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The Strengths and Limitations of Linking Medicare Claims Data Across Clinical Settings to Study Patients with Pressure Injuries

Author

Squitieri, Lee

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by

Lee Sook Hee Squitieri

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ABSTRACT OF THE DISSERTATION

The Strengths and Limitations of Linking Medicare Claims Data

Across Clinical Settings to Study Patients with Pressure Injuries

by

Lee Sook Hee Squitieri

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Professor Carol Mangione, Chair

Pressure injuries represent a major public health problem among older adults in the United States. Over the past decade, numerous policies and payment reforms have focused on reducing the incidence of pressure injuries and improving their quality of care. Pressure injuries typically occur in medically complex patients that receive treatment from multiple different providers over short periods of time, and the quality of care delivered in one setting may impact measured quality, patient outcomes, and cost/utilization in another. Despite the recent national focus on pressure injury quality of care, there is a paucity of national research evaluating patients with this condition across different clinical encounters and settings of care.

In this dissertation, we explored three distinct research aims using linked Medicare claims data to study pressure injury coding and population characteristics on a national level. The first aim studied consistency of pressure injury documentation across interfacility transfer

encounters. The second aim compared hospital-reported present-on-admission status for pressure injuries to diagnostic history in claims data, and the third aim used linked claims data to study the overall pressure injury population across different settings of care.

Our results demonstrated that pressure injury coding was not consistent across adjacent facility claims highlighting issues of documentation reliability and potential inaccuracy in claims data. We also found a substantial discrepancy between hospital-reported present-on-admission status of pressure injuries and diagnostic patient history in claims data. This finding has important implications for quality measurement and payment reimbursement in the acute inpatient setting, because current quality measures for pressure injuries rely on hospital-reported POA data to evaluate provider performance. Finally, we identified baseline differences in patient demographics, clinical comorbidity, and risk-adjusted mortality among patients diagnosed with pressure injuries in different settings of care that may inform future research, policy, and payment reform.

Taken together these results provide an important overview of the strengths and limitations of linking Medicare claims data to study patients with pressure injuries. The findings of this work may inform future research and quality measure development for pressure injuries and other chronic conditions.

The dissertation of Lee Squitieri is approved.

Daniel A. Waxman

David A. Ganz

Clifford Y. Ko

Jack Needleman

Debra Saliba

Carol M. Mangione, Committee Chair

University of California, Los Angeles

2017

To my husband Matthew and our amazing children Joseph and Isabella.

You make life beautiful.

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- Ludwig Wittgenstein

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Vita

Education and Training

2001-2005	BS, Mechanical Engineering – Massachusetts Institute of Technology (Cambridge, MA)
2004-2004	Study Abroad, Concentration in Writing – Oxford University (Oxford, UK)
2006-2011	MD – University of Michigan Medical School (Ann Arbor, MI)
2009-2010	MS, Health Management and Policy – University of Michigan School of Public Health (Ann Arbor, MI)
2014-2016	Robert Wood Johnson Clinical Scholars Program – University of California, Los Angeles (Los Angeles, CA)
2011-Present	Plastic Surgery Residency, Department of Surgery – University of Southern California (Los Angeles, CA)
2016-Present	Veterans Affairs Advanced Research Fellow – VA Greater Los Angeles Healthcare System (Los Angeles, CA)
2014-Present	PhD Candidate, Health Policy and Management – Fielding School of Public Health, University of California, Los Angeles (Los Angeles, CA)

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Chapter 1. Introduction to Pressure Injuries

1.1 Clinical and Financial Burden of Pressure Injuries in the United States

Pressure injuries, also known as "pressure ulcers", "decubitus ulcers", or "bed sores", are ubiquitous across all health care settings and represent a substantial clinical and financial burden on society. Studies estimate that approximately 1-2.5 million pressure injuries occur each year in the United States.[1-3] Pressure injuries occur most often in elderly patients, patients with chronic illnesses, and patients with functional disabilities, causing them significant pain and increased morbidity/mortality.[4-9] In 2006, the Agency for Healthcare Research and Quality (AHRQ) estimated that 60,000 deaths occur each year from pressure injury related complications, such as localized infection, endocarditis, sepsis, and squamous cell skin cancer.[1]

In addition to clinical issues of morbidity and mortality, pressure injuries are also associated with a substantial increase in the cost of care. The overall financial burden of pressure injuries in the United States is estimated to be between 5 and 11.6 billion dollars annually.[1-2] The cost associated with healing a single pressure injury varies according to patient population and injury severity, ranging from several hundred dollars to $151,000 per pressure injury.[2,10-11] These estimates may be conservative with regard to the true cost of pressure injuries as many do not include additional costs associated with treating chronic pressure injuries that never achieve wound healing or pressure injuries that recur after initial healing.

Given the disproportionate impact of pressure injuries on older adults, Medicare is currently the most common primary payer for patients with this condition. Approximately 4.5% of hospitalized Medicare beneficiaries have a pressure injury diagnosis.[1] Similarly, Medicare represents the primary payer for 74% and 78% of hospitalizations with a pressure injury diagnosis responsible for nearly three quarters of hospitalizations with either a primary or

secondary pressure injury diagnosis, respectively.[12] In the acute inpatient setting, the diagnosis of a pressure injury has been shown to increase both length of stay and cost of care.[1,12] Among Medicare beneficiaries the diagnosis of a pressure injury can add up to $43,180 in costs to a single hospital admission.[1] Due to the large clinical and financial impact of pressure injuries on older Americans, there has been a tremendous emphasis over the past decade to improve quality of care and reduce the occurrence of pressure injuries across all clinical settings.[13-14]

1.2 Nomenclature and Staging Guidelines

Pressure injuries can range from intact skin to an open ulcer with exposed underlying soft tissue or bone. A number of staging systems have been developed to describe pressure injuries and the most commonly used system in the United States is the National Pressure Ulcer Advisory Panel (NPUAP) staging system.[15] Table 1.1 describes the current NPUAP classification for pressure injuries.[15] Stage I represents the most mild form of pressure injury with "non-blanchable erythema of intact skin." Stage II involves partial thickness skin loss with exposed dermis and stage III involves full thickness skin loss with exposed subcutaneous adipose tissue (e.g., fat). Stage IV is the most severe category of pressure injury constituting full thickness skin loss with exposed or directly palpable fascia, muscle, tendon, ligament, cartilage, or bone in the ulcer. When the depth of injury is unable to be determined, the pressure injury may be classified as unstageable.[15] Deep tissue injury describes an area of intact skin with obvious underlying soft tissue damage.[15]

Table 1.1 NPUAP Pressure Injury Stage Definitions[15]

Stage	Description
Stage I	Intact skin with a localized area of non-blanchable erythema, which may appear differently in darkly pigmented skin. Color changes do not include purple or maroon discoloration, these may indicate deep tissue pressure injury.
Stage II	Partial thickness loss of skin with exposed dermis. The wound bed is viable, pink or red, moist, and may present as an intact or ruptured serum-filled blister. Adipose (fat) is not visible and deeper tissues are not visible. Granulation tissue, slough, and eschar are not present.
Stage III	Full thickness loss of skin, in which adipose (fat) is visible in the ulcer and granulation tissue and epibole (rolled wound edges) are often present. Slough and/or eschar may be visible. The depth of tissue damage varies by anatomical location. Undermining and tunneling may occur. Fascia, muscle, tendon, ligament, cartilage, and/or bone are not exposed. Slough or eschar may be present but does not obscure the extent of tissue loss.
Stage IV	Full thickness skin and tissue loss with exposed or directly palpable fascia, muscle, tendon, ligament, cartilage, or bone in the ulcer. Depth varies by anatomic location. Often includes undermining and tunneling. Slough or eschar may be present but does not obscure the extent of tissue loss.
Unstageable	Full thickness tissue loss in which the extent of tissue damage within the injury cannot be confirmed because is obscured by slough and/or eschar in the wound bed. If slough or eschar is removed, a stage III or stage IV pressure injury will be revealed.
Deep Tissue Injury	Intact or non-intact skin with localized area of persistent non-blanchable deep red, purple, or maroon discoloration or epidermal separation revealing a dark wound bed or blood filled blister. Discoloration may appear differently in darkly pigmented skin.

In 2016, the NPUAP held a pressure injury Staging Consensus Conference, where they reviewed and updated all pressure injury stage definitions.[16] They also announced a change in terminology from "pressure ulcer" to "pressure injury" to more accurately reflect the fact that pressure injuries can occur to both intact and ulcerated skin.[17] Then, in 2017 the NPUAP released an additional position statement to clarify that the term "injury" does not imply causation by the health care provider and is meant to emphasize prevention.[18] The statement also asserts that the development of a pressure injury may be unavoidable in some patients and dissociates the numerical staging system from linear progression of pressure injuries (i.e.,

pressure injuries do not necessarily progress in severity from Stage I to Stage IV, nor do they necessarily heal from Stage IV through Stage I).[18]

The current staging system endorsed by the NPUAP is based solely on the extent of tissue involvement visualized or palpated by the clinician assessing the wound.[15,18] Current stage categories do not include objective measures of wound size/depth or body location and clinicians must often rely on education and experience when assessing wound stage.[19] This subjective component of pressure injury stage classification has led to variable interrater reliability among clinicians with different levels of expertise.[20] However, despite potential issues in the reliability of pressure injury stage categories, the current staging system is commonly known across medical specialties and used for diagnostic coding in administrative billing claims.[21-22]

1.3 Etiology and Risk Factors for Developing Pressure Injuries

More than one hundred risk factors for developing a pressure injury have been documented in the literature, many of which are related to at least one of the following principles: immobility, malnutrition, reduced perfusion, and sensory loss.[23] Risk factors are usually classified as either intrinsic or extrinsic (Table 1.2).[24] Intrinsic factors refer to individual patient characteristics that increase the risk of chronic injury to the soft tissue or facilitate poor wound healing.[24] Alternatively, extrinsic factors (external to the patient) refer to environmental conditions that are associated with the pathophysiologic setting of pressure, friction, shearing, and/or moisture.[24]

Table 1.2 Intrinsic and Extrinsic Risk Factors for Pressure Injury Development

Intrinsic Factors	Extrinsic Factors
• Immobility	• Excessive Uniaxial Pressure
• Sensory Loss	• Friction and Shear Forces
• Age	• Impact Injury
• Disease	• Heat
• Body Habitus	• Moisture
• Poor Nutrition	• Posture
• Infection	• Incontinence

Most patients who develop pressure injuries are elderly with numerous chronic medical comorbidities.[4] However, special patient populations with specific medical conditions and/or functional disabilities are also at increased risk for developing pressure injuries, regardless of age, due to their decreased wound healing capabilities and/or limited mobility.[4,25] Despite robust efforts to improve pressure injury prevention over the past decade, many expert clinicians and wound care organizations have suggested that the development of a pressure injury may be unavoidable in some high risk patients.[18,26-28]

Identifying at-risk patients is a critical component of successful pressure injury prevention. A number of instruments to assess patient risk for developing soft tissue injury have been described in the literature.[29-34] However, formal risk assessment tools only cover a limited range of risk factors and their overall effectiveness in preventing pressure injuries has not been clearly established.[29-31,35-36] Thus, formal risk assessment tools are best used in conjunction with clinical judgement when evaluating individual patient risk.

1.4 Treatment Guidelines

Despite robust research and policy efforts to address pressure injury prevention, there is a paucity of national research evaluating the treatment of pressure injuries once they have

occurred.[37-39] The pressure injury population is medically complex and heterogeneous, with a wide range of treatment goals and management restrictions. Each patient has unique medical comorbidities and intrinsic risk factors, and each wound has distinct characteristics (e.g., size, body location, tissue involvement, and local extrinsic risk factors) that often warrant customized care.

Treatment decisions for pressure injuries should consider patient comorbidity, nutritional status, the presence of active infection/osteomyelitis, prior surgical history, and muscle spasm control.[37-39] It is also important to note that wound care often requires active participation from the patient and/or caregiver. Therefore, patient preference, mental status, and social/caregiver support also play a key role in medical decision making.[37-39] Due to the inherent diversity among pressure injury patients and their caregivers, current treatment guidelines are very general without specific evidence-based algorithms or well-defined indications for different interventions.[40-41]

Chapter 2. Pressure Injury Policy and Payment Reform

Pressure injuries currently affect approximately 1-2.5 million patients each year in the United States incurring up to 11.6 billion dollars in annual healthcare costs.[1-3] They typically occur in older patients with multiple comorbidities, and Medicare is the primary payer for approximately 75% of patient costs in the acute care setting.[12] Due to the substantial clinical and financial burden of pressure injuries in the United States Medicare population, a number of national policies and payment reforms over the past decade have focused on reducing the incidence of pressure injuries and improving quality of care for patients with this condition.[1,42-45]

2.1 Hospital-Acquired Conditions Payment Provision (2008)

In 2008, the Centers for Medicare and Medicaid Services (CMS) implemented the hospital-acquired conditions (HAC) payment provision, which applied a claim-based payment penalty to discharge records that contained any one of eight original hospital-acquired complications, termed never events (Table 2.1).[42] Since implementation of the HAC payment provision in 2008, the list of eligible diagnoses continues to expand (Table 2.1).[42] According to the 2005 Deficit Reduction Act, eligible HACs, including advanced stage (III-IV, unstageable) pressure injuries, are required to fulfill two of the three following criteria: 1) high cost, high volume, or both, 2) result in higher hospital payment when present as a secondary diagnosis, and 3) can be reasonably prevented through the application of evidence-based guidelines.[28,42] Under the HAC payment provision, hospitals were no longer able to justify increased reimbursement using a higher tier Medicare severity diagnosis related group (MS-DRG) for patients who developed a HAC during their hospital stay.[10,28,42,46]

Table 2.1 List of Hospital-Acquired Conditions[42]

Hospital-Acquired Condition (HAC)
• Stage III, IV pressure ulcers*
• Foreign object retained after surgery*
• Air embolism*
• Blood incompatibility*
• Falls and trauma*
• Manifestations of poor glycemic control
• Catheter-associated urinary tract infection (UTI)*
• Vascular catheter-associated infection*
• Surgical site infection, mediastinitis, following coronary artery bypass graft*
• Surgical site infection following bariatric surgery for obesity
• Surgical site infection following certain orthopedic procedures
• Surgical site infection following cardiac implantable electronic device (CIED)
• Deep vein thrombosis (DVT)/pulmonary embolism (PE) following certain orthopedic procedures
• Iatrogenic pneumothorax with venous catheterization

* Indicates HAC included in original list of eight complications in 2008

For example, prior to the 2008 HAC payment provision, if a patient admitted for an uncomplicated respiratory infection developed an advanced stage pressure injury during their hospital stay, the hospital was able to code the MS-DRG as a higher tier (i.e., respiratory infection with complication) and receive higher payment. After the 2008 policy, this same case would not be eligible for a higher tier reimbursement because advanced stage pressure injuries are included in the list of HACs covered under the payment provision. In other words, the 2008 payment provision did not decrease baseline facility reimbursement for admissions with a HAC, but it prevented these admissions from receiving increased payment for costs that were presumably associated with the hospital-acquired complication.

2.2 Hospital-Acquired Conditions Reduction Program (2014)

Early evaluation of the 2008 HAC payment provision demonstrated a dramatic reduction in hospital-acquired complications and substantial cost savings for the Medicare program.[47]

Thus, in 2014, CMS implemented an additional payment penalty based on HAC diagnoses.[43] The HAC reduction program (HACRP) calculates a composite HAC score, including advanced stage HAPIs, for each Medicare approved inpatient facility and applies a negative reimbursement adjustment to hospitals in the worst performing quartile.[43] Unlike the original 2008 HAC payment provision which denies increased reimbursement at the claim level for HACs, the HACRP applies a facility level reimbursement penalty to hospitals with poor performance.[42-43] The combined impact of claim-level and facility-level payment reforms for advanced stage pressure injuries through the 2008 HAC payment provision and 2014 HACRP, respectively, have led to widespread adoption of pressure injuries as an important facility-level quality metric over the past decade.

Chapter 3. Pressure Injury Quality Measurement in the Acute Inpatient Setting

3.1 Hospital-Reported Present-on-Admission Indicator

To measure facility quality and evaluate provider performance on an annual basis, payers currently use data derived from billing claims.[43,47] Among Medicare facilities, these administrative datasets are organized at the admission level and do not include patient information outside of the specific encounter.[48-49] For example, in the acute inpatient setting, Medicare discharge records do not reference patient information before or after facility admission. Thus, in order to identify hospital acquired pressure injuries (HAPIs) in the acute inpatient setting and evaluate facility level performance, Medicare began mandatory implementation of a hospital-reported present-on-admission (POA) indicator variable as part of the 2008 HAC payment provision.[42,50-51]

For each pressure injury diagnosis, hospitals must also report a POA variable to distinguish between pressure injuries that pre-dated the facility admission and pressure injuries that occurred during the hospital stay as a hospital acquired complication.[42,50-51] A POA designation of "yes" indicates that the pressure injury pre-dated the hospital stay and exempts the admission from financial payment penalty.[52] A POA designation of "no" indicates that the pressure injury developed during the hospital stay as a complication.[52] Discharge records with an advanced stage pressure injury designation of "no" are not eligible for higher tier reimbursement under the 2008 HAC payment provision.[42] These discharge records are also counted toward the facility level HAPI rate used to adjust overall facility reimbursement under the HACRP.[43,50,53-54]

3.2 Pressure Injury Coding Guidelines

In 2008, the Centers for Medicare and Medicaid Services (CMS), the National Center for Health Statistics (NCHS), the American Hospital Association (AHA), and the American Health Information Management Association (AHIMA) issued POA reporting guidelines in appendix I of the ICD-9-CM Official Guidelines for Coding and Reporting.[55] The original guidelines coincided with implementation of the 2008 HAC POA payment provision and were most recently updated in 2011 for ICD-9-CM and in 2017 for ICD-10-CM.[56-57] These guidelines serve as a set of rules to accompany and complement official conventions and instructions provided within ICD-9-CM and ICD-10-CM itself.[56-57]

For pressure injuries, ICD-9-CM guidelines state that two codes are necessary to completely describe a pressure injury: one corresponding to body location of the pressure injury and one corresponding to pressure injury stage.[56] If a patient is admitted with a pressure injury at one stage and it progresses to higher stage during the same admission, the coding should assign the highest stage reported for that pressure injury.[56] Bilateral pressure injuries with the same stage should have only have one location and stage reported, whereas bilateral pressure injuries with different stages should have one location and two stages reported.[56] Patients with multiple pressure injuries in different body locations should have a body location and stage code for each wound.[56]

POA coding guidelines are also published as an appendix to the official coding and reporting guidelines and the same POA guidelines apply to all HACs.[56] Because the POA indicator is a separate variable that accompanies eligible ICD-9-CM diagnosis codes, the POA guidelines are not intended to provide guidance on whether a specific pressure injury diagnosis should be coded, but rather serve as a guide on how to apply the POA indicator to a final set of

diagnosis codes that have been assigned as part of the official coding and reporting guidelines.[56] Current coding guidelines for the POA indicator allow HACs to be coded as POA if the diagnosis is: 1) a possible, probable, suspected, or rule out diagnosis condition at the time of discharge based on signs, symptoms, findings at admission, 2) an impending or threatened diagnosis at the time of discharge based on signs, symptoms, and findings at admission, and/or 3) a chronic condition, even if not diagnosed until after admission.[56] These details may be able to accurately distinguish POA status for many acute HACs, such as central line associated blood stream infections or catheter associated urinary tract infections. However, the wording of these guidelines may not be sufficient to reliably determine POA status for chronic or recurrent diagnoses, like pressure injuries, and may result in over-reporting of POA status.

3.3 The Agency for Healthcare Research and Quality Patient Safety Indicator 03

Under the 2014 HACRP, facility performance is evaluated using a total score for all eligible HACs.[43,54] The HAC score for each facility includes a composite measure of patient safety indicators, known as the Agency for Healthcare Research and Quality Patient Safety Indicator 90 (AHRQ PSI 90).[43,54] The AHRQ PSI 90 incorporates pressure injury quality of care using the AHRQ PSI 03, which calculates the HAPI rate for each facility at the admission level.[53] Under the AHRQ PSI 03, facility HAPI rates are calculated as the total number of discharge records with an advanced stage (III, IV, or unstageable) pressure injury per 1,000 eligible hospital discharges among patients 18 years and older.[53]

To avoid inappropriate penalization of hospitals that treat disproportionate shares of chronic (i.e., patients with pressure injuries that pre-dated their hospital admission) or high risk pressure injury patients, the AHRQ PSI 03 contains a set of admission exclusion criteria.

Discharge records meeting any one of these criteria are excluded from the facility HAPI rate calculation (i.e., will not be included in either the numerator or denominator). A complete list of exclusion criteria for the AHRQ PSI 03 can be found in Table 3.1, and includes any discharge record with a secondary pressure injury diagnosis where the hospital reported the pressure injury as POA.[53] Therefore, current facility quality measurement and provider performance for pressure injuries is directly influenced by hospital-reported POA data.

Table 3.1 AHRQ PSI 03 Exclusion Criteria[53]

AHRQ PSI 03 Exclusion Criteria
• Hospital length of stay less than 3 days • Principal diagnosis of pressure injury • Secondary pressure injury diagnosis coded as POA • Transferred from another facility • Admitted for pregnancy, childbirth, or puerperium (Major Diagnostic Category 14) • Admitted for a skin disorder (Major Diagnostic Category 9) • Diagnosis consistent with hemiplegia, paraplegia, spinabifida, or anoxic brain injury • Procedure performed for debridement or pedicle graft during same hospital stay

Chapter 4. Preface to my Original Research

4.1 Limitations of Existing Research

Given the substantial clinical and financial impact of pressure injuries on the United States population, many recent policy and payment reforms have targeted pressure injury prevention and quality of care.[1,12,40-45] Over the past decade, pressure injuries have been widely adopted as an important facility quality metric and numerous quality improvement programs have been implemented across all settings of care.[1,14] However, despite recent emphasis on measuring pressure injury quality and evaluating provider performance on a national level, there is a paucity of research evaluating national pressure injury data across different settings of care.[58-61]

Previous studies evaluating pressure injuries have fallen into one of two categories: 1) retrospective chart review or prospective data collection for a sample of patients, or 2) national studies using administrative claims data within a single clinical setting.[2-3, 6-12,28,36,38-39,46] Retrospective chart reviews and prospective data collection allow detailed examination of clinically relevant information and facilitate more meaningful impact on direct patient care.[2-3,6-9,11,28,36,38-39,46] However, these studies are costly and labor-intensive, making them impractical for annual provider performance evaluation on a national level. Furthermore, restriction to a sample of patients renders findings from these studies less generalizable to the total pressure injury population.

Alternatively, secondary data analysis of administrative claims represent a relatively low-cost practical method to annually assess provider performance and evaluation.[10,12] However, the current organization of facility claims at the encounter-level has limited research using these data to cross-sectional analysis of patients within a single clinical setting. Prior to development of the

POA indicator, studies using administrative data to research pressure injuries were only able to report prevalence. However, hospital-reported POA data has allowed more recent analyses to study the hospital-reported incidence of pressure injuries and evaluate provider performance.

4.2 Specific Research Aims

The purpose of this dissertation was to link Medicare claims data across different encounter and clinical settings to study patients diagnosed with a pressure injury. Specifically, we sought to better understand the strengths and limitations of using claims data to study patients with a pressure injury diagnosis. Using Medicare facility claims in the inpatient, outpatient, and skilled nursing facility setting, as well as independent provider claims covered under Medicare Part B, we studied the following specific aims:

Aim 1: Pressure injury documentation consistency in claims data across interfacility transfers.

Aim 2: Hospital-reported pressure injury present-on-admission status vs. diagnostic history in claims data.

Aim 3: Demographics and clinical characteristics of patients with pressure injuries across settings of care.

4.3 Description of Data Sources and Approach

This dissertation utilized administrative Medicare claims data at the patient, facility encounter, and independent provider claim level from 2010-2012.[49] Table 4.1 lists and describes each Medicare data file that was used for this dissertation and Table 4.2 lists the files that were used for each research objective. At the patient level, the Denominator file contains demographic and enrollment information for each beneficiary per calendar year.[49] For facility encounters, the MedPAR and Outpatient files provide clinical diagnosis and procedure information as well as cost data for each facility encounter or admission.[49] The MedPAR file includes inpatient hospital and skilled nursing facility admissions, whereas the Outpatient file includes outpatient facility encounters covered under Medicare Part B.[49]

In addition to claims submitted by Medicare approved facilities, we also used claims submitted by independent providers that may either accompany a concurrent facility claim or represent a unique patient encounter. These claims, located in the Carrier file, include Part B claims from non-institutional providers, such as physicians, physicians assistants, clinical social workers, nurse practitioners, etc.[49] They also include claims from free-standing facilities, such as independent laboratories, ambulance providers, and free-standing ambulatory surgical centers.[49] Each claim contains diagnostic and procedure information for services associated with a specific provider, and patients may have multiple carrier claims submitted by different providers for a single clinical encounter.

Table 4.1 Sources of Medicare Claims Data[49]

File Name	Description	Data Years	Sample	Data Level
MedPAR	Inpatient and skilled nursing facility claims	2010-2012	5%, 100%	Facility encounter
Outpatient	Outpatient facility claims covered under Medicare Part B	2010-2011	5% only	Facility encounter
Carrier	Independent provider claims covered under Medicare Part B	2010-2011	5% only	Provider claim
Denominator	Beneficiary demographic and enrollment data	2010-2012	5%, 100%	Patient

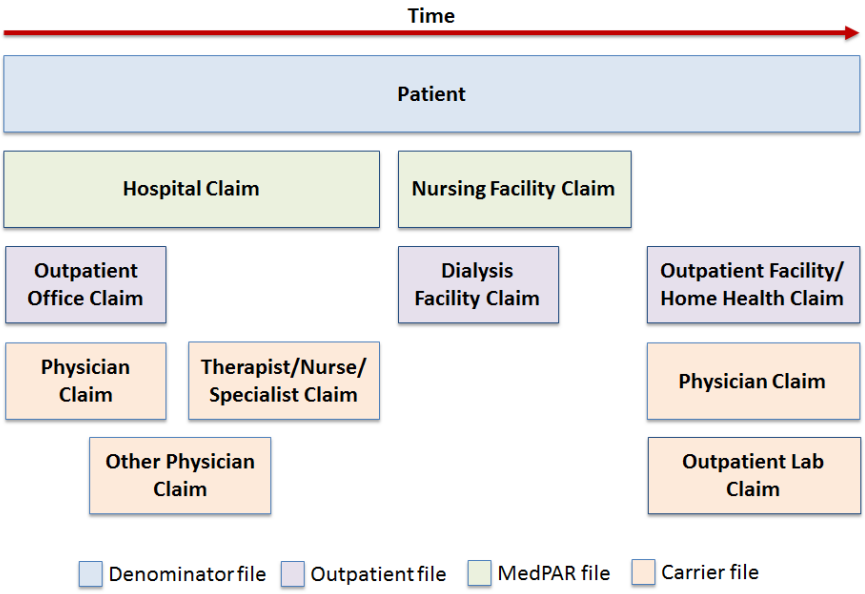
* All files were research identifiable files with a unique patient identifier for linking claims and demographic information

Table 4.2 Data Sources for Each Specific Research Aim

Specific Research Aim	Files Used	Years	Sample	Unit of Observation
Aim 1: Pressure injury documentation consistency in claims data across interfacility transfers	MedPAR	2011-2012	100%	Transfer encounter (pairs of adjacent facility claims)
Aim 2: Hospital-reported pressure injury present-on-admission status vs. diagnostic history in claims data	MedPAR Carrier Outpatient Denominator	2010-2011	5%	Hospital admission
Aim 3: Demographics and clinical characteristics of patients diagnosed with pressure injuries across settings of care	MedPAR Carrier Outpatient Denominator	2010-2012	5%	Patient

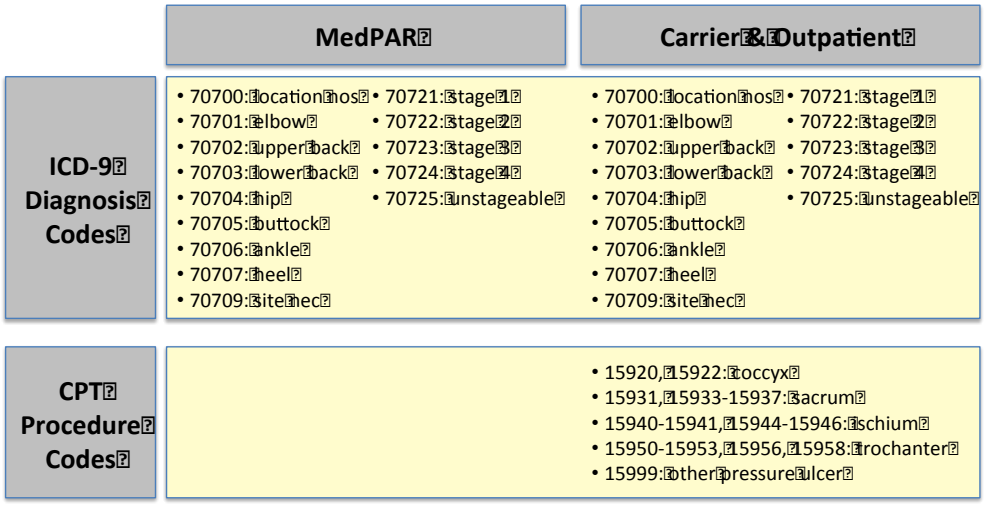
Within each research identifiable file, there is a unique patient identifier variable that allows claims to be linked within and between different files at the patient level.[49] The same patient identifier variable also allows linkage to patient level demographic and enrollment data in the Denominator file.[49] Figure 4.1 provides an illustrative example of linked claims from different files at the patient level. The same clinical encounter may have multiple overlapping claims located in different files and the same patient may have multiple encounters over a defined period of time.

Figure 4.1 Illustrative Example of Linking Medicare Claims Data at the Patient Level



Pressure injuries were identified in claims data using available ICD-9 diagnosis codes and CPT procedure codes contained in each file. Figure 4.2 displays all available ICD-9 and CPT procedure codes for pressure injuries in each data file.

Figure 4.2 Pressure Injury ICD-9 Diagnosis and CPT Procedure Codes



4.4 Significance and Innovation

Pressure injuries represent a major public health problem among older adults in the United States, and are the subject of numerous current policies and payment reforms. Despite recent widespread adoption of pressure injuries as an important measure of healthcare quality, there is a paucity of research evaluating patients with this condition across clinical settings. Linked claims data represent a unique opportunity to examine the pressure injury population across different providers and clinical settings on a national level.

In this dissertation, we describe three distinct methods for linking Medicare claims data across different providers and clinical settings to study patients with pressure injuries. Specific aims 1 and 2 address important issues regarding pressure injury coding in claims data and its impact on quality measurement. The results of these aims provide important information that may inform recommendations to improve pressure injury coding in claims data and drive future quality measure development for pressure injuries. Specific aim 3 uses linked claims to better understand the overall pressure injury population and identify meaningful differences in clinical characteristics that may guide future policy and treatment guidelines.

Chapter 5. Pressure Injury Documentation Consistency in Claims Data across Interfacility Transfers

5.1 Abstract

Background: Hospital-acquired pressure injuries (HAPIs) are publicly reported in the United States and used to adjust Medicare payment to acute inpatient facilities. Current methods used to identify HAPIs in administrative billing claims rely on hospital-reported present-on-admission data instead of referencing prior patient health information. The purpose of the present research was to evaluate coding agreement among interfacility transfers with a pressure injury diagnosis.

Study Design: Using the 2011-2012 100% MedPAR file, we identified all fee-for-service acute inpatient discharge records in 2012 with a pressure injury diagnosis among Medicare patients 65 years and older. We then identified additional facility claims (e.g., acute inpatient, long-stay inpatient, or skilled nursing facility) belonging to the same patient that satisfied one of the following criteria: 1) facility admission within one day of hospital discharge, or 2) facility discharge within one day of hospital admission. Multivariable logistic regression and stratified kappa statistics were used to measure agreement between transferring and receiving facilities in: 1) the presence or absence of a pressure injury, and 2) pressure injury stage.

Results: Among transfers to an acute inpatient hospital with a present-on-admission pressure injury diagnosis reported by the receiving hospital, only 34.0% had a documented pressure injury at the prior transferring facility (kappa=0.03). Similarly, among all transfers with an advanced stage pressure injury documented by the transferring facility, only 30.2% had an advanced stage pressure injury documented at the receiving hospital (kappa=0.17).

Conclusions: The observed discordance in pressure injury documentation and staging between transferring and receiving facilities may indicate potential inaccuracies when using claims data to identify HAPIs and measure provider performance. Future research evaluating the accuracy of claims data across different clinical settings and its impact on quality measurement for pressure injuries should be performed.

5.2 Introduction

Pressure injuries (also known as pressure ulcers, decubitus ulcers, or bedsores) are secondary diagnoses that affect approximately 2.5 million patients each year in the United States and are associated with 9.1-11.6 billion dollars in annual healthcare costs.[1,17] Pressure injuries typically occur in older patients with multiple comorbidities who are frequently transferred between different facilities for ongoing care. Due to the substantial clinical and financial burden of pressure injuries in the Medicare population, advanced stage (stage III, IV, and unstageable) pressure injuries have been widely adopted as a quality measure used to adjust facility reimbursement over the past decade.[42-45]

In 2008, the Centers for Medicare and Medicaid Services (CMS) implemented the hospital-acquired conditions (HAC) payment provision, which applied a claim-based payment penalty to discharge records with an advanced stage hospital-acquired pressure injury (HAPI).[42] Then in 2014, under the HAC reduction program, HAPI rates for each facility were incorporated into a composite HAC score used to adjust overall hospital reimbursement.[43] The current method used by payers to identify HAPIs (and calculate facility HAPI rates) depends solely on information from the billing claim for the acute inpatient hospitalization (i.e., it does not

reference patient information before or after admission).[47,53-54] Therefore, payers must rely on hospitals to accurately document a present-on-admission (POA) indicator for each pressure injury diagnosis listed on the billing claim.[42,50-51] A POA designation of "yes" indicates that the pressure injury pre-dated the hospital stay and exempts the admission from financial payment penalty.[52] A POA designation of "no" indicates that the pressure injury developed during the hospital stay as a complication, making the admission eligible for reimbursement penalty.[52]

Previous research evaluating the accuracy of hospital-reported POA data for pressure injuries has demonstrated inconsistency between hospital-reported POA status in claims data and information in patient medical records.[62-65] A review of administrative data from New York and California found that 86-89% of discharge records with a pressure injury diagnosis were documented by the hospital as POA.[62] However, large retrospective studies of patient chart data suggest that the true POA rate among admissions with a pressure injury diagnosis may be as low as 58-62%.[3,65] Consequently, current pressure injury quality measures relying on hospital reported POA data have an estimated sensitivity of 35.0% and specificity of 95.9%.[64]

Given the important role of HAPIs in quality measurement and provider reimbursement, it is important to measure this condition accurately. Interfacility transfers represent a unique opportunity to evaluate the consistency of coding for chronic conditions and identify potential documentation inaccuracy without medical chart review. The purpose of the present study was to evaluate coding agreement among interfacility transfers with a pressure injury diagnosis using Medicare claims data from different clinical settings (e.g., acute inpatient, long-stay inpatient, and skilled nursing facility). Specifically, we compared POA status reported by receiving acute inpatient hospitals with documentation of a pressure injury at the prior transferring facility. We

also evaluated agreement in pressure injury stage documented by the transferring and receiving facilities.

5.3 Methods

Data Sources and Sample:

We identified all acute inpatient admissions among fee-for-service (FFS) Medicare beneficiaries 65 years and older in the 2012 100% Medicare Provider and Analysis Review (MedPAR) file. Discharge records with a pressure injury diagnosis were identified using ICD-9-CM diagnosis codes 707.00-707.09 and 707.20-707.25. Using a unique patient identifier in the MedPAR Research Identifiable File (RIF), we isolated additional facility claims (e.g., acute inpatient, skilled nursing facility, or long-stay hospital) in the 2011 or 2012 100% MedPAR file that belonged to the same patient and met one of the following criteria: 1) facility discharge date within one day of original hospital admission, or 2) facility admission date within one day of original hospital discharge.[49] A dataset of transfer encounters was created based on pairs of adjacent facility claims.

Measures:

Transfer encounters were categorized into the following groups: 1) skilled nursing facility to acute inpatient hospital, 2) long-stay hospital to acute inpatient hospital, 3) acute inpatient hospital to acute inpatient hospital, 4) acute inpatient hospital to skilled nursing facility, and 5) acute inpatient hospital to long-stay hospital. For each transfer encounter, we collected pressure injury stage at the transferring facility and pressure injury stage at the receiving facility. Among transfers where the receiving facility was an acute inpatient hospital, we also collected

hospital-reported POA status of the pressure injury. Under the 2008 HAC payment provision, POA reporting for pressure injuries is only mandatory for acute inpatient hospitals.[42]

For all acute inpatient hospitals we also collected data regarding facility size (bed count), teaching status, and ownership from the 2012 Medicare Provider of Services (POS) file.[66] Geographic differences in hospital coding patterns were evaluated at the facility level for both transferring and receiving facilities by linking the facility zip code listed in the POS file to the measure of diagnostic intensity developed by Finkelstein and colleagues.[67] This measure assigns an adjustment factor to each hospital referral region. Regions with a higher adjustment factor, or diagnostic intensity, have been shown to have increased numbers of patient diagnoses reported in claims data.[67]

Statistical Analysis:

Descriptive statistics for patient demographics and pressure injury documentation were compared between all discharge records with a pressure injury diagnosis and admissions that also had an associated transfer encounter. Among transfers between acute inpatient hospitals, facility characteristics for both the receiving and transferring hospital were also reported.

To evaluate agreement in the presence/absence of a pressure injury at the time of transfer, we compared POA documentation (yes/no) at the receiving hospital to the presence/absence of a pressure injury diagnosis at the prior transferring facility. Among transfers with a pressure injury documented at the receiving hospital, agreement on the presence/absence of a pressure injury required: 1) a POA pressure injury documented at the receiving hospital and a pressure injury diagnosis at the transferring facility, or 2) a non-POA pressure injury documented at the receiving hospital and no pressure injury diagnosis at the transferring facility. Multivariable

logistic regression at the transfer encounter level was used to model agreement as a function of patient age, race/ethnicity, gender, and transfer category (SNF to acute, long-stay to acute, or acute to acute). We were not able to include other transfer categories in this analysis since pressure injury POA documentation is only required among acute inpatient facilities.

For agreement in pressure injury stage, we categorized stage into early (stage I or II)/missing or advanced (stage III, IV, or unstageable). Among transfers with a pressure injury documented at the acute inpatient hospital, stage agreement required documentation of the same stage category (early/missing or advanced) at both the transferring and receiving facility. Multivariable logistic regression at the transfer encounter level was used to model agreement as a function of patient age, race/ethnicity, gender, and transfer category (SNF to acute, long-stay to acute, acute to acute, acute to SNF, or acute to long-stay). Average marginal effects were used to estimate the adjusted percentage of agreement for each outcome measure (presence/absence of pressure injury and pressure injury stage) by transfer category, controlling for patient age, race/ethnicity, and gender.

Unstratified and stratified (adjusting for patient age, race/ethnicity, and gender) Cohen's kappa coefficients were used to measure agreement in pressure injury documentation.[68-69] Cohen's kappa coefficient for interrater agreement can be interpreted as follows: values ≤ 0 indicating no agreement; 0.01 to 0.20 as poor; 0.21-0.40 as fair; 0.41-0.60 as moderate; 0.61 to 0.80 as substantial; 0.81 to 1.00 as almost perfect.[69] The significance level for all analyses was $p < 0.05$ and all analyses were performed at the admission level using SAS, version 9.4 (SAS Institute Inc.).

5.4 Results

In 2012 there were 175,791 acute inpatient discharge records with a pressure injury diagnosis among FFS patients 65 years and older (Figure 5.1). 144,989 discharge records (82.5%) contained a facility claim within one day of admission or discharge (Figure 5.1). Transfers to (N = 74,772, 51.6%) and from (N = 32,619, 22.5%) skilled nursing facilities were the most common, followed by transfers between acute inpatient hospitals (N = 25,018, 17.3%).

Table 5.1 describes patient demographics, POA status, and pressure injury stage according to the type of sending and receiving facility. Receiving acute inpatient hospitals reported pressure injuries to be POA less often when patients were transferred from other acute inpatient hospitals (68.2%) than from other types of facilities (94.3%) . Among transfers between acute inpatient hospitals, receiving hospitals were generally larger ($p < 0.0001$) with a higher proportion of non-profit ownership ($p = 0.0003$) and teaching affiliation ($p < 0.0001$, Table 2). Diagnostic coding intensity did not differ significantly between transferring and receiving hospitals ($p = 0.7912$, Table 5.2).

Figure 5.1 Sample of Interfacility Transfer Encounters

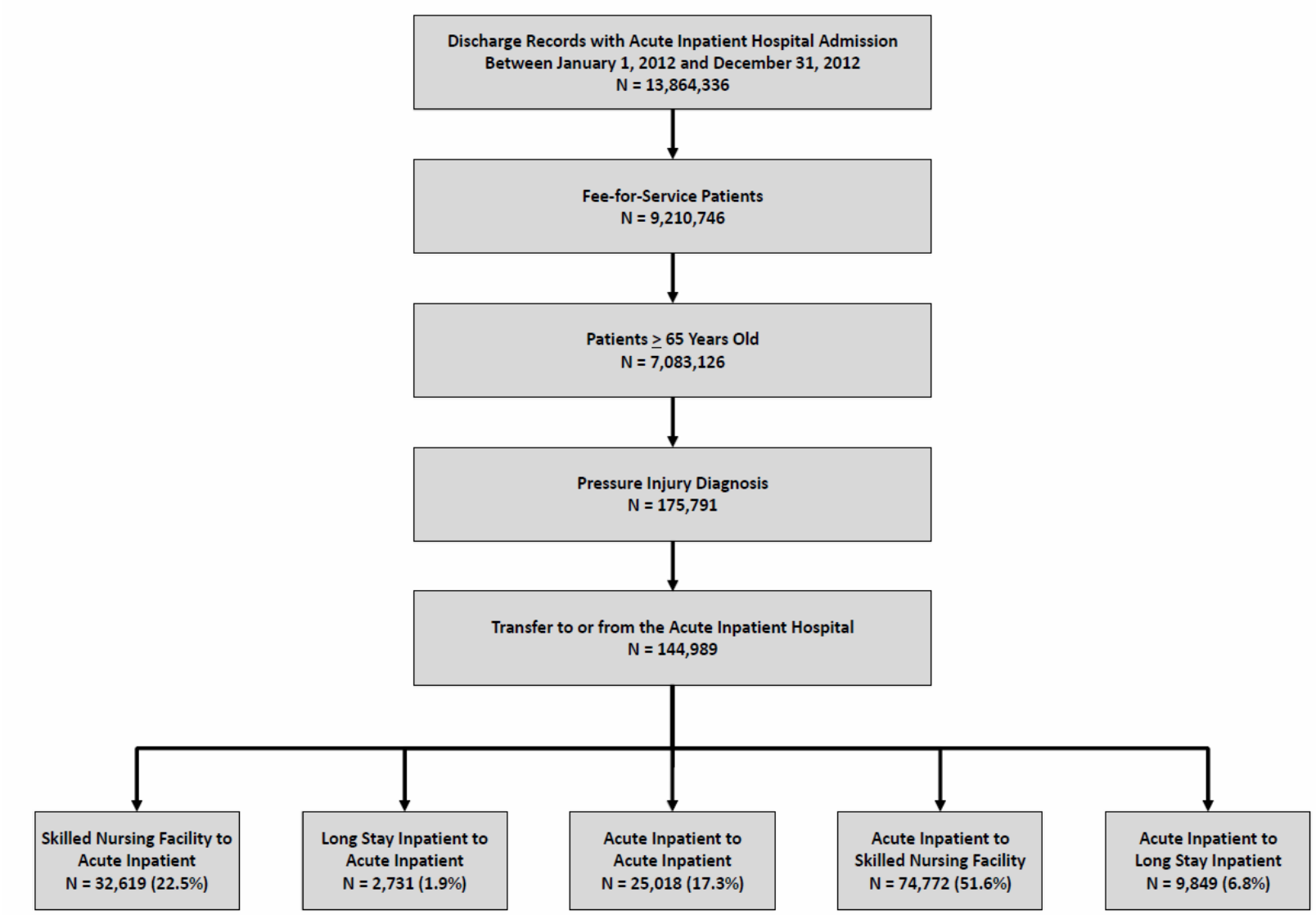


Table 5.1 Characteristics of Acute Inpatient Admissions with a Pressure Injury Diagnosis in 2012

	All Acute Inpatient Hospital Discharge Records with a Pressure Injury Diagnosis N=175,791	Transfers from Other Facilities to Acute Inpatient Hospitals[a] N=35,350	Transfers Between Acute Inpatient Hospitals N=25,018	Transfers from Acute Inpatient Hospitals to Other Facilities[a] N=84,621
Age (mean, SD)	79.5, 9.0	79.0, 8.8	79.2, 8.8	80.0, 8.9
Gender				
Female	101,664 (57.8%)	19,652 (55.6%)	13,535 (54.1%)	49,956 (59.0%)
Race/Ethnicity				
Caucasian	133,525 (76.0%)	26,034 (73.7%)	20,273 (81.0%)	65,640 (77.6%)
Black	31,883 (18.1%)	7,285 (20.6%)	3,436 (13.7%)	14,627 (17.3%)
Other	10,383 (5.9%)	2,031 (5.8%)	1,309 (5.2%)	4,354 (5.2%)
Pressure Injury Stage[b]				
I	25,381 (14.4%)	3,765 (10.7%)	3,651 (14.6%)	11,740 (13.9%)
II	57,636 (32.8%)	10,595 (30.0%)	8,294 (33.2%)	28,156 (33.3%)
III	21,266 (12.1%)	5,009 (14.2%)	2,221 (8.9%)	10,213 (12.1%)
IV	16,337 (9.3%)	4,361 (12.3%)	1,362 (5.4%)	7,541 (8.9%)
Unstageable	8,854 (5.0%)	2,125 (6.0%)	1,193 (4.8%)	4,541 (5.4%)
Multiple reported	15,567 (8.9%)	3,732 (10.6%)	1,513 (6.1%)	7,888 (9.3%)
Missing stage	30,750 (17.5%)	5,763 (16.3%)	6,784 (27.1%)	14,542 (17.2%)
Pressure Injury POA Status[c]				
Yes	158,811 (90.3%)	33,336 (94.3%)	17,051 (68.2%)	
No	9,267 (5.3%)	964 (2.7%)	1,101 (4.4%)	NA
Unable to Determine	1,536 (0.9%)	299 (0.9%)	276 (1.1%)	
Missing	6,177 (3.5%)	751 (2.1%)	6,590 (26.3%)	

[a] Other facilities include skilled nursing facilities and long-stay nursing facilities

[b] For transfers between acute inpatient hospitals and other facilities, data represents the pressure injury stage documented by the acute inpatient hospital. For transfers between acute inpatient hospitals, data represents the pressure injury stage documented by the receiving hospital.

[c] Present-on-admission (POA) reporting is only mandatory among acute inpatient hospitals. Therefore, data only reported for transfers to an acute inpatient hospital. For transfers between acute inpatient hospitals, data represents pressure injury POA status documented by the receiving acute inpatient hospital.

Table 5.2 Facility Characteristics among Transfers between Acute Inpatient Hospitals

	Transferring Inpatient Hospital	Receiving Inpatient Hospital	p-value
Bed Count (mean, SD)	403.3, 330.2	449.8, 347.3	< 0.0001
Ownership (for profit, % total)	4,343 (17.4%)	4,044 (16.2%)	0.0003
Teaching Status (yes, % total)	7,468 (29.9%)	8,761 (35.0%)	< 0.0001
Diagnostic Intensity (mean, SD)[a]	0.98, 0.5	0.98, 0.5	0.7912

[a] Regions with a higher diagnostic intensity adjustment factor have been shown to have increased numbers of patient diagnoses reported in claims data. Values range from 0.867 to 1.107 with a mean of 1.00 and a standard deviation of 0.044.[67]

Table 5.3 demonstrates the concordance between pressure injury POA status documented by the receiving hospital and the presence/absence of a pressure injury at the transferring facility. Among transfers with a POA pressure injury reported by the receiving hospital (N=50,387), only 34.0% (N = 17,112) had a pressure injury documented at the prior transferring facility (stratified kappa = 0.03). Transfers from the skilled nursing facility to the acute inpatient setting had the lowest agreement between POA reporting and prior documentation (19.6% adjusted, stratified kappa = 0.01), and transfers between acute inpatient facilities were the most consistent (64.0% adjusted), but still had a poor level of agreement (stratified kappa = 0.14).

We also found substantial differences in pressure injury staging between transferring and receiving facilities (Table 5.4). Among 25,711 discharge records where the transferring facility reported a single advanced stage pressure injury, only 30.2% (N=7,767) also contained an advanced stage pressure injury documented at the receiving facility (stratified kappa=0.17). Lack of agreement was greatest among transfers between the acute inpatient setting and skilled nursing facilities (Table 5.4). Acute inpatient hospitals with the same motivations and requirements for documenting pressure injuries had the most consistent staging across interfacility transfers (stratified kappa = 0.61, Table 5.4).

Table 5.3 Transfers to an Acute Inpatient Hospital with a Present-on-Admission Pressure Injury Diagnosis

Transferring Facility	Receiving Facility	Transfers with POA PI Reported by Receiving Facility[a]	POA Transfers with PI Documented at Transferring Facility[b]	Unadjusted % Agreement in PI Diagnosis[c]	Adjusted % Agreement in PI Diagnosis[d]	Cohen's Kappa Coefficient[e]
Skilled Nursing Facility	**Acute Inpatient Hospital**	30,948	5,449 (17.6%)	19.6%	19.6%	0.01
Long-Stay Inpatient Hospital	**Acute Inpatient Hospital**	2,388	1,027 (43.0%)	45.7%	45.7%	0.06
Acute Inpatient Hospital	**Acute Inpatient Hospital**	17,051	10,636 (62.4%)	64.1%	64.0%	0.14
Total	**Total**	50,387	17,112 (34.0%)	36.3%	36.3%	0.03

[a] Data represents the number of transfers where the receiving hospital reported a present-on-admission pressure injury diagnosis.

[b] Data represents the number of transfers with a POA PI reported by the receiving hospital that also had a PI diagnosis at the prior transferring facility (% of transfers with a POA PI reported by the receiving hospital).

[c] Agreement in PI diagnosis required one of the following: 1) POA PI documented by receiving hospital and PI diagnosis at transferring facility, or 2) Non-POA PI documented by receiving hospital and no PI diagnosis at transferring facility.

[d] Multivariable logistic regression was used to model agreement in PI diagnosis as a function of patient age, race, gender, and transfer type. Adjusted percentage agreement in PI diagnosis represents the mean predicted probability of agreement for each transfer type times 100%.

[e] Data represents an overall stratified Cohen's kappa coefficient for interrater agreement in PI diagnosis, adjusting for patient age, gender, and race.[68] Strata were weighted by sample size and the age variable was categorized into patients 65-74 years, patients 75-84 years, and patients 85 years and older. Values of Cohen's kappa coefficient can be interpreted as follows: ≤ 0 indicate no agreement; 0.01 to 0.20 as poor; 0.21-0.40 as fair; 0.41-0.60 as moderate; 0.61 to 0.80 as substantial; 0.81 to 1.00 as almost perfect.[69] Unstratified kappa coefficients did not differ from stratified kappa coefficients and were all statistically significant ($p < 0.0001$).

Table 5.4 Transfers with an Advanced Stage (Stage III, IV, or Unstageable) Pressure Injury Diagnosis at the Transferring Facility[a]

Transferring Facility	Receiving Facility	Transfers with Advanced Stage PI Documented at Transferring Facility[b]	Advanced Stage Transfers Also Reported as Advanced Stage by Receiving Facility[c]	Unadjusted % Agreement in PI Advanced Stage Status[d]	Adjusted % Agreement in PI Advanced Stage Status[e]	Cohen's Kappa Coefficient[f]
Skilled Nursing Facility	**Acute Inpatient Hospital**	1,415	1,044 (73.8%)	66.0%	65.9%	0.10
Long-Stay Inpatient Hospital	**Acute Inpatient Hospital**	436	307 (70.4%)	74.9%	74.8%	0.34
Acute Inpatient Hospital	**Acute Inpatient Hospital**	2,369	2,084 (88.0%)	89.2%	89.2%	0.61
Acute Inpatient Hospital	**Skilled Nursing Facility**	18,444	2,350 (12.7%)	74.6%	74.6%	0.14
Acute Inpatient Hospital	**Long-Stay Inpatient Hospital**	3,047	1,982 (65.1%)	76.1%	76.0%	0.48
Total	**Total**	25,711	7,767 (30.2%)	74.8%	74.8%	0.17

[a] Analysis limited to transfers with a single pressure injury documented at both the transferring and receiving facility (N=124,799).
[b] Data represents the number of transfers with a single stage III, IV, or US PI documented at the transferring facility
[c] Data represents the number of transfers with a single stage III, IV, or US PI documented at the transferring facility and a single stage III, IV, or US PI at the receiving facility (% of transfers with a single stage III, IV, or US PI documented at the transferring facility).
[d] Agreement in PI advanced stage status required one of the following: 1) documentation of a single stage III, IV, or US PI at both the transferring and receiving facility or 2) documentation of a single stage I or II PI at both the transferring and receiving facility.
[e] Multivariable logistic regression was used to model agreement in PI advanced stage status as a function of patient age, race, gender, and transfer type. Adjusted percentage agreement in PI diagnosis represents the mean predicted probability of agreement for each transfer type times 100%.
[f] Data represents an overall stratified Cohen's kappa coefficient for interrater agreement in PI advanced stage status, adjusting for patient age, gender, and race.[68] Strata were weighted by sample size and the age variable was categorized into patients 65-74 years, patients 75-84 years, and patients 85 years and older. Values of Cohen's kappa coefficient can be interpreted as follows: ≤ 0 indicate no agreement; 0.01 to 0.20 as poor; 0.21-0.40 as fair; 0.41-0.60 as moderate; 0.61 to 0.80 as substantial; 0.81 to 1.00 as almost perfect.[69]

5.5 Discussion

For older medically complicated patients who receive treatment from multiple different providers over short periods of time, it is vital to ensure accuracy and consistency of patient health data across settings to optimize patient safety. Our results demonstrate poor agreement in claim documentation of pressure injury diagnosis and reported stage across interfacility transfers. This finding may indicate potential inaccuracy when using claims data to identify pressure injuries, and raises concern regarding current methods used by payers to identify pressure injuries in claims data for provider performance evaluation and payment adjustment.

The greatest discrepancy in both pressure injury diagnosis and staging occurred among transfers between skilled nursing facilities and acute inpatient hospitals, which were also the most common type of interfacility transfer. These findings may be the result of different facility motivations to code pressure injuries or varying capacity to maintain properly trained staff to document pressure injuries with good inter-rater reliability. For example, nursing facilities document pressure injuries in both administrative billing claims and patient assessment data (e.g., Minimum Data Set). However, POA documentation for pressure injuries and financial penalties based on claims data only apply to the acute inpatient setting under the HAC POA payment provision. These differences create unique coding behavior in each clinical setting that may contribute to the observed discrepancy in pressure injury documentation. Alternatively, facilities with poor staffing capabilities and inadequate experience with pressure injuries may have unreliable medical record documentation leading to inaccurate billing claims. The relative contribution of each of these issues to our observed results is unable to be ascertained from claims data alone, but is important to address given the role of pressure injuries in quality measurement and payment reform.

Our results also raise considerable concern regarding the accuracy of hospital-reported POA status for pressure injuries in claims data. A previously published review of 51,842 FFS Medicare patient charts in 2006 and 2007 found that among admissions with a documented pressure injury (N=4,810), 62% were POA (N=2,999).[3] This figure represents a substantial difference from our data demonstrating that 90.3% of hospital admissions with a pressure injury diagnosis are reported by the hospital as POA in claims data. The potential inconsistency between hospital reported POA data and information documented in patient charts calls the validity of hospital reported POA data for pressure injuries into question and is an issue that warrants further research.

Our study has several limitations. First, while we demonstrate inconsistency, we cannot measure the relative accuracy of documentation by the transferring or receiving facility. Therefore, we are not able to comment on whether there was over- or under-reporting among any type of facility, and our ability to make specific recommendations regarding improving the accuracy or reliability of claims data is limited. Second, we allowed a time window of one day within hospital admission or discharge for each transfer encounter and were unable to measure smaller increments of time. If a new pressure injury occurred during that time period (e.g., during transport on an inadequate pressure support surface or in the emergency room between transfers), then inconsistent documentation would be valid. We also did not evaluate documentation across more than one interfacility transfer for the same patient. For example, if a patient was hospitalized in the acute setting, then discharged to a SNF, and then rehospitalized, we did not evaluate concordance in documentation between the two hospital facilities. Therefore, the implications of our results are only sufficient to demonstrate inconsistencies in

immediately adjacent facility claims, and not inconsistencies between provider and facility claims or documentation inconsistencies over longer periods of time.

Another limitation is that our method of capturing transfer encounters only included transfers with a pressure injury diagnosis at an acute inpatient hospital. We did not include transfers with a pressure injury diagnosis at another facility type and no pressure injury diagnosis at the acute inpatient hospital. Including such cases would allow a more complete assessment of agreement and potentially further reduce or estimated level of documentation agreement. Finally, if implementation of the 2008 HAC payment provision incentivized acute inpatient hospitals to only report pressure injuries that were POA, then our results may not be an accurate representation of pressure injury epidemiology in the acute inpatient setting.

Despite the above limitations, the methods and results of our study improve upon the existing literature in several ways. Evaluating the consistency of claims data across clinical settings is an easily reproducible approach for payers to study coding patterns, motivations, and inconsistencies that may be useful to understand in the context of value based payment reform. Our finding of greater coding discrepancy among transfers between SNFs and acute inpatient hospitals raise important questions regarding the role of staffing/coding capacity versus different coding motivations between facility types. Furthermore, the substantially different rate of POA pressure injuries reported among transfers between acute inpatient hospitals (68.2%) versus transfers from other facilities to acute inpatient hospitals (94.3%), and the corresponding difference in the rate of missing POA data (26.3% and 2.1%, respectively), deserves further evaluation. Finally, potentially inaccurate coding of hospital reported POA data in administrative billing claims may challenge the results of previously published studies evaluating pressure injury epidemiology and payment reform policy.[10,12] Understanding the magnitude and

impact of inaccurate and inconsistent claims data on quality measures and developing methods to improve these issues will be important for pressure injuries and other chronic conditions moving forward.

Chapter 6. Hospital-Reported Pressure Injury Present-on-Admission Status vs. Diagnostic History in Claims Data

6.1 Abstract

Background: Identification of hospital-acquired pressure injuries (HAPIs) in claims data require accurate documentation of a mandatory present-on-admission (POA) indicator to differentiate between pressure injuries that pre-date hospital admission and pressure injuries that occur during the hospital stay as a hospital-acquired complication. Previous retrospective chart reviews have demonstrated inconsistency between hospital-reported POA data in administrative claims and patient information in medical records. The purpose of this study was to compare hospital-reported POA status to patient diagnostic history in claims data among acute inpatient admissions with a pressure injury diagnosis. We also examined the impact of hospital reported POA data on measured HAPI rates.

Study Design: For this study we used a 5% sample of fee-for-service (FFS) Medicare data from the 2010-2011 MedPAR, carrier, outpatient, and denominator files. We identified acute inpatient hospitalizations with a pressure injury diagnosis in 2011 using ICD-9 diagnosis codes (707.00-707.09, 707.20-707.25). Discharge records with a pressure injury diagnosis were classified as "new diagnosis admissions" if the beneficiary did not have any claim with a pressure injury diagnosis or CPT procedure code (15920-15999) in the MedPAR, outpatient, or carrier file for 365 days prior to admission. We then compared the proportion of new diagnosis pressure injury admissions (based on claims data history) and the proportion of admissions with a hospital-reported HAPI (using the POA indicator). All patients were required to have continuous

Medicare part A and B FFS enrollment for 365 days prior to admission. The unit of our analysis was a hospital admission.

Results: Among admissions with a pressure injury diagnosis, there is a large discrepancy between hospital-reported POA data (5.2% hospital-acquired) and patient history in claims data (49.7% new diagnosis). HAPI rates using the POA indicator are 95.6% lower than previously published data verified in patient records and 89.4% lower than HAPI rates using a new diagnosis classification. Hospital-reported POA status was responsible for 90% of excluded discharge records from current quality measures used to calculate facility HAPI rates.

Conclusions: Potentially inaccurate hospital-reported POA data may result in quality measurement error and inappropriate facility reimbursement penalties. As payers and healthcare organizations expand the use of quality measures it is important to consider how the measures are implemented, coding revisions to improve measure validity, and the impact of patient exclusion criteria on provider performance evaluation.

6.2 Introduction

Over the past decade, payers and healthcare organizations have increasingly used hospital-acquired conditions (HACs) to monitor patient safety and assess quality of care. In 2008, The Centers for Medicare and Medicaid Services (CMS) introduced a claim-level payment penalty that denied increased reimbursement for discharge records that contained a documented HAC.[42] Early results of this program demonstrated a reduction in adverse events and substantial cost saving for Medicare in the acute inpatient setting, supporting expansion of HACs as a

mechanism for value-based payment reform.[47] In 2014, CMS implemented the HAC reduction program, which calculates a facility-level performance score to adjust reimbursed payment in addition to individual claim penalties applied under the 2008 HAC payment provision.[42-43] The HAC reduction program calculates a composite HAC score for each acute inpatient facility and applies negative reimbursement adjustments to hospitals in the worst performing quartile.[43]

HACs eligible for inclusion in the original 2008 payment provision were required to fulfill two of the following criteria: 1) high cost, high volume, or both, 2) result in higher hospital payment when present as a secondary diagnosis, and 3) can be reasonably prevented through the application of evidence based guidelines.[42] Due to the substantial clinical and financial burden of pressure injuries in the Medicare population, advanced stage (stage 3-4 and unstageable) pressure injuries were among the first HACs to be approved under the 2008 HAC payment provision. Subsequent to implementation of this policy, pressure injuries have become widely accepted as an important measure of healthcare quality by payers and organizations across all clinical settings.[3,70] However, unlike many other HACs that represent acute discrete events with clear diagnostic criteria and readily identifiable treatment/complication patterns, advanced stage pressure injuries are more difficult to diagnose and accurately document.

Successful HAC monitoring and valid HAC score measurement require accurate documentation of a mandatory hospital-reported present-on-admission (POA) indicator to distinguish between pre-existing comorbidities present at the time of admission and complications acquired during the patient's hospital stay.[42,50-52] Mandatory reporting of POA indicators has been shown to increase the sensitivity and validity of HAC reporting by facilities, but may be prone to biased documentation when associated with provider performance evaluation and payment adjustment.[63,65,71-72] Furthermore, the accuracy of POA indicator

reporting varies significantly between different types of diagnoses and may be worse among conditions with poor diagnostic inter-rater reliability and conditions with low diagnostic sensitivity in administrative records.[64-65]

Previous studies evaluating the POA indicator for hospital-acquired pressure injuries (HAPIs) have relied on manual chart abstraction from samples of admissions to verify accuracy and found that up to 35% of pressure ulcer admissions may be inappropriately labeled as POA.[64-65] Patient chart abstraction is labor-intensive and impractical to implement on an annual basis for assessment of provider performance. As payers and organizations continue to expand the use of HACs under value-based payment reform, it is important to find practical ways to examine patterns of hospital-reported POA data on a national level with routinely collected data. The purpose of the current study was to compare hospital-reported POA status to patient history in claims data among acute inpatient admissions with a pressure injury diagnosis. We also evaluated the impact of hospital reported POA data on measured HAPI rates.

6.3 Methods

Sample:

We used a 5% sample of fee-for-service (FFS) Medicare claims data from the 2010 and 2011 MedPAR (inpatient and skilled nursing facility encounters), carrier (independent provider claims), outpatient (outpatient facility claims), and denominator (beneficiary demographic information) files.[49] We evaluated acute inpatient hospitalizations between January 1, 2011 and December 31, 2011 and identified admissions with a pressure ulcer using ICD-9 diagnosis codes 707.00-707.09 and 707.20-707.25. Admissions were categorized into three groups: 1) admissions without a pressure ulcer diagnosis, 2) admissions with a "new" pressure ulcer

diagnosis, and 3) admissions with a previously documented pressure ulcer diagnosis. New diagnosis classification required that the admitted patient did not have any pressure ulcer ICD-9 diagnosis or CPT procedure code (15920-15999) in the MedPAR, outpatient, or carrier file for 365 days prior to admission. We limited our analysis to patients over 65 years old. All patients were required to have continuous Medicare part A and B FFS enrollment for 365 days prior to admission, making them at least 66 years old at the time of hospital admission. Our final study cohort included a 5% sample of Medicare FFS patients 66 years and older admitted to an acute inpatient hospital in 2011 with a full year of part A and B FFS enrollment prior to admission.

Measures:

Patient demographics (age, race, sex, and Medicaid dual eligibility) were obtained from the 2011 denominator file corresponding to the year of hospital admission. To assess patient comorbidity, we calculated weighted and unweighted Elixhauser scores using all diagnoses from MedPAR, outpatient, and carrier file claims 365 days prior to and including hospital admission.[73-74] Unweighted scores reflect the raw count of comorbidity categories (range 0-30) and weighted values represent the index score proposed by van Walraven and colleagues.[75] We also calculated each beneficiary's area deprivation index (ADI) as a measure of socioeconomic status, using the beneficiary's residential zip code listed in the denominator file for 2011.[76] The ADI is a validated measure of neighborhood socioeconomic disadvantage composed of 17 U.S. Census data elements regarding poverty, education, housing, employment, and living conditions.[76] Higher ADIs correspond with higher levels of socioeconomic disadvantage and are associated with greater 30-day hospital readmission rates and increased patient mortality.[76-77]

For each hospital admission we used MedPAR data to determine the hospital length of stay and transfer status from another facility. Given the increased prevalence of pressure injuries among nursing home patients, we identified probable nursing home residents by reviewing independent provider claims for 30 days prior to admission and identifying place of service codes and CPT procedure codes consistent with services rendered in nursing home facilities.[78] We also reviewed all outpatient and MedPAR claims for 30 days prior to hospital admission to identify patients recently discharged from another facility.

Among hospitalizations with a pressure injury diagnosis, we obtained the pressure injury stage (ICD-9 diagnosis codes: 707.20-707.25) and POA status recorded in the MedPAR discharge record. Under the 2008 HAC payment provision, hospitals are required to report a corresponding POA indicator status for each pressure ulcer diagnosis code: 1) Y, indicating that the diagnosis was present at the time of admission, 2) N, indicating that the diagnosis was not POA (i.e., hospital-acquired complication), 3) U, indicating insufficient documentation to determine POA status, or 4) W, indicating that the provider is unable to clinically determine whether the condition was POA.[52]

Under the 2014 HAC reduction program, HAPI rates are included in the total HAC score as part of the Agency for Health Research and Quality (AHRQ) Patient Safety and Adverse Events Composite (PSI 90) score.[43,54] This score uses the AHRQ Patient Safety Indicator 03 (PSI 03) to calculate facility HAPI rates at the admission level.[53] The AHRQ PSI 03 calculates HAPI rates as the number of admissions with an advanced stage (III, IV, unstageable) pressure injury per 1,000 eligible hospital discharges among patients 18 years and older.[53] To avoid penalizing hospitals for admissions with a pressure injury diagnosis that was not hospital-acquired, the AHRQ PSI 03 excludes discharge records that meet any one of the following

criteria: 1) if they have hospital length of stay less than 3 days, 2) if they have a principal diagnosis for pressure ulcer, 3) if their secondary pressure ulcer diagnosis is coded as POA, 4) if they are transferred from another facility, 5) if they are admitted for pregnancy, childbirth, or puerperium (Major Diagnostic Category 14), 6) if they are admitted for a skin disorder (Major Diagnostic Category 9), 7) if they have any diagnosis consistent with hemiplegia, paraplegia, spina bifida, or anoxic brain injury, and 8) if they receive a procedure for debridement or pedicle graft during their hospital stay.[53] We used ICD-9 diagnosis codes listed on the hospital discharge record to identify admissions that fulfilled any of the above exclusion criteria.

Statistical Analysis:

Consistent with current methods used by payers and healthcare organizations to evaluate HAPU rates, we used hospital admissions as the primary unit of analysis and allowed multiple admissions per patient.[53-54] Descriptive statistics for patient demographics, admission characteristics, pressure injury stage, and hospital-reported POA status were compared between admissions with a new pressure injury diagnosis, admissions with a previously documented pressure injury diagnosis, and non-pressure injury admissions. Among hospitalizations with a pressure injury diagnosis, we stratified hospital-reported POA status by pressure injury stage. We also identified the number and type of pressure injury admissions (e.g., admissions with a pressure injury diagnosis, admissions with a new pressure injury diagnosis, and admissions with a documented HAPI using the POA indicator) associated with each AHRQ PSI 03 patient exclusion category and examined the impact of these criteria on national HAPI rates. All analyses were performed using SAS, version 9.4 (SAS Institute Inc.).

6.4 Results

In our 5% FFS Medicare sample, we identified 388,191 acute inpatient hospitalizations among patients age 66 years and older with 365 days of continuous Part A and B FFS enrollment prior to hospital admission (Figure 6.1). Among admissions with a pressure injury diagnosis (N=13,972), the proportion classified as "new diagnosis admissions" based on claims history was 49.7% (N=6,945). However, only 5.2% (N=725) of admissions with a pressure injury diagnosis were reported as hospital-acquired using the hospital-reported POA indicator (POA = "N"). Furthermore, 80.6% of admissions with a new pressure injury diagnosis (based on claims history) were reported by the hospital as POA, despite the absence of a pressure injury claim in the MedPAR, carrier, or outpatient file for 365 days prior to hospital admission (Figure 6.1).

We observed increasing levels of comorbidity, hospital use, and nursing home use with advancing pressure injury status from no pressure injury diagnosis, to new pressure ulcer diagnosis, to previously documented pressure ulcer diagnosis (Table 6.1). Non-pressure injury admissions had the lowest level of comorbidity, followed by admissions with a new pressure injury diagnosis, and admissions with a previously documented pressure ulcer diagnosis had the highest level of comorbidity. Similar patterns were also observed in the proportion of patients residing in nursing homes, the proportion of patients directly transferred from another facility, and the proportion of patients discharged from an inpatient or skilled nursing facility within 30 days of admission (Table 6.1). Advancing pressure injury status was also associated with an increase in the proportion of black patients and patients with supplemental Medicaid coverage (Table 6.1). However, ADI scores did not differ significantly between the patient populations.

Figure 6.1 Sample of Acute Inpatient Admissions with a Pressure Injury Diagnosis in 2011

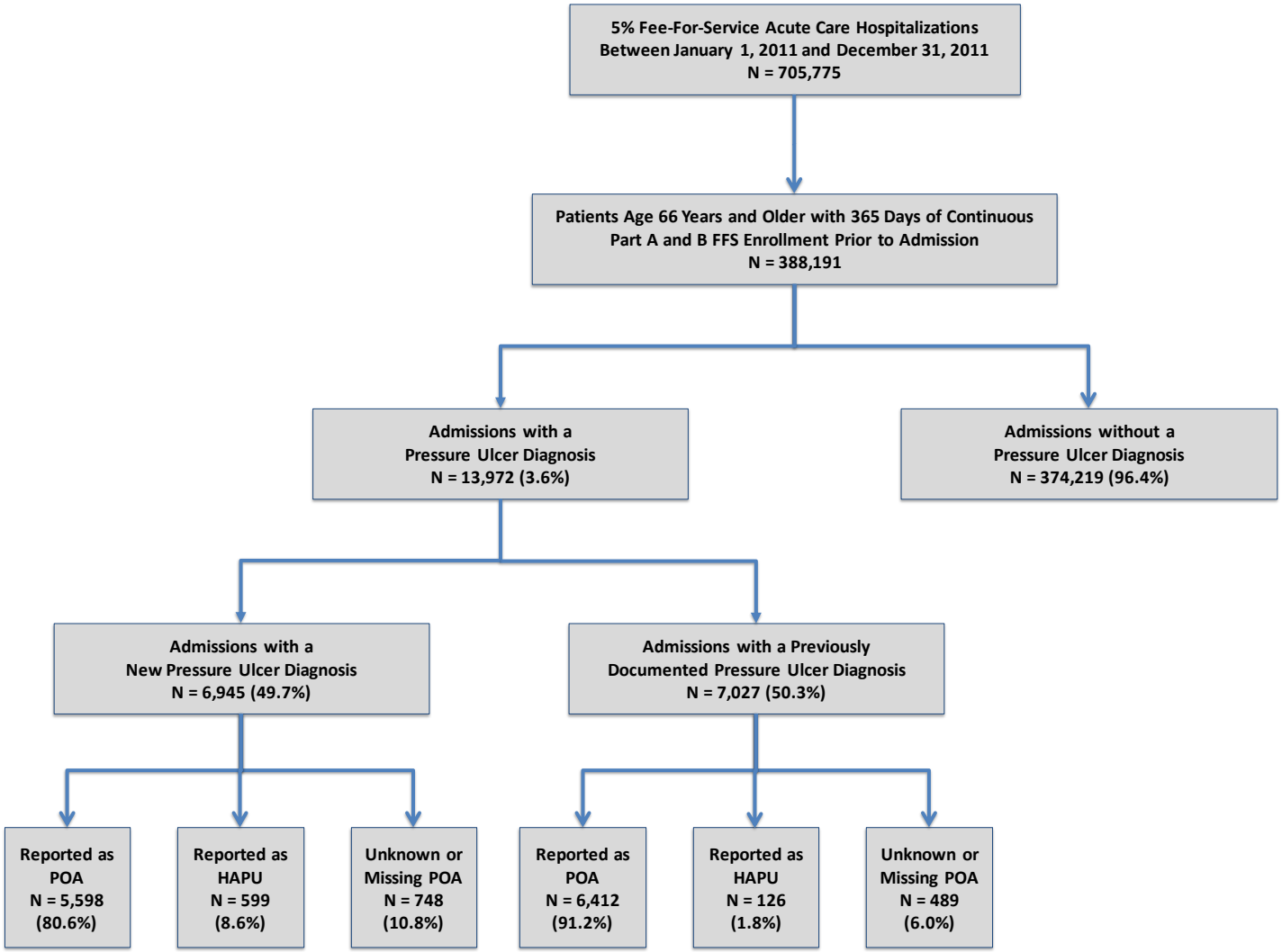


Table 6.1 Characteristics of Acute Inpatient Admissions with a Pressure Injury Diagnosis in 2011

	Admissions Without a Pressure Injury Diagnosis N=374,219	Admissions with a New Pressure Injury Diagnosis N=6,945	Admissions with a Prior Pressure Injury Diagnosis N=7,027	P-Value Comparing Pressure Ulcer and Non-Pressure Ulcer Admissions	P-Value Comparing New and Prior Pressure Ulcer Admissions
Age (mean, SD)	78.5, 7.8	81.3, 8.0	80.3, 8.1	<0.0001	<0.0001
Gender					
Female	216,523 (57.8%)	4,001 (57.6%)	4,059 (57.8%)	0.6840	0.8547
Race/Ethnicity					
Caucasian	322,953 (86.3%)	5,678 (81.8%)	4,981 (70.9%)	<0.0001	<0.0001
Black	33,884 (9.1%)	891 (12.8%)	1,606 (22.9%)		
Other	17,382 (4.6%)	376 (5.4%)	440 (6.3%)		
Supplemental Medicaid Coverage	70,933 (19.0%)	1,833 (26.4%)	2,568 (36.5%)	<0.0001	<0.0001
Area Deprivation Index (mean,SD)	97.7, 19.8	97.7, 20.4	98.1, 20.3	0.2303	0.3005
Elixhauser Score[a]					
Unweighted (mean, SD)	7.1,3.5	8.6, 3.4	10.7, 3.5	<0.0001	<0.0001
Weighted (mean, SD)	16.8, 11.9	22.8, 11.9	27.7, 12.1	<0.0001	<0.0001
Transfer from Another Facility	35,040 (9.4%)	1,222 (17.6%)	1,608 (22.9%)	<0.0001	<0.0001
Nursing Home Resident[b]	30,772 (8.2%)	1,534 (22.1%)	2,754 (39.2%)	<0.0001	<0.0001
Discharge from Inpatient Hospital within 30 days	65,687 (17.6%)	2,001 (28.8%)	3,075 (43.8%)	<0.0001	<0.0001
Discharge from SNF within 30 days	22,648 (6.1%)	989 (14.2%)	2,002 (28.5%)	<0.0001	<0.0001
Discharge from Outpatient Facility within 30 days	162,593 (43.5%)	2,613 (37.6%)	3,014 (42.9%)	<0.0001	<0.0001

[a] Elixhauser scores were calculated using all diagnoses from MedPAR, carrier, and outpatient claims 365 days prior to and including hospital admission.[73-74] Unweighted scores reflect the raw count of comorbidity categories (range 0-30) and weighted values represent the index score proposed by van Walraven and colleagues.[75]

[b] Nursing home residents were identified by reviewing independent provider claims for 30 days prior to admission and identifying place of service codes and CPT procedure codes consistent with services rendered in nursing home facilities.[78]

Among admissions with a new pressure injury diagnosis, advanced stage (III, IV, unstageable) pressure injuries associated with financial penalties were more frequently coded as POA (87.8%) than early stage (I, II) pressure injuries that are not associated with payment adjustment (80.3%, Table 6.2). Similarly, hospital-reported HAPIs (POA = "N") were more frequently missing a stage diagnosis (31.4%) compared to pressure injuries reported by the hospital as POA (POA = "Y", 20.3%).

We observed a total pressure injury prevalence rate of 36 per 1000 admissions for all pressure injuries and 9.4 per 1000 admissions for advanced stage pressure injuries (Table 6.3). Based on patient claims history, we found a new pressure injury diagnosis rate of 17.9 per 1000 admissions for all pressure injury stages and 2.9 per 1000 admissions for advanced stage pressure injuries. However, HAPI rates based on hospital-reported POA data were substantially lower with a rate of 1.9 per 1000 admissions for all pressure injury stages and 0.2 per 1000 admissions for advanced stage pressure injuries.

12,747 out of 13,972 admissions (91.2%) with a pressure injury diagnosis qualified for elimination from facility HAPI rate calculation, based on current AHRQ PSI 03 exclusion criteria (Table 6.4). 90.3% of admissions qualifying for exclusion were due to hospital-reported POA data and 47.4% of excluded admissions were classified as "new diagnosis admissions" based on patient claims history. We also found that 59.0% (N=8,246) of admissions with a pressure injury diagnosis, 47.3% (N=3,286) of new diagnosis admissions, and 28.1% (N=204) of admissions with a hospital-reported HAPI (POA= "N") were excluded on the basis of other exclusion criteria (Table 6.4).

Table 6.2 Hospital-Reported Pressure Injury Present-on-Admission Status Stratified by Pressure Injury Stage

Admissions with a New Pressure Injury Diagnosis				
	Total Admissions[a]	POA[b]	Non-POA[b]	Missing or Uncertain POA[b,c]
Stage 1-2	3,966	3,183 (80.3%, 61.1%)	338 (8.5%, 58.0%)	445 (11.2%, 65.2%)
Stage 3-4 or Unstageable	1,106	971 (87.8%, 18.6%)	62 (5.6%, 10.6%)	73 (6.6%, 10.7%)
Missing Stage	1,404	1,057 (75.3%, 20.3%)	183 (13.0%, 31.4%)	164 (11.7%, 24.0%)
Total	6,476	5,211 (80.5%, 100.0%)	583 (9.0%, 100.0%)	682 (10.5%, 100.0%)
Admissions with a Previously Documented Pressure Injury Diagnosis				
	Total Admissions[a]	POA[b]	Non-POA[b]	Missing or Uncertain POA[b,c]
Stage 1-2	2,418	2,103 (87.0%, 37.8%)	70 (2.9%, 56.9%)	245 (10.1%, 58.8%)
Stage 3-4 or Unstageable	2,514	2,425 (96.5%, 43.6%)	15 (0.6%, 12.2%)	74 (2.9%, 17.7%)
Missing Stage	1,171	1,035 (88.4%, 18.6%)	38 (3.3%, 30.9%)	98 (8.4%, 23.5%)
Total	6,103	5,563 (91.2%, 100.0%)	123 (2.0%, 100.0%)	417 (6.8%, 100.0%)

[a] We eliminated 1,393 (10.0%) pressure ulcer admissions (656 new diagnosis admissions and 737 previously documented admissions) with multiple reported pressure ulcer stages or POA statuses, resulting in a total of 386,798 hospitalizations between January 1, 2011 and December 31, 2011.

[b] Data reported as number of patients (row percentage, column percentage).

[c] Data includes pressure ulcer admissions with missing POA indicator or POA value of "U" or "W."

Table 6.3 National Pressure Injury Rates Per 1000 Acute Inpatient Admissions (2011)

Numerator Inclusion Criteria	Pressure Injury Rate per 1000 Admissions (All Stages)	Pressure Injury Rate per 1000 Admissions (Stage 3+)
All Admissions with a Pressure Injury Diagnosis	36.0	9.4
Admissions with a New Pressure Injury Diagnosis (Based on Claims History)[a]	17.9	2.9
Admissions with a Hospital-Reported HAPI (POA = "N")[b]	1.9	0.2

[a] Admissions with a new pressure injury diagnosis required that the patient had no prior facility (inpatient, outpatient, or skilled nursing) or independent provider claim containing a pressure injury ICD-9 diagnosis or CPT procedure within 12 months prior to admission. All patients were required to have 12 months of continuous part A and B FFS enrollment for 12 months prior to admission.

[b] Data includes admissions with pressure injury diagnosis and corresponding POA indicator of "N"; HAPI = hospital-acquired pressure injury

Table 6.4 Admissions with a Pressure Injury Diagnosis Meeting AHRQ PSI 03 Patient Exclusion Criteria in 2011

AHRQ PSI 03 Patient Exclusion Category	Admissions with a Pressure Injury (PI) Diagnosis *N (% Total PI Admissions)*[a]	Admissions with a New Pressure Injury Diagnosis (Claims History) *N (% New PI Diagnosis Admissions)*[b]	Admissions with a HAPI (Hospital-Reported POA Indicator) *N (% HAPI Admissions)*[c]
Length of Stay Less than 3 Days	1,592 (12.5%)	709 (10.2%)	≤ 10 (≤1.4%)[d]
Principal Pressure Injury Diagnosis	511(4.0%)	139 (2.0%)	≤ 10 (≤1.4%)[d]
Secondary Pressure Injury Diagnosis Coded as POA	11,515 (90.3%)	5,461 (78.6%)	0 (0.0%)
Transferred from Another Facility	2,830 (22.2%)	1,222 (17.6%)	121 (16.7%)
Major Diagnostic Category 9 or 14[e]	777 (6.1%)	294 (4.2%)	≤ 10 (≤1.4%)[d]
Diagnosis of Hemiplegia, Paraplegia, Spina bifida, or Anoxic Brain Injury	1,666 (13.1%)	633 (9.1%)	65 (9.0%)
Procedure for Debridement or Pedicle Graft During their Hospital Stay	870 (6.8%)	289 (4.2%)	32 (4.4%)
All Exclusion Categories	12,747 (100%)	6,047 (87.1%)	204 (28.1%)

[a] Data reported as number of admissions with a pressure injury diagnosis meeting exclusion criteria (% total admissions with a pressure injury diagnosis).

[b] New diagnosis classification required that patients have no prior facility (inpatient, outpatient, or skilled nursing) or independent provider claim containing a pressure injury ICD-9 diagnosis or CPT procedure for 365 days prior to admission. Data reported as number of new diagnosis admissions meeting exclusion criteria (% total new diagnosis admissions).

[c] Data includes admissions with pressure injury diagnosis and corresponding hospital-reported POA indicator of "N." Data reported as number of hospital-acquired pressure injuries (HAPIs) meeting exclusion criteria (% admissions with hospital reported HAPI using POA indicator).

[d] To protect patient privacy we did not display the results of data figures that were less than or equal to ten.

[e] Major diagnostic category 9 corresponds to admissions with diseases and disorders of the skin, subcutaneous tissue, and breast. Major diagnostic category 14 corresponds to pregnancy, childbirth, and puerperium.

6.5 Discussion

In this study, we observed a substantial discrepancy between hospital-reported POA data for pressure injuries and patient history in claims data. We found that 5.2% of admissions with a pressure injury diagnosis were reported by hospitals as HAPI using the POA indicator (POA = "N"). However, our review of patient history in claims data revealed a substantially higher "new diagnosis admission" proportion of 49.7%, which is more consistent with data published in previous retrospective chart reviews (POA proportion of 58-62%).[3,65] We also found that 80.6% of admissions with a new pressure injury diagnosis (based on claims history) were reported by the hospital as POA, despite the absence of a pressure injury claim in the MedPAR, carrier, or outpatient file for 365 days prior to hospital admission. Taken together, these findings may indicate potential under-reporting of HAPIs when relying on hospital-reported POA data.

Current coding guidelines for the POA indicator allow HACs to be coded as POA if the diagnosis is: 1) a possible, probable, suspected, or rule out diagnosis condition at the time of discharge based on signs, symptoms, findings at admission, 2) an impending or threatened diagnosis at the time of discharge based on signs, symptoms, and findings at admission, and/or 3) a chronic condition, even if not diagnosed until after admission.[56-67] Under these conditions, it is plausible that 80% of admissions with a new pressure injury diagnosis (based on claims history) could be correctly documented by the hospital as POA, even if the pressure injury was not directly examined by a clinician at the time of hospital admission and documented in the medical record as POA. Unlike other HACs, pressure injuries are chronic conditions that are often omitted from routine clinical examination. Clinical distinction between stage 2 and stage 3 pressure injuries is not always clear and inter-rater reliability for pressure injury staging among health care professionals is poor.[20,79] Thus, coding patterns for HAPIs may be influenced by

pressure injury staging difficulties and coding guidelines that are not specific enough to accurately identify POA status among chronic conditions.

We also found that 91.2% of admissions with a pressure injury diagnosis qualified for exclusion from facility HAPI rate calculations based on the current AHRQ PSI 03 exclusion criteria.[53] An overwhelming proportion of these admissions were disqualified on the basis of hospital-reported POA data (90.3%) and 47.4% of excluded admissions were classified as "new diagnosis" based on patient claims history. Even after accounting for hospital-reported POA status of secondary pressure injury diagnoses, the other AHRQ PSI 03 exclusion criteria resulted in inappropriate elimination of an additional 28.1% of hospital-reported HAPIs (POA = "N"). This finding warrants further research beyond the scope of this analysis to identify the accuracy of each AHRQ PSI 03 exclusion criteria with respect to POA status. Understanding the potential impact of patient exclusion criteria on the sensitivity and specificity of true HAPI identification is critical in the context of current provider performance evaluation and payment reform under the HACRP.[43]

As with any study using administrative claims data, the internal validity of our analysis is limited by the accuracy and completeness of coding for each medical record assessed, and our results must be interpreted with caution. Our analysis included all inpatient, outpatient, and skilled nursing facility claims as well as independent provider claims. However, we did not have access to home health agency claims, durable medical equipment claims, long term nursing facility claims, or hospice facility claims which may have limited our ability to detect pressure injury diagnoses and related procedures. Examination of POA reporting patterns among diagnosed pressure injuries depends on accurate and complete documentation of pressure injury diagnoses. However, the coding patterns for pressure injury diagnoses themselves are prone to

poor sensitivity, geographic variation, and bias associated with payment incentives and financial penalties.[58-60] Without chart-abstracted verification of this data, we were unable to measure the true coding sensitivity, accuracy, and reliability of claims-based pressure injury diagnoses and their corresponding POA indicators. However, chart abstracted data examining pressure injury and POA coding have been shown to vary by facility and may not be accurate unless universally implemented, a task that is time-consuming, costly, and impractical.[63]

Despite the above limitations, the methodology and results presented in this analysis make several unique contributions to the literature that are important in the context of leveraging administrative data to inform value-based payment reform. This is the first study to link Medicare claims from multiple clinical settings at the patient level and use diagnostic history in claims data to identify new pressure injury diagnoses. In the acute inpatient setting, this allowed us to evaluate rates of new pressure injury diagnosis without relying on the hospital-reported POA indicator or manual chart abstraction.

The results of our analysis demonstrated inconsistency between hospital-reported POA status for pressure injuries and patient history in claims data, indicating potential underreporting of HAPIs by hospitals and quality measurement error when using the AHRQ PSI 03. For patients with pressure injuries who frequently traverse multiple clinical settings, current POA coding guidelines may not be specific enough to accurately differentiate between pre-existing comorbidities and hospital-acquired complications. Furthermore, current patient exclusion criteria for the AHRQ PSI 03 should be carefully examined in the context of POA reporting to ensure that they do not result in elimination of actual HAC events.

Chapter 7. Demographics and Clinical Characteristics of Patients Diagnosed with Pressure Injuries across Settings of Care

7.1 Abstract

Background: Understanding characteristics of patients diagnosed with pressure injuries (PI) is important to improve quality of care. However, nationally representative data evaluating patients with PIs across different clinical settings is limited. The purpose of this study was to compare demographic and clinical characteristics of patients diagnosed with a new PI in different clinical settings.

Study Design: Using a 5% sample of Medicare inpatient, outpatient, and nursing facility data as well as independent provider claims from 2010-2012, we identified patients with a pressure injury diagnosis using ICD-9 diagnosis and CPT procedure codes. Patients classified as having a "new" PI were required to have a 365 day period prior to diagnosis without any PI claim. Elixhauser comorbidity categories were determined for each patient using all diagnoses reported in claims data for 365 days prior to, and including, the date of PI diagnosis. 90 and 365 day risk-adjusted mortality rates were compared between patients diagnosed in different clinical settings, controlling for patient age, race, gender, and Elixhauser comorbidity categories.

Results: In 2011, the diagnosis of a new PI impacted 1.8% of aged FFS Medicare beneficiaries. The majority were diagnosed in the inpatient setting (38%), followed by the outpatient office setting (31%), long-stay nursing facilities (17%), and other settings (14%). Patients diagnosed in the inpatient setting had the highest comorbidity profile (mean Elixhauser sum 8.7) and the highest 90 and 365 day risk-adjusted mortality (38.8% and 57.9%, respectively).

Conclusions: PIs diagnosed in different clinical settings are associated with baseline differences in demographics, clinical comorbidity, and risk-adjusted mortality that corresponded with acuity of the diagnostic setting.

7.2 Introduction

Pressure injuries (i.e., pressure ulcers, decubitus ulcers, bed sores) are ubiquitous across all clinical settings and represent a substantial clinical and financial burden on the healthcare system.[17] National estimates suggest that pressure injuries affect 1-2.5 million people in the United States and are responsible for 60,000 deaths and 11 billion dollars in healthcare costs each year.[1-3,12] Over the past decade, pressure injuries have been the subject of numerous payment reform policies and become readily adopted as an important quality of care metric.[1,40-45]

However, there is still a paucity of nationally representative research describing patients with pressure injuries across different clinical settings.[40-41] Pressure injuries are secondary diagnoses that typically occur in older patients with multiple pre-existing conditions who seek care from many different types of providers and clinical settings. These factors engender a complex heterogeneous population with inherent differences in risk for developing a pressure injury, optimal treatment algorithms, patient outcomes, and utilization patterns. In order to improve quality of care for patients with pressure injuries, clinicians, researchers, and policymakers would benefit from more detailed descriptive information about the pressure injury population.

Prior research evaluating the pressure injury population in the United States has been limited to studies within a single clinical setting.[2-4,6-12,14,28,46,70] This is because longitudinal data

for pressure injuries across providers and facilities does not readily exist, and many current national datasets are organized by setting or provider type.[48-49] Due to the chronic nature of many pressure injury diagnoses, studies estimating the incidence of pressure injuries in a particular clinical setting have required manual data abstraction from patient charts or relied on potentially inaccurate present-on-admission (POA) data reported in administrative claims (acute inpatient setting). [2-3, 6-12,28,36,38-39,46] These data limitations have led to wide variation in estimates of pressure injury incidence across different clinical settings and a poor overall understanding of how populations differ from each other by setting.[23]

Linked claims data represent a unique opportunity to study the entire pressure injury population across multiple different clinical settings. The purpose of the present study was to link Medicare claims data from multiple different providers in order to identify the clinical setting of new pressure injury diagnoses among older adults in the United States. We also evaluated differences in patient comorbidity at the time of pressure injury diagnosis and risk-adjusted mortality 90 and 365 days after new diagnosis.

7.3 Methods

Data Sources and Study Sample

We used a 5% sample of fee-for-service (FFS) Medicare claims data from the 2010-2012 MedPAR (inpatient and skilled nursing facility claims), carrier (independent provider claims), outpatient (outpatient facility claims), and denominator (beneficiary demographic information) files.[49] We identified pressure injury claims using ICD-9-CM diagnosis codes (707.00-707.09, 707.20-707.25) and CPT procedure codes (15920-15999). Patients with a new pressure injury

diagnosis were required to have a 365 day period prior to diagnosis without any pressure injury claim (ICD-9-CM diagnosis or CPT procedure code).

We limited our analysis to patients over 65 years old. All patients were required to have continuous Medicare part A and B fee-for-service enrollment for 365 days prior to new diagnosis and all patients were followed until their date of death or 365 days after new diagnosis. Our final study cohort included patients 66 years and older diagnosed with a new pressure injury between January 1, 2011 and December 31, 2011.

Measures

We obtained patient demographics (age, race, sex, and Medicaid dual eligibility) from the 2011 denominator file. Elixhauser comorbidity categories were determined for each patient using all diagnoses listed in any MedPAR, outpatient, or carrier file claim belonging to the same patient within the 365 days prior to, and including the date of, the new diagnosis.[73-74] We also calculated each beneficiary's area deprivation index (ADI) as a measure of socioeconomic status using the beneficiary's residential zip code listed in the denominator file for 2011.[76] The ADI is a validated measure of neighborhood socioeconomic disadvantage composed of 17 U.S. Census data elements regarding poverty, education, housing, employment, and living conditions.[76] Higher ADIs correspond with higher levels of socioeconomic disadvantage and are associated with greater 30-day hospital readmission rates and increased patient mortality.[76-77] The 2011 and 2012 denominator files were used to determine patient death at 90 and 365 days after new diagnosis.

The clinical setting of new diagnosis was determined from the file type (e.g., MedPAR, carrier, outpatient) and variables corresponding to the place of service in each file. Patients were

categorized into one of the following clinical settings of diagnosis: 1) inpatient, 2) short stay nursing, 3) long-stay nursing, 4) outpatient office, or 5) other. Patients with a MedPAR facility claim on the date of new diagnosis were classified in the inpatient or short stay nursing facility setting. Patients without any MedPAR claim on the date of new diagnosis who had a carrier claim for inpatient hospital stay, inpatient rehabilitation facility, or inpatient psychiatric facility were classified in the inpatient clinical setting, as patients with a non-Medicare primary insurance may have an inpatient carrier claim but no corresponding inpatient facility claim. Patients without any MedPAR facility claim on the index date were examined for provider claims with nursing facility place of service codes or CPT codes associated with nursing facilities to identify patients in the long stay nursing facility setting.[78] The outpatient office setting was determined among patients without a MedPAR facility claim on the index date of diagnosis who also had one of the following: 1) an outpatient facility claim, or 2) a carrier provider claim with outpatient office listed as the place of service. Patients who did not satisfy any of the above claim requirements were classified in the "other" clinical setting of diagnosis, which includes the home health, hospice, assisted living, outpatient emergency room/urgent care, etc.[49]

Statistical Analysis

The national rate of new pressure injury diagnosis in the FFS Medicare population was calculated as the number of patients with a new pressure injury diagnosis in our cohort divided by the number of FFS Medicare beneficiaries 66 years and older in 2011. Consistent with Medicare guidelines for determining full FFS coverage, beneficiaries were included in the general FFS population if they had continuous part A and B FFS enrollment for the entire

calendar year or until their date of death (if death occurred in the same calendar year).[80] The proportion of patients with a new pressure injury diagnosis in each clinical setting was determined as the number of patients with a new pressure injury diagnosis in each clinical setting divided by the total number of patients with a new pressure injury diagnosis in 2011.

Descriptive statistics for patient demographics and comorbidity categories were compared between the FFS Medicare population 66 years and older and patients with a new pressure injury diagnosis in each clinical setting. To equalize opportunity for comorbidity capture between groups, we required FFS patients in this analysis to also have 365 days of continuous part A and B coverage in 2010. Mortality rates among pressure injury patients were calculated as the number of patients who died within 90 and 365 days after diagnosis divided by the total number of patients with a new pressure injury diagnosis.

To assess mortality in the FFS Medicare population, beneficiaries were randomly assigned to a date between January 1, 2011 and December 31, 2011. Ninety- and 365-day mortality was defined as death within 90 and 365 days of random date assignment (respectively), and patients who died before their random date assignment were excluded from mortality rate calculations. Mortality rates were calculated as the number of beneficiaries who died within 90 and 365 days of their random date assignment divided by the total number of FFS Medicare patients greater than or equal to 66 years old (excluding those who died before random date assignment).

Rates of new pressure injury diagnosis and mortality were stratified by age, gender, and race/ethnicity. Separate multivaraible logistic regressions were used to model 90- and 365-day mortality as functions of patient age, gender, race/ethnicity, individual Elixhauser comorbidity categories (N=30), and clinical setting of diagnosis. Recycled predictions were used to calculate

risk-adjusted mortality estimates for each clinical setting of diagnosis, controlling for patient age, gender, race/ethnicity, and comorbidity. Kaplan-Meier survival curves were constructed to compare one year survival functions among patients diagnosed with a new pressure injury in different clinical settings, controlling for patient age, race/ethnicity, gender, and Elixhauser comorbidity categories. All statistical analyses were performed using SAS, version 9.4 (SAS Institute Inc.).

7.4 Results

In our 5% Medicare sample, we identified 22,049 patients with a new pressure injury diagnosis who met inclusion criteria. This corresponded to an overall new diagnosis rate of 1.8% in the 2011 FFS Medicare population greater than or equal to 66 years old. New pressure injuries were most commonly diagnosed in the inpatient setting (38%), followed by the outpatient office setting (31%), the long-stay nursing home setting (17%), and other clinical settings (14%, Figure 7.1).

Compared to the general FFS population, patients diagnosed with a new pressure injury were generally older with more clinical comorbidities (Table 7.1). Comorbidity rates varied with acuity of the diagnostic setting, with the highest Elixhauser scores in the inpatient setting and lowest scores in the outpatient office setting (mean 8.7 vs. mean 5.8, respectively). The new pressure injury population also included a higher proportion of black patients and patients with dual Medicare/Medicaid coverage (Table 7.1). Although dual-eligibility varied by clinical setting of diagnosis, area deprivation remained relatively consistent across clinical settings.

Figure 7.1 Distribution of Patients Diagnosed with a New Pressure Injury in 2011 across Different Settings of Care

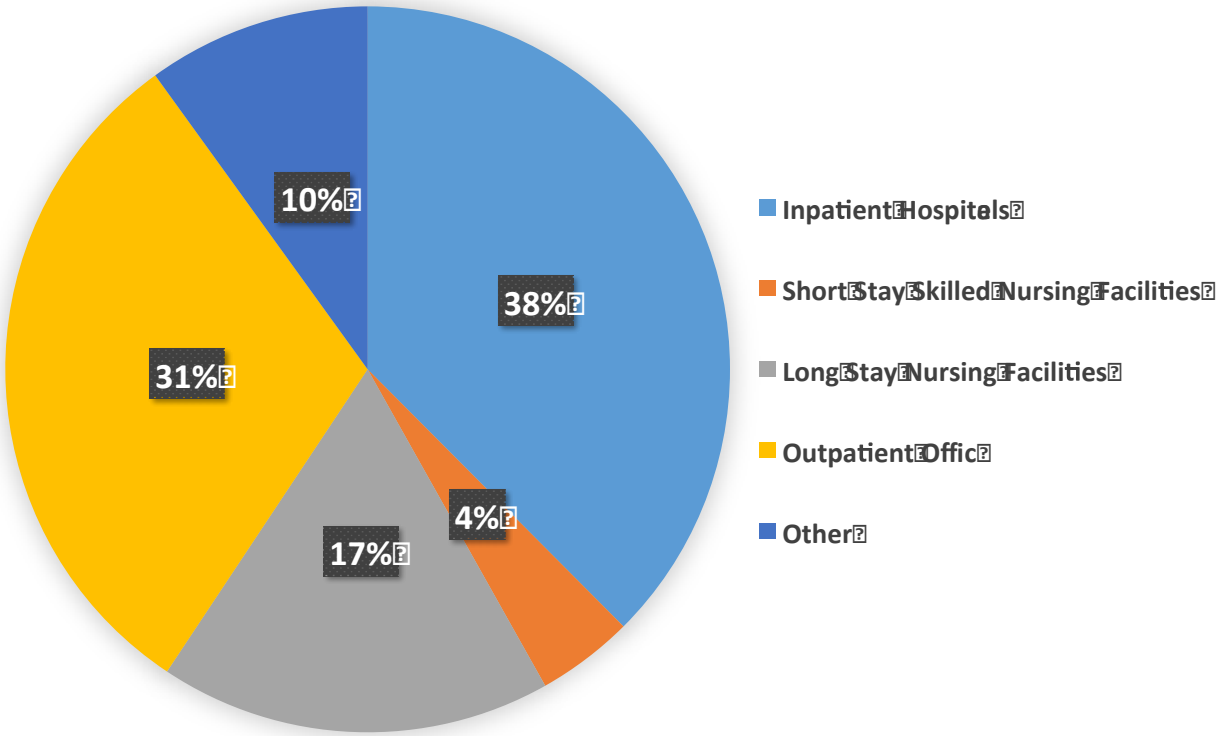


Table 7.1 Characteristics of Patients Diagnosed with a New Pressure Injury Stratified by Diagnostic Setting

	Medicare Fee-for-Service Population[a] N=1,227,891	New PI Inpatient Hospital[b] N=8,725	New PI Short Stay Nursing[b] N=953	New PI Long Stay Nursing[b] N=3,857	New PI Outpatient Office[b] N=6,765	New PI Other Clinical Setting[b] N=2,199
Age (mean, SD)	76.2, 7.6	80.9, 8.1	82.5, 7.6	83.7, 7.7	81.4, 8.0	81.5, 8.2
Gender						
Female	710,956 (57.9%)	4,720 (57.0%)	585 (61.4%)	2,551 (66.1%)	4,129 (61.0%)	1,372 (62.4%)
Race/Ethnicity						
Caucasian	1,062,441 (86.5%)	6,747 (81.5%)	802 (84.2%)	3,211 (83.3%)	5,913 (87.4%)	1,779 (80.9%)
Black	93,097 (7.6%)	1,071 (12.9%)	95 (10.0%)	496 (12.9%)	567 (8.4%)	317 (14.4%)
Other	72,353 (5.9%)	457 (5.5%)	56 (5.9%)	150 (3.9%)	285 (4.2%)	103 (4.7%)
Dual Eligible[c]	166,420 (13.6%)	2,180 (26.3%)	273 (28.7%)	1,328 (34.4%)	1,426 (21.1%)	610 (27.7%)
Area Deprivation Index (mean,SD)[d]	96.2, 21.2	98.0, 20.3	96.0, 22.6	95.3, 20.7	97.5, 20.4	96.2, 21.5
Elixhauser Score (mean, SD)[e]	3.1, 2.6	8.7, 3.4	8.4, 3.3	7.7, 3.6	5.8, 3.4	6.9, 3.7
Pressure Injury Stage[f]						
Early (I-II)		3,913 (47.3%)	343 (36.0%)	127 (3.3%)	542 (8.0%)	52 (2.4%)
Advanced (III-IV, US)	NA	972 (11.8%)	132 (13.9%)	55 (1.4%)	263 (3.9%)	34 (1.6%)
Multiple or missing		3,390 (41.0%)	478 (50.2%)	3,675 (95.3%)	5,960 (88.1%)	2,113 (96.1%)

[a] Data represents Medicare beneficiaries ≥ 66 years old with full fee-for-service coverage in 2011 using the 5% sample.

[b] Data represents patients ≥ 66 years old diagnosed with a new pressure injury in 2011 using the 5% sample. Patients with a new pressure injury diagnosis were required to have a 365 day period prior to diagnosis without any pressure injury claim. Clinical setting of diagnosis was determined based on the claim file type (e.g., MedPAR, carrier, or outpatient) and variables corresponding to the place of service in each file. Two sample t-tests and chi-square tests comparing the general FFS population and patients diagnosed with a new pressure injury (N=22,049) were statistically significant ($p < 0.0001$) for all variables.

[c] Data reflects patients who were eligible for supplemental Medicaid coverage, as indicated in the Denominator file for 2011.

[d] Area deprivation index (ADI) was estimated using the beneficiary's zip code of residence listed in the Denominator file. Higher ADIs correspond with higher levels of socioeconomic disadvantage.

[e] Data represents the raw sum of all individual Elixhauser comorbidity categories (N=30). Potential scores may range from 0 to 30.

[f] Multiple pressure injury stage refers to: 1) patients who had multiple claims submitted for the date of new diagnosis with different reported stage categories, or 2) patients with a single pressure injury claim on the date of new diagnosis with multiple reported pressure injury stage categories. Missing pressure injury stage refers to patients who did not have a stage category listed on any claim for the index date of diagnosis.

Overall, pressure injury stage was poorly documented in claims data across all clinical settings, with a large proportion of missing or inconsistent data (Table 7.1). Stage reporting was best among patients with an inpatient facility claim (41.0% missing/inconsistent stage), where documentation of pressure injuries in claims data is linked to reimbursement penalty.[4-5] Alternatively, patients without inpatient or skilled nursing facility claims (i.e., patients with only provider or outpatient office claims) had the highest proportion of missing or inconsistent stage documentation (Table 7.1).

Table 7.2 demonstrates the prevalence of each Elixhauser comorbidity category among patients diagnosed with a new pressure injury and patients in the general FFS Medicare population. Compared to the general FFS Medicare population, patients diagnosed with a new pressure injury had a higher prevalence of all comorbidity categories (Table 7.2). Individual comorbidity categories generally had the lowest prevalence among patients diagnosed with new pressure injuries in the outpatient office setting compared to those diagnosed in other clinical settings (Appendix 7.1).

New pressure injury patients had substantially higher rates of all-cause mortality compared to the general FFS population at both 90 days (25.8% vs 1.4%) and 365 days (45.7% vs 5.4%, Appendix 7.2, Appendix 7.3). The rate of new pressure injury diagnosis and mortality (90 and 365 days) increased with patient age across both genders and all race/ethnicity categories (Appendix 7.2, Appendix 7.3). Men and women had similar rates of new diagnosis across age categories, but men had higher mortality rates compared to women (Appendix 7.2). Compared to whites, black patients had higher rates of new pressure injury diagnosis and higher mortality rates at both 90 and 365 days (Appendix 7.3), even after adjusting for patient age, gender, and comorbidity (Table 7.3).

Table 7.2 Prevalence of Elixhauser Comorbidity Categories Among New Pressure Injury Patients and the General Medicare Fee-for-Service Population

	Prevalence Among Medicare Fee-for-Service Population N=686,429[a]	Prevalence Among New Pressure Ulcer Population N=22,049[b]
Peripheral vascular disease	116,853 (17.0%)	10,373 (47.1%)
Rheumatoid arthritis/collagen vascular	39,845 (5.8%)	2,305 (10.5%)
Diabetes, uncomplicated	192,198 (28.0%)	10,101 (45.8%)
Diabetes, complicated	65,728 (9.6%)	5,827 (26.4%)
Renal failure	69,425 (10.1%)	7,849 (35.6%)
Cardiac arrhythmias	156,627 (22.8%)	12,128 (55.0%)
Solid tumor without metastasis	86,790 (12.6%)	3,887 (17.6%)
Leukemia/lymphoma	7,909 (1.2%)	487 (2.2%)
Liver disease	23,850 (3.5%)	1,828 (8.3%)
Valvular disease	95,344 (13.9%)	6,579 (29.8%)
Pulmonary circulation disorders	23,051 (3.4%)	3,182 (14.4%)
Hypertension	490,463 (67.1%)	19,388 (87.9%)
Hypothyroidism	140,886 (20.5%)	6,611 (30.0%)
Coagulopathy	25,721 (3.8%)	3,485 (15.8%)
Obesity	31,673 (4.6%)	2,446 (11.1%)
Weight loss	33,881 (4.9%)	6,444 (29.2%)
Fluid and electrolyte disorders	84,468 (12.3%)	12,615 (57.2%)
Blood loss anemia	11,084 (1.6%)	1,428 (6.5%)
Deficiency anemia	59,985 (8.7%)	5,230 (23.7%)
Alcohol abuse	5,864 (0.9%)	653 (3.0%)
Drug abuse	3,857 (0.6%)	480 (2.2%)
Psychosis	19,456 (2.8%)	3,589 (16.3%)
Depression	72,652 (10.6%)	6,999 (31.7%)
Neurodegenerative disorders	44,292 (6.5%)	6,762 (30.7%)
Congestive heart failure	90,253 (13.2%)	10,375 (47.1%)
Chronic obstructive pulmonary disease	139,771 (20.4%)	9,604 (43.6%)
Metastatic cancer	9,588 (1.4%)	1,256 (5.7%)
HIV/AIDS	448 (0.1%)	34 (0.2%)
Paralysis	7,229 (1.1%)	1,796 (8.2%)

[a] Data represents Medicare beneficiaries $\geq$ 66 years old with full fee-for-service (FFS) coverage in 2011 using the 5% sample. To assess comorbidity, patients were also required to have 365 days of continuous part A and B coverage in 2010 (N=730,786). 44,357 patients did not have any claims data in 2010 and we were unable to determine their Elixhauser comorbidity profile. Therefore, our effective sample size was 686,429.

[b] Data represents patients $\geq$ 66 years old diagnosed with a new pressure injury in 2011 using the 5% sample. Patients with a new pressure injury diagnosis were required to have a 365 day period prior to diagnosis without any pressure injury claim. Chi-square tests for difference in proportion between the FFS population and new pressure injury population were statistically significant ($p < 0.0001$) for all comorbidity categories.

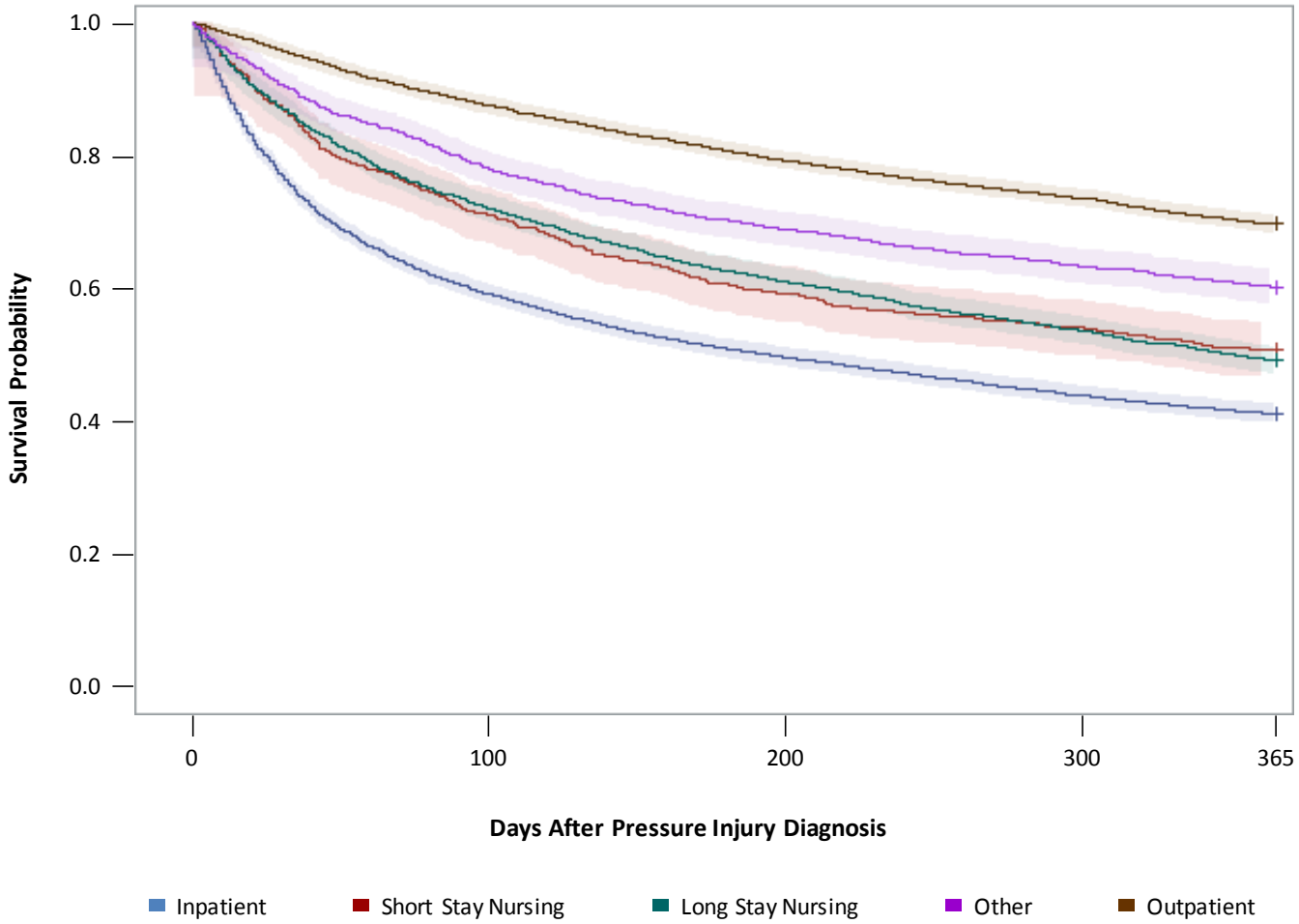
Among patients diagnosed with a new pressure injury, risk-adjusted mortality was highest among patients diagnosed in the inpatient setting (38.8% at 90 days and 57.9% at 365 days) and lowest among patients diagnosed in the outpatient office setting (11.4% and 29.9%, respectively, Table 7.3). Patients diagnosed with a new pressure injury in the inpatient and nursing home setting experienced a relatively steep decline in survival in the first 90 days, whereas patients diagnosed in the outpatient office setting had a more gradual decrease in survival over time (Figure 7.2).

Table 7.3 Risk-Adjusted All-Cause Mortality Among Patients with a New Pressure Injury Stratified by Diagnostic Setting

Clinical Setting of Diagnosis	Risk-Adjusted 90 Day Mortality Rate Among Patients with a New Pressure Injury[a]	Risk-Adjusted 365 Day Mortality Rate Among Patients with a New Pressure Injury[a]
Inpatient	38.8%	57.9%
Short Stay Nursing Facility	27.3%	48.6%
Long Stay Nursing Facility	26.0%	50.1%
Outpatient Office	11.4%	29.9%
Other	19.9%	39.2%
Total	25.8%	45.7%

[a] Multivariable logistic regression was used to adjust for patient age, race/ethnicity, gender, and all individual Elixhauser comorbidity categories (N=30). Due to the high proportion of missing data, we were unable to adjust for pressure injury stage.

Figure 7.2 One Year Kaplan-Meier Survival Curves for Patients Diagnosed with a New Pressure Injury in Different Settings of Care



* All survival curves were adjusted for patient age, race/ethnicity, gender, and individual Elixhauser comorbidity categories (N=30). Shaded areas represent 95% confidence bands.

7.5 Discussion

To our knowledge, this analysis is the first nationally representative description of new pressure injury diagnoses among older adults across multiple clinical settings. In 2011, the diagnosis of a new pressure injury affected 1.8% of FFS Medicare beneficiaries greater than or equal to 66 years old. New pressure injuries were most commonly diagnosed in the inpatient setting, followed by the outpatient office setting, long-stay nursing facility setting, and other clinical settings. We also found evidence of baseline differences in patient demographics, clinical comorbidity, and risk-adjusted mortality among patients diagnosed with pressure injuries in different clinical settings.

Overall, our mortality estimates are consistent with previously published data from smaller cohort studies.[3,6-9,61] We found that patients diagnosed with a new pressure injury in the inpatient setting had the highest risk-adjusted mortality compared to patients diagnosed in other settings, and a substantial number of deaths occurred within 90 days (38.8%). This may reflect increased risk of death due to pressure injury diagnosis or increased likelihood of pressure injury diagnosis among sick patients in the acute care setting with higher baseline risk of death.

As with any study using administrative data to evaluate population health, the results of our analysis are associated with several limitations. First, the accuracy of our method for classifying new pressure injury diagnoses has not been validated against individual patient medical records. Thus, our population estimates may not reflect the true incidence of pressure injuries among elderly patients. However, administrative claims data are the basis for many policy decisions, national quality metrics, and payment reform for pressure injuries and we believe that our analysis represents a practical alternative to national medical chart review.

Second, the sensitivity of pressure injury documentation in claims data may vary depending on the type of claim (e.g., facility or provider) and specific reporting requirements for different clinical settings. For example, advanced stage pressure injury diagnosis in the acute inpatient setting is associated with financial payment penalties that may influence coding in claims data.[42-43] Due to the poor documentation of pressure injury stage, we were unable to adjust our mortality estimates by pressure injury stage. Finally, because we did not have baseline population data for the outpatient office or long-stay nursing facility setting, we were unable to compare the rate of pressure injury diagnosis by clinical setting. Access to this data would have allowed us to examine differences in the risk of new pressure injury diagnosis.

Despite the above limitations, we believe that our study adds several unique and important contributions to the existing literature. Most importantly, the use of linked claims data produces a population-level estimate of new pressure injury diagnosis across different clinical settings. Our results also highlight substantial clinical differences within the pressure injury patient population that correspond to the acuity of diagnostic setting. Additional research to better understand the etiology of missing pressure injury stage data could help identify specific ways to improve pressure injury documentation in claims data and allow for a more robust analysis of variation within the pressure injury population. Future studies evaluating differences in pressure injury risk, treatment, and longitudinal outcomes could inform development of more specific treatment guidelines and quality metrics for this patients diagnosed with pressure injuries in different clinical settings. Furthermore, studies evaluating variation in cost/utilization patterns among pressure injury patients will improve our understanding of the attributable economic impact of this condition and may inform future value-based payment reform.

Chapter 8. Conclusions and Recommendations

8.1 Summary of findings

The work presented in this dissertation provide three distinct examples of linking Medicare claims data across provider encounters and clinical settings to study patients with pressure injuries. Results from the first aim demonstrated that the presence/absence of a pressure injury diagnosis and pressure injury stage documentation were not consistent in claims data across interfacility transfers. Inconsistency among adjacent facility claims may imply potential inaccuracy of pressure injury coding in claims data that could affect quality measurement and payment adjustment in the inpatient setting.

The greatest discrepancy in both pressure injury diagnosis and staging occurred among transfers between skilled nursing facilities and acute inpatient hospitals, which were also the most common type of interfacility transfer. These findings may be the result of different facility motivations to code pressure injuries or varying capacity to maintain properly trained staff to document pressure injuries with good inter-rater reliability. The relative contribution of each of these issues to our observed results is unable to be ascertained from claims data alone, but is important to address in future research given the role of pressure injuries in quality measurement and payment reform.

The second aim sought to compare hospital-reported present-on-admission (POA) status for pressure injuries with patient diagnostic history in claims data. Using claims data, admissions with a pressure injury were classified as "new diagnosis admissions" if the patient did not have a previous pressure injury related claim (across all available facility and provider claims) for 365 days prior to hospital admission. Among admissions with a pressure injury diagnosis, 5.2% were reported by hospitals as hospital-acquired (POA = "no"). This figure is

substantially lower than the proportion "new diagnosis admissions" based on patient history in claims data (49.7%) and the proportion of hospital-acquired pressure injuries found in large previously published retrospective chart reviews (38-42%).[3,65]

As part of the second research aim we also examined the impact of hospital-reported POA data on quality measurement using the Agency for Healthcare Research and Quality Patient Safety Indicator 03 (AHRQ PSI 03). We found that 91.2% of admissions with a pressure injury diagnosis in 2011 met at least one AHRQ PSI 03 exclusion criteria. Hospital-reported POA designation was responsible for 90.3% of qualifying exclusions and 47.4% of excluded admissions were classified as having a new pressure injury diagnosis based on patient history in claims data. Even after accounting for hospital-reported POA status of pressure injury diagnoses, the other AHRQ PSI 03 exclusion criteria resulted in inappropriate elimination of 28.1% of hospital-reported HAPIs (POA = "N"). Given the current role of the AHRQ PSI 03 in payment reform under the HACRP, this finding warrants additional research evaluating the potential impact of patient exclusion criteria on the sensitivity and specificity of HAPI identification in administrative claims.[43]

Finally, as a third research objective, we linked Medicare claims data at the patient level across settings of care to evaluate the entire population of new pressure injury patients across settings of care. We found that new pressure injuries were most commonly diagnosed in the inpatient setting followed by the outpatient office setting, long-stay nursing facility setting, and other clinical settings. Our results also demonstrated substantial differences in baseline patient demographics, clinical comorbidity, and risk-adjusted 90- and 365-day mortality among patients diagnosed with a new pressure injury in different settings of care.

Patients diagnosed in the inpatient setting had the highest comorbidity and risk-adjusted mortality compared to patients diagnosed in other settings, and a substantial number of patients died within 90 days (38.8%). It is important to note that increased risk-adjusted mortality may not be attributable to pressure injury diagnosis and may be the result of other risk factors that were not able to be measured. However, the relative distribution of new pressure injury diagnoses across settings of care and their observed differences in patient characteristics and outcomes may inform future research, policy, and payment reform.

8.2 Strengths and Limitations of Linking Medicare Claims Data across Settings

The diverse complexity of the pressure injury population and the chronic/recurrent nature of pressure injuries themselves, create unique challenges with regard to studying this condition on a national level. The ideal data source to evaluate the entire pressure injury population should follow patients longitudinally over time across different clinical settings and provider encounters. Documentation of pressure injuries within this data source should be accurate, reliable, and consistent across providers and settings. If the purpose of data collection is to evaluate pressure injury risk, outcomes, or quality of care, the data should also contain relevant clinical detail, patient information, and provider characteristics. Furthermore, if data results will be used to evaluate provider performance and adjust payment, the data should be nationally available and practical to collect and analyze on a routine basis.

Currently, there is no readily available dataset that meets all of these criteria to adequately study the pressure injury population and accurately measure quality of care. Linked claims data provide a unique opportunity to longitudinally evaluate pressure injury patients on a national level across different settings of care. Furthermore, secondary data analysis of

administrative claims is a relatively cost-effective and practical method to study patient populations and provider performance on a routine basis. In the current context of value-based payment reform and emphasis on studying quality of care across different settings, linked claims provide opportunities to study chronic conditions, like pressure injuries, without relying on provider-reported data, like the hospital-reported POA indicator. Linked claims may also provide additional information about baseline patient comorbidity, healthcare utilization, and provider characteristics that could potentially improve risk-adjustment methods for current and future quality measures.

However, the strength of linked claims data to longitudinally evaluate patients heavily depends on the quality of administrative coding for the condition being studied. Diagnostic coding for pressure injuries in claims data is hindered by inconsistency across different encounters and potential inaccuracy of hospital-reported POA data. Without further research and intervention to improve the quality of pressure injury reporting in claims data, linked claims may not reach their full potential to study the pressure injury patient population.

8.3 Future Recommendations

To improve the reliability of pressure injury reporting in claims data, we recommend additional research evaluating the potential causes of coding inconsistency in different clinical settings. In our first research aim, transfers between skilled nursing facilities and acute inpatient hospitals had the poorest agreement in pressure injury documentation. Because each clinical setting has different pressure injury reporting requirements, staffing capability, and expertise with chronic wounds, it is difficult to identify the root cause of documentation inconsistency and

potential inaccuracy. However, understanding the primary etiology for coding inconsistency is necessary to inform future interventions to improve pressure injury coding and documentation.

For example, if inconsistent reporting is the result of different coding requirements and financial penalties (e.g., POA reporting and HAC reimbursement penalties only apply to the acute inpatient setting) then policies to standardize data collection and payment incentives may improve consistency of pressure injury documentation across settings of care. Alternatively, if inconsistent pressure injury diagnosis and documentation is the result of varying expertise and staffing capacity, then programs to standardize education and staffing support may be more effective.

To improve accuracy of hospital-reported POA data for pressure injuries in the acute inpatient setting, we recommend additional research to determine the cause of discrepancy between hospital-reported POA data and patient medical records/claims history. If current POA coding guidelines allow legitimate POA coding for pressure injuries that were not truly present at the time of hospital admission, we suggest revising these guidelines. We also recommend further examination diagnostic claims history as a potential method for detecting new pressure injury diagnoses.

Finally, as electronic medical records become more pervasive across all clinical settings of care, we recommend efforts to develop quality measures using data directly from patient medical records. We also suggest additional research regarding inter-rater reliability for pressure injury stage classification among different healthcare providers and recommend standardizing and improving documentation of pressure injuries in the patient chart. For example, pressure injury stage category may not be sufficient to adequately study pressure injury risk, outcomes, or cost/utilization. Standardized documentation of the following, in addition to pressure injury

stage, may improve future studies evaluating patients with pressure injuries and enhance the capabilities medical record data assessment: pressure injury size, extent of necrotic tissue, presence of additional pressure injuries, and recurrence of old pressure injury.

Patients with pressure injuries represent a diverse and challenging population to research and measure quality of care. However, the clinical and financial burden of pressure injuries in the United States population is substantial and quality measurement for this condition is already linked to Medicare payment reform. In this dissertation, we demonstrated the strengths and weaknesses of using linked Medicare claims to study the pressure injury population across different settings of care. As health information technology continues to expand over the next decade, we hope that the findings of this dissertation help to improve quality measure development and value of care for patients with this condition.

Appendices

Appendix 6.1 Area Deprivation Index Indicators from United States Census Data[76]

17 Indicators from U.S. Census Data Included in Area Deprivation Index
• % Population ≥ 25 years with < 9 years education
• % Population ≥ 25 years with high school diploma
• % Employed population ≥ 16 years with white-collar jobs
• Median family income
• Income disparity
• Median home value
• Median gross rent
• Median monthly mortgage
• % Owner occupied housing units
• % Labor force ≥ 16 years who are unemployed
• % Families below federal poverty level
• % Population below 150% of federal poverty threshold
• % Single-parent households with children ≤ 18 years
• % Households without motor vehicle
• % Households without telephone
• % Occupied housing units without complete plumbing
• % Households with ≥ 1 person per room

Appendix 7.1 Elixhauser Comorbidity Categories Among Patients Diagnosed with a New Pressure Injury Stratified by Diagnostic Setting

	New PI Inpatient Hospital N=8,725	New PI Short Stay Nursing N=953	New PI Long Stay Nursing N=3,857	New PI Outpatient Office N=6,765	New PI Other Clinical Setting N=2,199
Peripheral vascular disease	3,884 (46.9%)	450 (47.2%)	2,168 (56.2%)	2,753 (40.7%)	1,118 (50.8%)
Rheumatoid arthritis/collagen vascular	873 (10.6%)	106 (11.1%)	356 (9.2%)	769 (11.4%)	201 (9.1%)
Diabetes, uncomplicated	4,034 (48.8%)	445 (46.7%)	1,756 (45.5%)	2,810 (41.5%)	1,056 (48.0%)
Diabetes, complicated	2,268 (27.4%)	235 (24.7%)	976 (25.3%)	1,707 (25.2%)	641 (29.2%)
Renal failure	3,661 (44.2%)	409 (42.9%)	1,328 (34.4%)	1,745 (25.8%)	706 (32.1%)
Cardiac arrhythmias	5,460 (66.0%)	611 (64.1%)	2,056 (53.3%)	2,942 (43.5%)	1,059 (48.2%)
Solid tumor without metastasis	1,750 (21.2%)	197 (20.7%)	614 (15.9%)	1,003 (14.8%)	323 (14.7%)
Leukemia/lymphoma	230 (2.8%)	29 (3.0%)	66 (1.7%)	133 (2.0%)	29 (1.3%)
Liver disease	914 (11.1%)	91 (9.6%)	291 (7.5%)	381 (5.6%)	151 (6.9%)
Valvular disease	2,964 (35.8%)	375 (39.4%)	1,119 (29.0%)	1,566 (23.2%)	555 (25.2%)
Pulmonary circulation disorders	1,577 (19.1%)	169 (17.7%)	530 (13.7%)	644 (9.5%)	262 (11.9%)
Hypertension	7,535 (91.1%)	893 (93.7%)	3,434 (89.0%)	5,623 (83.1%)	1,903 (86.5%)
Hypothyroidism	2,525 (30.5%)	306 (32.1%)	1,283 (33.3%)	1,860 (27.5%)	637 (29.0%)
Coagulopathy	1,805 (21.8%)	165 (17.3%)	595 (15.4%)	639 (9.5%)	281 (12.8%)
Obesity	1,158 (14.0%)	110 (11.5%)	341 (8.8%)	571 (8.4%)	266 (12.1%)
Weight loss	3,351 (40.5%)	294 (30.9%)	1,190 (30.9%)	1,107 (16.4%)	502 (22.8%)
Fluid and electrolyte disorders	6,390 (77.2%)	649 (68.1%)	2,136 (55.4%)	2,398 (35.5%)	1,042 (47.4%)
Blood loss anemia	687 (8.3%)	84 (8.8%)	259 (6.7%)	267 (4.0%)	131 (6.0%)
Deficiency anemia	2,228 (26.9%)	273 (28.7%)	971 (25.2%)	1,267 (18.7%)	491 (22.3%)
Alcohol abuse	364 (4.4%)	29 (3.0%)	89 (2.3%)	117 (1.7%)	54 (2.5%)
Drug abuse	233 (2.8%)	23 (2.4%)	68 (1.8%)	112 (1.7%)	44 (2.0%)
Psychosis	1,535 (18.6%)	167 (17.5%)	897 (23.3%)	665 (9.8%)	325 (14.8%)
Depression	2,799 (33.8%)	322 (33.8%)	1,681 (43.6%)	1,550 (22.9%)	647 (29.4%)
Neurodegenerative disorders	3,087 (37.3%)	335 (35.2%)	1,353 (35.1%)	1,371 (20.3%)	616 (28.0%)
Congestive heart failure	4,620 (55.8%)	537 (56.4%)	1,842 (47.8%)	2,426 (35.9%)	950 (43.2%)
Chronic obstructive pulmonary disease	4,286 (51.8%)	465 (48.8%)	1,626 (42.2%)	2,322 (34.3%)	905 (41.2%)
Metastatic cancer	689 (8.3%)	66 (6.9%)	181 (4.7%)	218 (3.2%)	102 (4.6%)
HIV/AIDS	18 (0.2%)	≤10 (≤1.0%)	≤10 (≤1.0%)	≤10 (≤1.0%)	≤10 (≤1.0%)
Paralysis	868 (10.5%)	84 (8.8%)	328 (8.5%)	354 (5.2%)	162 (7.4%)

Appendix 7.2 Age-Gender Stratified Rates of New Pressure Injury Diagnosis in 2011 and All-Cause Mortality

	Fee-For-Service (FFS) Population[a]	New Pressure Injury Population (% FFS Population)[b]	90 Day Mortality Rate		365 Day Mortality Rate	
			New Pressure Injury Population[c]	General FFS Population[d]	New Pressure Injury Population[c]	General FFS Population[d]
Men						
66-74 years	270,924	2,324 (0.9%)	555 (23.9%)	1,845 (0.7%)	954 (41.1%)	7,485 (2.8%)
75-84 years	181,672	3,540 (1.9%)	1,023 (28.9%)	2,832 (1.6%)	1,762 (49.8%)	11,317 (6.4%)
≥ 85 years	64,339	2,828 (4.2%)	937 (33.1%)	2,512 (4.3%)	1,624 (57.4%)	9,623 (16.3%)
All men	516,935	8,692 (1.7%)	2,515 (28.9%)	7,189 (1.4%)	4,340 (49.9%)	28,425 (5.7%)
Women						
66-74 years	318,722	2,585 (0.8%)	492 (19.0%)	1,527 (0.5%)	879 (34.0%)	6,074 (1.9%)
75-84 years	254,703	4,860 (1.9%)	1,068 (22.0%)	2,989 (1.2%)	1,916 (39.4%)	12,083 (4.9%)
≥ 85 years	137,531	5,912 (4.1%)	1,611 (27.3%)	4,609 (3.6%)	2,936 (49.7%)	17,813 (14.0%)
All women	710,956	13,357 (1.8%)	3,171 (23.7%)	9,125 (1.3%)	5,731 (42.9%)	35,970 (5.2%)
Total	1,227,891	22,049 (1.8%)	5,686 (25.8%)	16,314 (1.4%)	10,071 (45.7%)	64,395 (5.4%)

[a] Data represents the number of patients ≥ 66 years old in our 5% sample that had full FFS coverage in 2011.

[b] Data represents the number of patients ≥ 66 years old with a new pressure injury diagnosis in 2011 using the 5% sample (% of total FFS population ≥ 66 years old). Patients with a new pressure injury diagnosis were required to have a 365 day period prior to diagnosis without any pressure injury claim.

[c] Data represents the number of new pressure injury patients that died within 90 and 365 days of diagnosis (% of new pressure injury population).

[d] Data represents the number of FFS patients ≥ 66 years old who died within 90 and 365 days of random date assignment between January 1, 2011 and December 31, 2011 (% FFS population ≥ 66 years old, excluding patients with a random date assignment after observed date of death). 34,136 FFS patients were excluded from our proportion calculation due to random date assignment after observed date of death and our total eligible denominator population was 1,193,755.

Appendix 7.3 Age-Race Stratified Rates of New Pressure Injury Diagnosis in 2011 and All-Cause Mortality

	Fee-For-Service (FFS) Population[a]	New Pressure Injury Population (% FFS Population)[b]	90 Day Mortality Rate		365 Day Mortality Rate	
			New Pressure Injury Population[c]	General FFS Population[d]	New Pressure Injury Population[c]	General FFS Population[d]
White						
66-74 years	504,942	3,944 (0.8%)	821 (20.8%)	2,794 (0.6%)	1,439 (36.5%)	11,286 (2.3%)
75-84 years	379,320	7,023 (1.8%)	1,746 (24.9%)	5,036 (1.4%)	3,065 (43.6%)	20,339 (5.5%)
≥ 85 years	178,179	7,485 (4.0%)	2,173 (29.0%)	6,376 (3.9%)	3,887 (51.9%)	24,473 (14.9%)
All white	1,062,441	18,452 (1.7%)	4,740 (25.7%)	14,206 (1.4%)	8,391 (45.5%)	56,098 (5.4%)
Black						
66-74 years	49,424	748 (1.5%)	175 (23.4%)	407 (0.8%)	317 (42.4%)	1,608 (3.3%)
75-84 years	30,807	965 (3.0%)	245 (25.4%)	492 (1.7%)	421 (43.6%)	1,918 (6.4%)
≥ 85 years	12,866	833 (6.1%)	258 (31.0%)	436 (3.7%)	454 (54.5%)	1,722 (14.5%)
All black	93,097	2,546 (2.7%)	678 (26.6%)	1,335 (1.5%)	1,192 (46.8%)	5,248 (5.8%)
Other						
66-74 years	35,280	217 (0.6%)	51 (23.5%)	171 (0.5%)	77 (35.5%)	665 (1.9%)
75-84 years	26,248	412 (1.6%)	100 (24.3%)	293 (1.1%)	192 (46.6%)	1,143 (4.5%)
≥ 85 years	10,825	422 (3.8%)	117 (27.7%)	309 (3.0%)	219 (51.9%)	1,241 (12.2%)
All other	72,353	1,051 (1.4%)	268 (25.5%)	773 (1.1%)	488 (46.4%)	3,049 (4.3%)
Total	1,227,891	22,049 (1.8%)	5,686 (25.8%)	16,314 (1.4%)	10,071 (45.7%)	64,395 (5.4%)

[a] Data represents the number of patients ≥ 66 years old in our 5% sample that had full FFS coverage in 2011.

[b] Data represents the number of patients ≥ 66 years old with a new pressure injury diagnosis in 2011 using the 5% sample (% of total FFS population ≥ 66 years old). Patients with a new pressure injury diagnosis were required to have a 365 day period prior to diagnosis without any pressure injury claim.

[c] Data represents the number of new pressure injury patients that died within 90 and 365 days of diagnosis (% of new pressure injury population).

[d] Data represents the number of FFS patients ≥ 66 years old who died within 90 and 365 days of random date assignment between January 1, 2011 and December 31, 2011 (% FFS population ≥ 66 years old, excluding patients with a random date assignment after observed date of death). 34,136 FFS patients were excluded from our proportion calculation due to random date assignment after observed date of death and our total eligible denominator population was 1,193,755.

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