



Cost Analysis of Cellulitis Treatment for Medicare Patients

Citation

Tung, Joe. 2020. Cost Analysis of Cellulitis Treatment for Medicare Patients. Doctoral dissertation, Harvard Medical School.

Link

<https://nrs.harvard.edu/URN-3:HUL.INSTREPOS:37364910>

Terms of use

This article was downloaded from Harvard University's DASH repository, and is made available under the terms and conditions applicable to Other Posted Material (LAA), as set forth at

<https://harvardwiki.atlassian.net/wiki/external/NGY5NDE4ZjgzNTc5NDQzMGIzZWZhMGFIOWI2M2EwYTg>

Accessibility

<https://accessibility.huit.harvard.edu/digital-accessibility-policy>

Share Your Story

The Harvard community has made this article openly available.
Please share how this access benefits you. [Submit a story](#)

Scholarly Report submitted in partial fulfillment of the MD Degree at Harvard Medical School

Date: 17 February 2020

Student Name: Joe K. Tung

Scholarly Report Title: Cost Analysis of Cellulitis Treatment for Medicare Patients

Mentor Name and Affiliations: Vinod Nambudiri, MD, MBA, Department of Dermatology, Brigham and Women's Hospital, Assistant Professor, Harvard Medical School

Abstract

Title: Inpatient Medicare Spending on Cellulitis: Analysis of 2011-2015 Trends and Volume

Joe K. Tung, BS, Vinod E. Nambudiri, MD, MBA

Purpose: Cellulitis is one of the most common reasons for hospital admission in the United States, accounting for over two million emergency department visits and 650,000 hospital admissions every year. As many of these patients are Medicare beneficiaries given the demographics of cellulitis, we sought to investigate trends in Medicare spending on inpatient cellulitis.

Methods: We analyzed all publicly available reports released by the Center for Medicare and Medicaid Services (CMS) for more than 3,000 hospitals that received Medicare payments from 2011 to 2015. The total number of discharges, total amount charged by hospitals, total payments, and total Medicare reimbursements were identified for cellulitis inpatient admissions. The average hospital charges, payments, Medicare reimbursements, and proportion of charges reimbursed by Medicare over these five years were calculated. Results were stratified according to cellulitis severity.

Results: From 2011 to 2015, the number of cellulitis discharges decreased each year, from 158,608 in 2011 to 139,306 in 2015 (12.2% decrease). This decline was driven entirely by a 14.8% decrease in hospitalizations for cellulitis without major complications, as hospitalizations for cellulitis with major complications actually increased by 9.1%. Despite decreases in total cellulitis discharges, costs charged by hospitals for cellulitis care increased from \$3.53 billion in 2011 to \$3.70 billion in 2015 (4.8%), with average charge per cellulitis admission increasing from \$22,249 to \$26,534 (19.3%). However, total payments and Medicare reimbursements over this time period only increased from \$6,405 to \$7,096 (10.8%) and Medicare reimbursements per admission increased from \$5,265 to \$5,591 (6.2%). The primary driver of this relative decline in reimbursement has been a 2.6% decrease in Medicare payments for cellulitis with major complications. As a result, the proportion of hospital charges reimbursed by Medicare has fallen steadily. In 2011, 23.7% of charges for cellulitis admissions were paid by Medicare, compared to 21.1% in 2015.

Conclusions: Using CMS data, we highlight recent trends in cellulitis admissions, hospital charges, and Medicare reimbursements, stratified by cellulitis complexity. These findings suggest that more cost-effective methods of taking care of patients with cellulitis are warranted, as total payments and Medicare reimbursements continue to decrease, identifying a potential role for dermatologists to enhance quality while decreasing costs.

Table of Contents

5	Section 1: Introduction
7	Section 2: Student Role
8	Section 3: Methods
9	Section 4: Results
13	Section 5: Discussion
15	Section 6: Acknowledgements
16	Section 7: References

Introduction

Cellulitis is a deep infection of the skin most often caused by *Staphylococcus aureus* or *Streptococcus pyogenes*. In immunocompetent patients, the bacteria often gain entry into the dermis by a break in the external skin while in immunosuppressed patients bacteria may seed the skin from the blood.¹ Patients often present with an acute fever before the skin lesion appears, followed by a localized area of inflammation, redness, warmth, swelling, and pain. The diagnosis is often made clinically based on morphologic features and patient history, although sometimes skin or blood cultures may be used to confirm the infectious agent. With systemic antibiotic therapy, the fever usually resolves within one day, while the skin inflammation subsides over one to two weeks.²

Cellulitis is one of the most common dermatologic and infectious diseases that lead to hospital admissions in the United States. It causes over two million emergency department visits every year, and about 14%-17% of these patients end up being admitted to an inpatient unit. The costs of these hospitalizations are rarely looked at and are often unknown to patients and providers.^{3,4}

In 2015, health care costs in the United States were over \$3 trillion and accounted for 18% of the national gross domestic product (GDP). That translates to an annual cost of about \$10,000 per person, and this figure continues to rise as health care costs are growing at 2% faster than GDP. It is well recognized that the United States healthcare system needs to better understand the cost of delivering health care in order to curb these rising costs.

Of the national health care expenditures, Medicare payments account for a significant portion. Currently, Medicare covers 44 million beneficiaries—over 15 percent of the U.S. population. As the U.S. population ages, enrollment is expected to rise to 79 million people by 2030. Medicare spending currently accounts for \$672.1 billion a year, or about 20% of the total national health expenditure.⁵ Many private insurers also base their reimbursement rates on Medicare rates, so understanding drivers of cost for Medicare may have a significant impact not only for Medicare patients, but also for the entire healthcare system.

In this study, we sought to analyze recent trends in cellulitis admissions, hospital charges, and Medicare reimbursements, stratified by cellulitis complexity. By looking at regional variations of cost and the factors associated with different charges and reimbursements, we can identify both high and low outliers of costs. This project will allow us to quantify the extent to which the reimbursement landscape has changed in recent years. This allows us to explore and advocate for best practice standards in cellulitis care in order to minimize costs to the healthcare system. It will also serve as an initial step to analyzing and optimizing value of care, defined as the outcomes important to patients over the costs of delivering these outcomes.

Previously, other studies have looked at the health care costs associated with recurrent cellulitis managed in the outpatient setting.⁶ Although many cases of cellulitis are managed in outpatient clinics, these costs are often lower than inpatient costs and therefore are not major drivers of rising health care costs in the United States. Other studies have examined the hospital admissions rates for cellulitis among specific patient populations. One group used a retrospective population-based study approach to assess hospital costs for non-purulent lower extremity cellulitis. However, the study data was based on the Rochester Epidemiology Project and only included the incidence of cellulitis in Olmsted County, Minnesota. Hospital costs were determined based on a sample size of only 34 patients.⁷ This study aims to expand that study to a national scale using Medicare data and analyze trends through multiple years.

Student Role

Along with my mentor Dr. Vinod Nambudiri, I helped brainstorm the study concept and design. I looked up the publicly available Medicare data from the Centers for Medicare and Medicaid Services website. I had full access to all the data in the study and take responsibility for the integrity and accuracy of the data acquisition, analysis, and interpretation. I created the spreadsheets for data analysis, sorted through them by the variables I found most relevant, assessed correlations for statistical significance, and drafted the report.

Methods

All the data for this project were collected from the Inpatient Prospective Payment System (IPPS) Provider Summary for the Top 100 Diagnosis-Related Groups for fiscal years 2011 to 2015, which are all the publicly available years as of the time of this project (<https://data.cms.gov>). These files included hospital-specific charges and reimbursements for the more than 3,000 U.S. hospitals that receive Medicare IPPS reimbursements, paid under Medicare based on a rate per discharge using the Medicare Severity Diagnosis Related Group (DRG). The spreadsheet includes columns for DRG, provider ID, provider name, provider address (street address, city, state, and zip code), total discharges, average covered charges, average total payments, and average Medicare payments. For cellulitis, the DRGs are further broken down into cellulitis with major complications and comorbid conditions (MCC) and cellulitis without MCC. The lists for what qualifies as MCC are provided here; representative conditions include congestive heart failure, HIV, sepsis, end stage renal disease, and severe malnutrition:

https://www.cms.gov/icd10manual/fullcode_cms/p0031.html

https://www.cms.gov/icd10manual/fullcode_cms/P0036.html

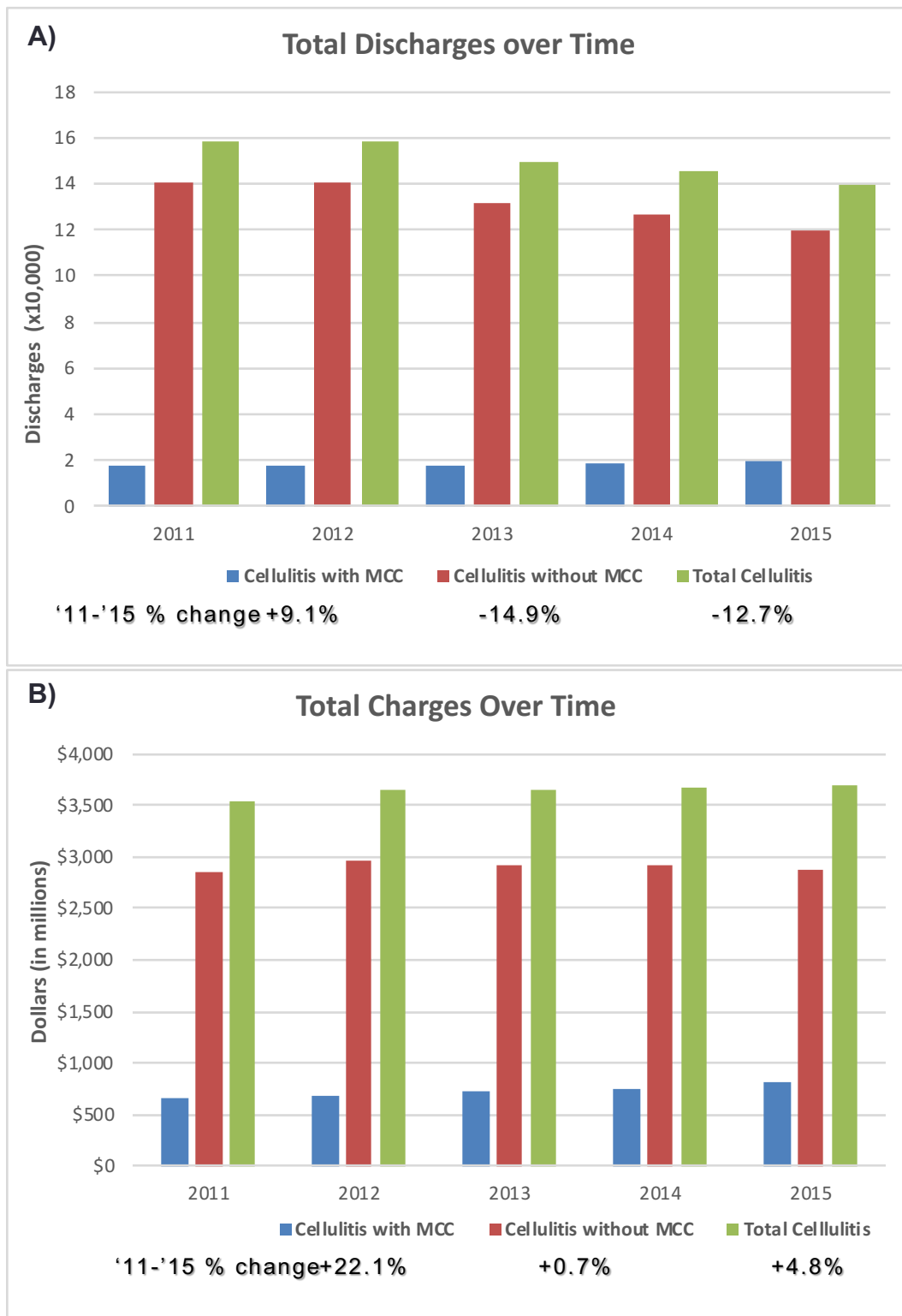
Data Analysis: After sorting through the data and separating out cellulitis with MCC and cellulitis without MCC, cumulative totals for the number of distinct providers, number of discharges, total covered charges, total payments, total Medicare payments, average covered charges, average payments, average Medicare payments, and proportion of hospital charges paid by Medicare were tabulated. The average covered charges, total payments, and Medicare payments were calculated as the sum of these values divided by the total number of discharges.

Biostatistical methods: The sample size includes all the data available publicly from Medicare. This includes 158,608 total cellulitis-related discharges in 2011 from 3752 providers, 158,144 discharges in 2012 from 3712 providers, 149,410 discharges in 2013 from 3631 providers, 145,415 discharges in 2014 from 3622 providers, and 139,306 discharges in 2015 from 3584 providers.

Results

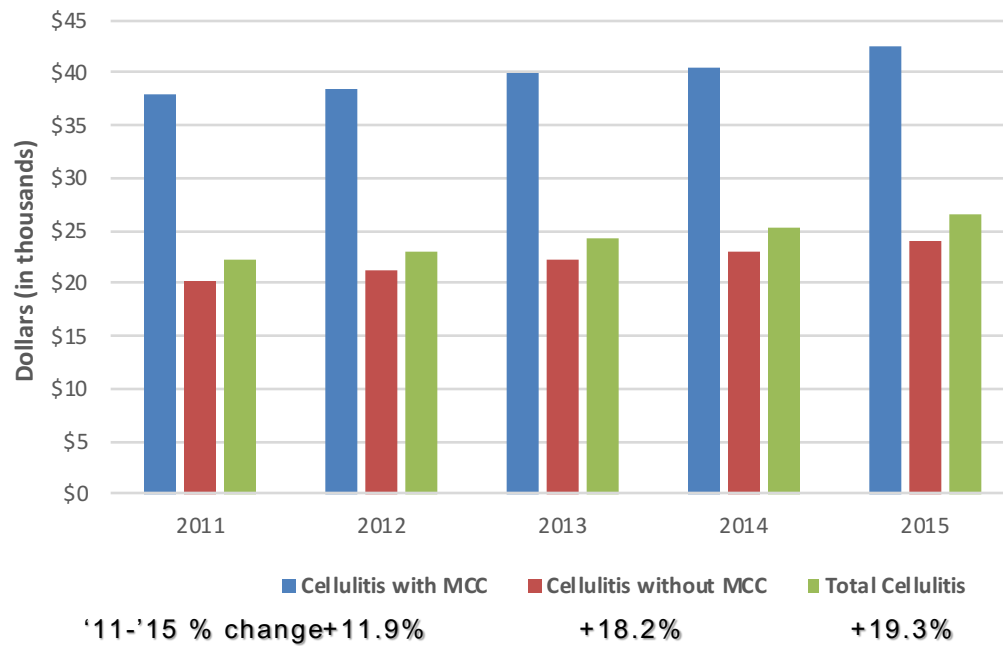
From 2011 to 2015, the number of cellulitis discharges decreased each year, from 158,608 in 2011 to 139,306 in 2015 (12.7% decrease). This decline was driven entirely by a 14.9% decrease in hospitalizations for cellulitis without major complications, as hospitalizations for cellulitis with major complications actually increased by 9.1% (Figure 1A). Despite decreases in total cellulitis discharges, costs charged by hospitals for cellulitis care increased from \$3.53 billion in 2011 to \$3.70 billion in 2015 (4.8%) (Figure 1B), with average charge per cellulitis admission increasing from \$22,249 to \$26,534 (19.3%) (Figure 1C). However, total payments over this time period only increased from \$6,405 to \$7,096 (10.8%) and total Medicare payments decreased by 6.7% (Figure 1D). When accounted for the decrease in volume, the resulting Medicare reimbursements per admission increased from \$5,265 to \$5,591 (6.2%) (Figure 1E). The primary driver of this relative decline in reimbursement has been a 2.6% decrease in Medicare payments for cellulitis with major complications. Consequently, the proportion of hospital charges reimbursed by Medicare has fallen steadily. In 2011, 23.7% of charges for cellulitis admissions were paid by Medicare, compared to 21.1% in 2015 (Figure 1F).

Figure 1. Trends in Cellulitis Hospitalizations, Charges, and Medicare Reimbursements



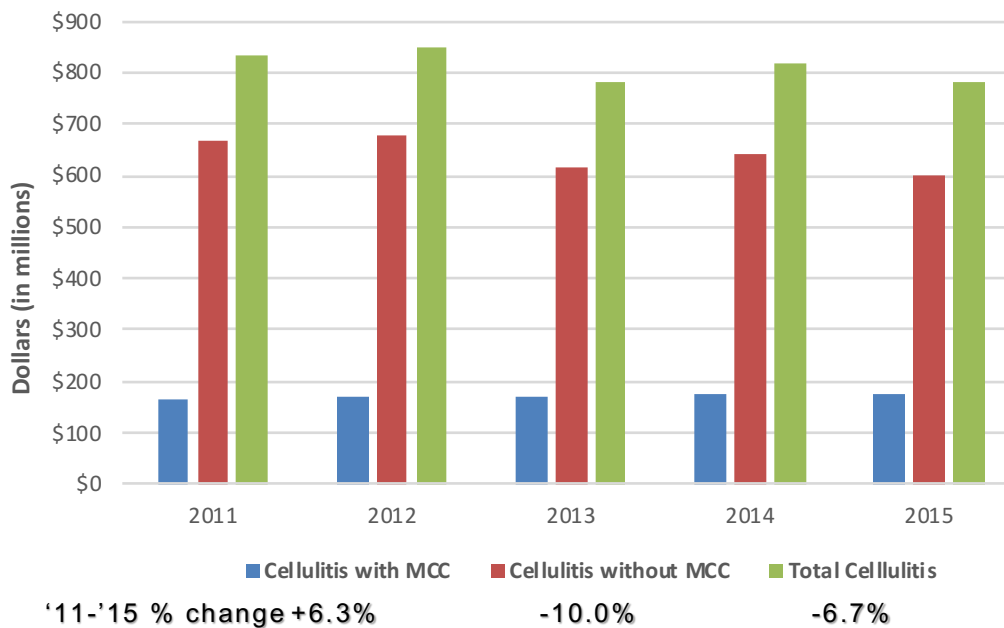
C)

Average Covered Charges Over Time



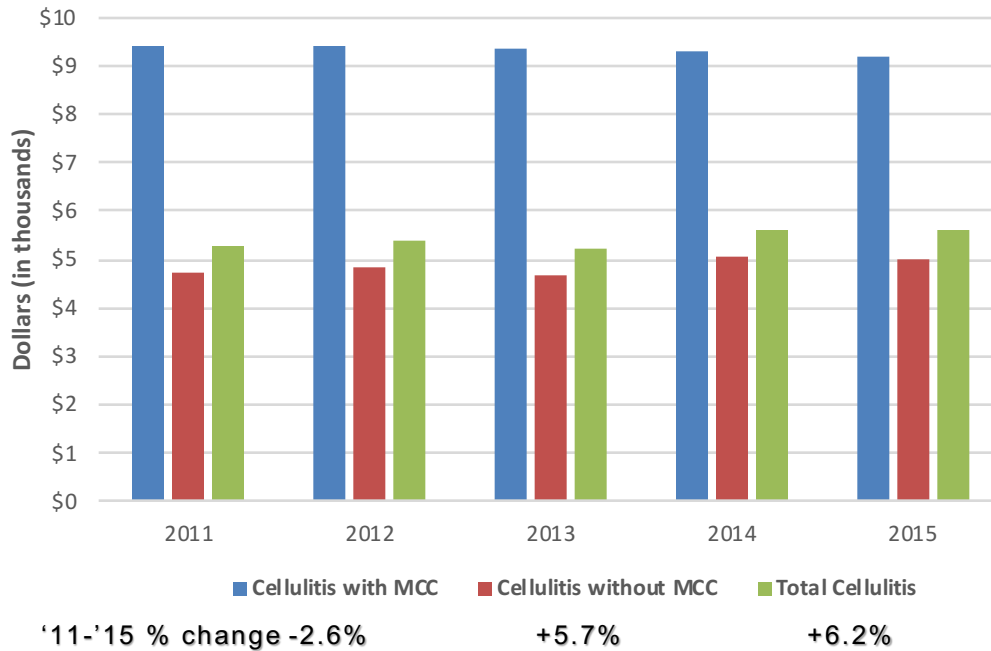
D)

Total Medicare Payments Over Time



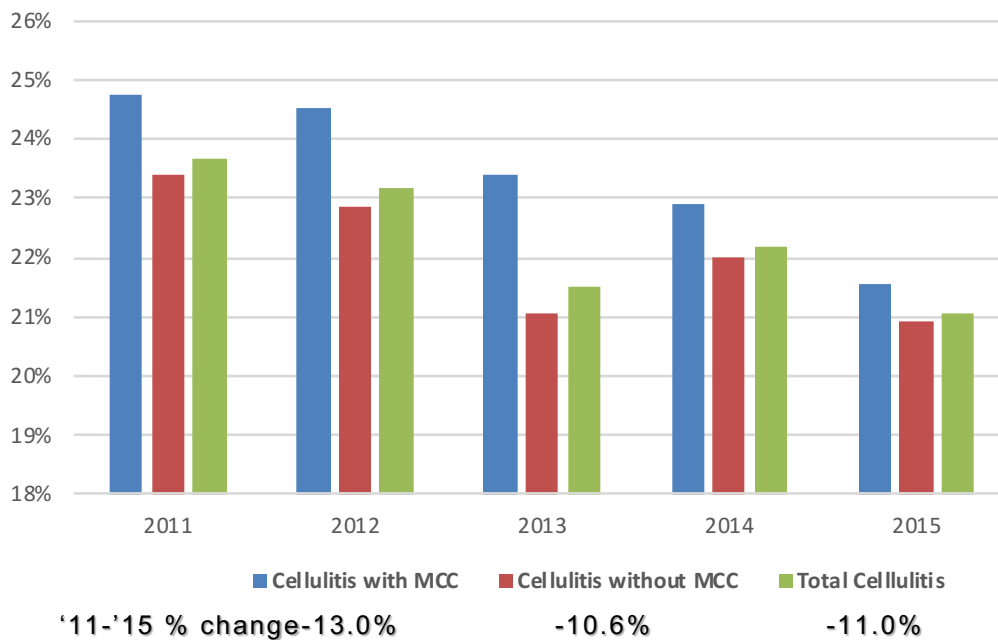
E)

Average Medicare Payments Over Time



F)

Proportion of Charges Reimbursed by Medicare



Discussion

The results of this study have significant management level implications for hospitals in the United States and the overall healthcare system. From 2011 to 2015, the number of total cellulitis discharges decreased each year, and the overall proportion of submitted charges reimbursed by Medicare also decreased. These changes might be partially explained by the enactment of the Affordable Care Act in 2010, in which alternative payment models have become increasingly prevalent.

Alternative payment models compensate providers based on treating a specific medical issue or managing a pool of patients. In a bundled payment system, providers are paid for the care of a patient's medical condition across the entire care cycle. In a capitated model, healthcare providers are compensated with a flat fee per patient per month. In these payment systems, some healthcare providers engage in shared savings and shared risk models. This study quantifies the extent to which these models have contracted reimbursements for cellulitis care.⁸

Because of decreasing reimbursements, going forward, it will be even more important for hospital management to identify potential roles for dermatologists to enhance quality while decreasing costs of cellulitis treatment. One study found that inflammatory dermatoses of the lower extremity are often misdiagnosed as cellulitis and mistreated as a result. These misdiagnoses lead to unnecessary patient morbidity and considerably increased health care spending.⁹ Early dermatologic consultation is instrumental in improving patient outcomes, identifying alternate diagnoses in a timely fashion, and decreasing length of antibiotic treatment for cellulitis diagnoses.¹⁰ These efforts become increasingly important as we shift toward a value-based healthcare system. Hospital managers should consider mandating dermatologist consultation as early in the treatment cycle as possible for potential cellulitis diagnoses.

In the future, correlations between provider size, cellulitis volume, and treatment costs will need to be explored to determine the effects of hospital consolidation on operational efficiency. Regional variations in cellulitis volume, costs, and reimbursements can also be

further detailed to share any learnings from lower cost provider systems with higher cost systems.

There are some limitations of this study due to the study design. One key consideration is that only providers that request Medicare reimbursement were included, and only for cases where the patient has Medicare coverage. Furthermore, hospitals receive a fixed payment for the cellulitis DRG, which do not account for physician services (e.g. use of consults). Discharge destination, alternative treatments for marginal hospitalization cases, and readmission rates would also be helpful to know when thinking about value for a bundled payment system. There are also limitations surrounding risk adjustment for the cellulitis cases. The only risk adjustment possible based on the Medicare data is to separate cellulitis into cellulitis with MCC and cellulitis without MCC. However, this characterization does not fully account for differences that might not fall into the MCC category; for instance, the presence of diabetes, obesity, and hypertension might all impact hospitalization costs and outcomes but would not be possible to distinguish within the dataset.

Acknowledgements

The author would like to thank Dr. Vinod Nambudiri for his mentorship and guidance through this project, Dr. Elizabeth Klerman for reviewing the project and providing her feedback, the Brigham and Women's Department of Dermatology, and the Harvard Medical School Scholars in Medicine Office.

References

1. Marks JG, Miller JJ. Lookingbill and Marks' Principles of Dermatology 6th Edition. Elsevier Health Sciences; 2017.
2. Saavedra A, Wolff K, Johnson R et al. Fitzpatrick's Color Atlas and Synopsis of Clinical Dermatology, Eighth Edition. McGraw-Hill Education / Medical; 2017.
3. Talan DA, et al. Factors associated with decision to hospitalize emergency department patients with skin and soft tissue infection. *West J Emerg Med*. 2015;16(1):89-97.
4. Christensen KL, et al. Infectious disease hospitalizations in the United States. *Clin Infect Dis*. 2009;49(7):1025-1035.
5. Centers for Medicare & Medicaid Services. On its 50th anniversary, more than 55 million Americans covered by Medicare. <https://www.cms.gov/Newsroom/MediaReleaseDatabase/Press-releases/2015-Press-releases-items/2015-07-28.html>. Published July 28, 2015. Accessed February 2020.
6. St John J, Strazzula L, Vedak P, Kroshinsky D. Estimating the health care costs associated with recurrent cellulitis managed in the outpatient setting. *J Am Acad Dermatol*. 2018;78(4):749-753.
7. Challener D, Marcelin J, Visscher S, Baddour L. Hospital costs for patients with lower extremity cellulitis: a retrospective population-based study. *Hosp Pract* (1995). 2017;45(5):196-200.
8. Center for Medicare and Medicaid Services, "Accountable Care Organizations: What Providers Need to Know," Center for Medicare and Medicaid Services website, https://www.cms.gov/Medicare/Medicare-Fee-For-Service-Payment/sharedsavingsprogram/Downloads/ACO-Providers_Factsheet-ICN907406TextOnly.pdf, accessed February 2020.
9. Weng QY, Raff AB, Cohen JM, et al. Costs and Consequences Associated With Misdiagnosed Lower Extremity Cellulitis. *JAMA Dermatol*. 2017 Feb 1;153(2):141-146.

10. Ko LN, Garza-mayers AC, St john J, et al. Effect of Dermatology Consultation on Outcomes for Patients With Presumed Cellulitis: A Randomized Clinical Trial. *JAMA Dermatol.* 2018 May 1;154(5):529-536.