An Analysis of Current Procedural Terminology Accuracy for Professional Services: A Comparison Between Certified Professional Coders and Physicians

Kathleen Burris-Fowlkes

A capstone project submitted to the faculty of Radford University

in partial fulfillment of the requirements for the degree of

Doctor of Health Sciences

Jeannine Everhart, PhD, MPH, MBA, MCHES®, Committee Chair	April 28, 2023 Date
Stephen Lowery, DNP, RN, NEA-BC, Committee Member	April 28, 2023 Date
Benjamin Hull, MD, Committee Member	April 28, 2023 Date

Abstract

Medical coding is the translation of a medical provider's documentation into alphanumerical codes. These codes become part of the patient's medical record and are used by insurance companies and hospitals to generate costs for medical procedures. There are over 70,000 defined medical codes to describe a patient's condition and treatment, and each code has specific rules to dictate when and how the code should be applied. Medical coding is quite complex since coding rules are numerous and vary across different insurance companies. In addition, there is no federal requirement regarding the training/expertise required for those performing medical coding. In combination, these issues affect medical coding accuracy. Inaccurate coding costs the United States healthcare system an estimated $82 billion to $272 billion annually.

To better understand the specific factors associated with coding inaccuracies, approximately 2.5 million claims provided by a large national healthcare system were examined, with 4,036 observations that met the criteria for analysis. Results found that certified professional coders were the most accurate at CPT selection out of the groups studied, while surgical providers were the least accurate. Findings from this study may be used to target corrective measure to improve medical coding accuracy, encourage policy change to mandate coder certification, and encourage education program creation for providers during their residency training.

Keywords: medical coding, coding accuracy, professional services, Current Procedural Terminology accuracy

Dedication Page

To my dearest husband, how lucky I am to have found someone who just understands. Thank you for indulging my constant conversations about medical coding and for being my forever proof-reader. I would have never even started this if it hadn't been for your encouragement that I could do it. You make every day of mine brighter. We can finally catch up on Ted Lasso now. To Ellie, Jake, Adam, and Abigail, there were a lot of early mornings and late nights while this project was being completed. Thank you for all the smiles, laughs, words of encouragement, dishwasher loads and unloads, drawings, coffees, and dog walks that were supplied so I could do this. It is the joy of my life to watch you all grow. To my sweet friend Roxanne, I can't count on my fingers and toes how many times your friendship during this program carried me through. You are a light in the world of healthcare and your passion for your community is a delight to witness. Thank you for everything, truly. To my mom, you've been in my corner since day one and I know you always will be. I wouldn't be here without your constant support and encouragement. Thank you for all that you've done for me, not just for this project, but for every passion I have ever had. And to my dad, who showed me early on that education is the foundation for making a difference. This one is for you, Dad.

Acknowledgements

There were multiple people that made this project a reality. Dr. Everhart, thank you for pushing me in the right direction, the weekly conversations, the feedback, and the overall time you spent with me to make sure this was a success. You have had such a positive impact on my academic career and my experience in this program. I cannot say thank you enough. Dr. Lovern, you were one of the first professors I had in this program, and I felt an immediate sense of respect for you and your outlook on healthcare today. Thank you for the excellent feedback and for spending your time helping me with this project. I was lucky to have you on my committee. Dr. Hull, one of the happiest days I had during this work was when you called and accepted being on my committee. Thank you for all the excellent feedback and for sharing your perspective. I know your time is limited and I'm grateful that you extended it to me and my work. Dr. Francis Dane, thank you for easing my insecurities about statistical analysis and for the hours you spent teaching and talking with me about this data. Radford is lucky to have you in their corner. And to all my peers in this program, what a joy it was to get to know you all. Every single one of you impacted this research in some way. I'm beyond excited to see what the future holds for all the current and future graduates of this program.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

AAPC..........................American Academy of Professional Coders

AMA ....American Medical Association

CCU ....Centralized Coding Unit

CMS ....Centers for Medicare and Medicaid Services

CQR ....Coding Quality Dataset

CPT ....Current Procedural Terminology

FCA.............................False Claims Act

GME............................Graduate Medical Education

HIPAA ....Health Insurance Portability and Accountability Act

ICD-10-CM................International Classification of Disease, Tenth Revision, Clinical Modification

JD-R ....Job Demands-Resource Theory

MPFS ....Medicare Physician Fee Schedule

NCCI...........................National Correct Coding Initiative

NCHS..........................National Center for Health Statistics

PCCL...........................Provider Coding Changes Log Dataset

RVU ....Relative Value Units

WHO ....World Health Organization

WRVUS ....Work Relative Value Units

Chapter One

Introduction

According to the American Academy of Professional Coders (2022), medical coding is defined as “the transformation of healthcare diagnosis, procedures, medical services, and equipment into universal medical alphanumeric codes” (p. 1). The process of medical coding can be completed by several individuals including certified professional coders and medical doctors. The coder’s role is to extract relevant information from the patient records and assign a code that represents a complete picture of a patient’s stay (Bajaj et al., 2007). There are two standard coding systems used within the United States for provider professional services. Procedures are categorized using the American Medical Association’s (AMA) Current Procedural Terminology (CPT) code system. According to the AMA (2022), CPT codes provide a uniform nomenclature for coding medical procedures and services.

Diagnosis codes are quantified using the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM). ICD-10-CM is a standardized system created by the World Health Organization (WHO) of diagnosis codes that represent conditions and diseases, related health problems, abnormal findings, signs and symptoms, injuries, and external causes of injuries and diseases (Hirsch et al., 2016). Though there are two standard sets of procedural and diagnosis codes used within the United States, there is not one singular set of medical coding guidelines that are followed by professional coders and physicians to outline how to apply the codes in practice. Due to this lack of standardized guidance and education, medical coding inaccuracies are rampant and cost the U.S. healthcare system billions annually (Cremeans et al., 2019).

The purpose of this study was to explore which group has more accurate CPT code selection between physicians and certified medical coders under AMA's CPT guidelines, what additional variables influence these coding accuracy rates, and what the cost impact of these errors is. By determining accuracy rates among providers and certified coders, healthcare systems will be able to create education programs for both providers and coders to decrease the amount of money spent on incorrect claim submission annually. Targeted education programs in the areas that errors occur the most frequently could increase accurate claim submission rates thus increasing revenue and improving provider satisfaction with the medical coding process. Furthermore, accurately coded claims will decrease the staggering amount of money spent on Medicare fraud and abuse annually. This study adds to the research around coding accuracy for providers' professional services.

Background

CPT codes first were introduced in 1966 by the AMA to code surgical procedures on insurance claims (AMA, 2022). The CPT coding system is the preferred method of coding and describing healthcare services in federal programs; it also has been adopted by private insurers and providers of healthcare services (Dotson, 2013). The International Classification of Disease system was created for the accurate tracking of disease diagnosis within a population by the World Health Organization and is utilized worldwide. Originally used by epidemiologists to track causes of death, it now has become an integral part of the payment infrastructure within the United States (Hirsch et al., 2016). Even though other countries in the world have begun using ICD-11-CM as of January 2022, the United States only recently implemented ICD-10-CM in October 2015 with no plans of integrating ICD-11-CM for several years (American Academy of Professional Coders, 2022). According to Clemente et al. in their 2018 study, healthcare expenditures are expected to grow 1.1% faster than the Gross Domestic Product per year between 2017 and 2024. This estimated growth indicates that the costs for combating fraud and abuse will continue to increase also. The enormous expenditures on fraud and abuse factors into the long-term fiscal stability of the Medicare and Medicaid programs.

According to Coustasse et al., in their 2018 study, reimbursement models rooted in production further encourage upcoding. Numerous compensation models for providers exists; however, many of them continue to have some level of a productivity component measured by relative value units and CPT codes. Even salary-based models include some level of performance initiatives embedded in the contracting. The AMA states that the 19% of providers that are under a salary model continue to be at risk for aggressive coding practices to meet production incentives (Drabiak & Wolfson, 2019).

Medical coding is part of the revenue cycle process and one of the administrative requirements placed on healthcare organizations and providers to complete. Healthcare administrative costs in 2017 total $812.0 billion or $2,497 per capita (Himmelstein et al., 2020). Additionally, citizens of the United States report that they spend a large amount of time on paperwork and phone calls related to their medical bill disputes. Hospital administrative costs are driven by the complexity of the coding and reimbursement system (Reid, 2010).

Significance

In 2016, Centers for Medicare and Medicaid Services (CMS), the largest insurer in the United States, spent over one trillion dollars on insuring over 145 million

Americans (Clemente et al., 2018). It has been estimated that out of the one trillion dollars spent on healthcare, $95 billion of this was for improper payments connected to claims submitted fraudulently (Herland et al., 2018). CMS (2021) defines healthcare abuse as “practices that may directly or indirectly result in unnecessary costs to the Medicare Program” (p. 7). Medicare and Medicaid fraud was estimated in 2014 to range from $82 billion to $272 billion and involved spending $1.4 billion to combat it (Coustasse et al., 2021). Accurately identifying the amount spent on fraud and abuse can be difficult; however, the Federal Bureau of Investigation estimated in 2017 that 3-10% of healthcare billing was fraudulent (Clemente et al., 2018). Moreover, spending money on fraudulent claims diverts funds from genuine medical services (Price & Norris, 2009).

Purpose of the Research

The primary purpose of this research was to determine who has more accurate CPT selection between providers and certified medical coders, what additional factors impact errors rates, and what the cost of these errors are. Accurately coded claims are paramount to decreasing the billions spent on Medicare fraud and abuse in the United States annually. This research could assist in many different areas in healthcare as well. These include resource management for coding education and training, staffing models for hiring and retaining certified coders, burnout reduction for providers relating to clerical and administrative tasks, and satisfaction improvements for providers compensated on productivity-based models tied to work relative value units. Additionally, accurately coded data is also important as claims data is used commonly to create healthcare databases (Alonso et al., 2020).

Research Question(s) and Hypotheses

Research Question 1: What group between providers and certified professional coders has a higher rate of upcoding CPTs for claims data?

Hypothesis 1: Surgical providers will have a higher rate of upcoding services than certified professional coders.

Research Question 2: What groups between providers and certified professional coders has a higher rate of down-coding CPTs for claims data?

Hypothesis 2: Surgical providers will have a higher rate of downcoding services than certified professional coders.

Research Question 3: Is there a statistical significance between coding accuracy for groups of providers and certified professional coders for CPT selection for claims data?

Hypothesis 3: Surgical providers will be more accurate at CPT code selection than certified professional coders.

Research Question 4: Is there a statistical significance between coding accuracy for certified professional coders employed domestically and certified professional coders employed by third-party vendors?

Hypothesis 4: Certified professional coders employed domestically will be more accurate than third-party vendors.

Research Question 5: Is there a statistical significance between coding accuracy for providers in medical specialties and providers in surgical specialties?

Hypothesis 5: Surgical providers will have a higher accuracy rate for CPT selection than medical providers.

Research Question 6: Is there a statistical significance of the category of CPT codes where providers and certified professional coders have the most errors?

Hypothesis 6.1: Medical providers will have the most errors within the evaluation and management CPT code category (90000-99999).

Hypothesis 6.2: Certified professional coders will have the most errors within the errors within the Respiratory, Cardiovascular, Hemic, and Lymphatic System (30000-39999) category of CPT codes.

Research Question 7: Which group between certified professional coders and medical providers has the highest cost impact for medical coding errors?

Chapter Two

Review of the Literature

Medical Coding in the United States

Medical coding is required in the United States healthcare system for claims to be reimbursed in a standard manner (Dotson, 2013). Although coding originally existed as a practice for future access to health data and research planning, it is now the fundamental driver of reimbursement within the United States (Campbell & Giadresco, 2020). In addition to being the crux of the United States healthcare reimbursement model, medical coding claim's data also is used commonly to create healthcare databases, a practice of vital importance for studying healthcare across populations (Alonso et al., 2020). Medical coding is a key element for health information management as it serves both clinical and administrative purposes as well as being a foundation for clinical research purposes (Campbell & Giadresco, 2020). The simple definition of medical coding is to extract relevant information from the patient records and assign codes that represent a picture of the patient's healthcare encounter (Bajaj et al., 2007).

There is no federal requirement that defines who is required to complete the coding process, and the National Correct Coding Initiative (NCCI) Manual, which defines the payment of services under Medicare and was published by CMS, only uses the terminology of provider/supplier regarding the coding process (CMS, 2022b). This leads to many different types of persons coding and releasing claims within the United States healthcare system. Medical providers, certified professional coders, non-certified coders, other clinical staff such as nurses, offshore coding consultant companies, and computer assisted coding software were all documented within the literature as performing varying aspects of the coding process at different institutions (Aiello et al., 2016; Drabiak & Wolfson, 2019; Heywood et al., 2016; Roberts et al., 2018). Interestingly, even though coding can be performed by a myriad of individuals, the Office of Inspector General puts the responsibility of accurate coding squarely on the shoulders of the medical providers and states that providers cannot abdicate this duty by over-reliance on computer assisted coding tools or coding staff (Burks et al., 2022).

Complexity of coding creates challenges for identifying consistent causes for expensive errors that inaccurate medical coding costs the U.S. healthcare system. Medical providers lack the resources necessary to focus on the coding and billing process. They receive no formal coding training during their medical education and residency. In their study from 2022, Burks et al. found that there was a common feeling of unpreparedness and unfamiliarity with the coding process among physicians of all levels including residents, fellows, and post-training practitioners. Education and training of the coding guidelines are reliant on the employer and oftentimes completed on the job for individuals in a coding role. Even certified professional coders are at risk for errors due to a lack of available resources and education (King et al., 2001).

A coder’s experience directly influences their quality of coding (Roberts et al., 2018). Since coding is often trained on the job and does not conform to a standard process, variances may exist between institutions on how their coding process is organized (Aiello et al., 2016). Coders are reliant on the quality of a provider’s documentation. A study by Heywood et al. (2016) found that coder error was the most common reason for coding inaccuracies in their study population and attributed this to coders wrongly identifying codes from the documentation, failure of coders to follow national standards, inexperienced coding staff, gaps in their coding training, and increased pressure around tighter deadlines.

The Need for Coding Standards

As the population of the United States increased, the number of patients utilizing the United States healthcare system has grown. Therefore, a clear mechanism for reporting procedures and services in a consistent language was required. Furthermore, The Health Insurance Portability and Accountability Act (HIPAA) of 1996 required a national code system for procedures and diagnosis codes to assist with the electronic exchange of information (Hirsch et al., 2016). Classifying disease using diagnosis codes across countries is of utmost importance to overall world population health as it allows comparable statistics on causes of mortality and morbidity between places and over time (World Health Organization, 2022). The United States has been using a standard system to track patient diagnoses for population health purposes since 1898 under the "International List of Causes of Death" by the Parisian statistician Jacques Bertillon (Hirsch et al., 2016). The United States healthcare payment system is linked intricately with coding standards as the codes selected for each medical service are used to determine reimbursement, develop national datasets, and for provider compensation (Alonso et al., 2020; Beck et al., 2020; Howard & Reddy, 2018).

Coding Standards in the United States

There are currently two code sets used for medical coding of professional services in the United States, CPT and ICD-10-CM. CPT codes were developed by the AMA. The ICD-10-CM standard was developed by the World Health Organization (WHO). ICD-10-CM in the United States is maintained by the Centers for Medicare and Medicaid

Services (CMS) and the National Center for Health Statistics (NCHS). Each medical insurance claim created in the United States requires both a CPT procedural code to define what service was performed, and an ICD-10-CM diagnosis code to identify the reason the service was medically necessary. To understand the importance of accurately coded data, a solid foundation of the history of these code sets and how they drive compensation and reimbursement is necessary.

ICD-10-CM Codes

The International Classification of Disease (ICD) system was created primarily to track a disease within a population by the WHO and is used worldwide (WHO, 2022). At the beginning of the ICD's implementation, the ICD code-set was used mostly by epidemiologists to track mortality causes (Hirsch et al., 2016). The United States only recently adopted the 10th edition of ICD in October 2015, years behind its original release date of January 1993 by the WHO (American Academy of Professional Coders, 2022). There is now an 11th edition of the ICD code-set, which was released January 2022 (World Health Organization, 2022). However, the United States does not plan on adopting the 11th edition for several years as enactment of ICD-11 would require an overhaul of electronic health records systems, and extensive education for providers and coders (American Academy of Professional Coders, 2022).

ICD-10-CM diagnosis coding guidelines are described in a 110-page document reviewed annually by CMS and NCHS (CMS & NCHS, 2021). ICD-10-CM codes undergo annual revisions. This revision process results in addition, deletion, and modification of ICD-10-CM codes in October of each year. The ICD-10-CM codes are found within the Tabular List of the guidelines. The Tabular List is a structured list of codes divided into chapters based on body system or condition (American Academy of Professional Coders, 2021). The list of chapters and code ranges can be seen in Table 1.

Table 1

ICD-10-CM Chapters and Code Ranges

Chapter	Code Range	Description
1	A00-B99	Certain Infectious and Parasitic Diseases
2	C00-D49	Neoplasms
3	D50-D80	Diseases of the Blood and Blood-Forming Organs and Certain Disorders Involving the Immune Mechanism
4	E00-E89	Endocrine, Nutritional and Metabolic Diseases
5	F01-F99	Mental, Behavioral and Neurodevelopmental Disorders
6	G00-G99	Diseases of the Nervous System
7	H00-H59	Diseases of the Eye and Adnexa
8	H60-H95	Diseases of the Ear and Mastoid Process
9	I00-I99	Diseases of the Circulatory System
10	J00-J99	Diseases of the Respiratory System
11	K00-K95	Diseases of the Digestive System
12	L00-L99	Diseases of the Skin and Subcutaneous Tissue
13	M00-M99	Diseases of the Musculoskeletal System and Connective Tissue
14	N00-N99	Diseases of the Genitourinary System
15	O00-O9A	Pregnancy, Childbirth, and the Puerperium
16	P00-P96	Certain Conditions Originating in the Perinatal Period
17	Q00-Q99	Congenital Malformations, Deformations, and Chromosomal Abnormalities
18	R00-R99	Symptoms, Signs, and Abnormal Clinical and Laboratory Findings, Not Elsewhere Classified
19	S00-T88	Injury, Poisoning, and Certain Other Consequences of External Causes
20	V00-Y99	External Causes of Morbidity
21	Z00-Z99	Factors Influencing Health Status and Contact with Health Services

Note. Examples of ICD-10-CM chapters, corresponding code ranges, and descriptions. Adapted from “The ICD-10-CM Official Coding Guidelines” by the World Health Organization, 2022, Source: https://www.cms.gov/medicare/icd-10/2022-icd-10-cm.

ICD-10-CM codes are comprised of three to seven characters. Each code begins with an alpha character that shows the chapter to which the code is classified (CMS & NCHS, 2021). The second and third characters in a code are always numbers while the four, fifth, six, and seventh characters can be letters or numbers. Examples of ICD-10-CM codes and code names are referenced in Table 2.

Table 2

Example of ICD-10-CM Codes

ICD-10 Code	Code Description
K50.013	Crohn’s disease of small intestine with fistula
E08.22	Diabetes mellitus due to an underlying condition with diabetic chronic kidney disease
L89.213	Pressure ulcer of right hip, stage III
ICD-10 Code	Code Description
T81.530	Perforation due to foreign body accidently left in body following surgical operation
C50.212	Malignant neoplasm of upper-inner quadrant of left female breast
Z23	Encounter for immunization

Note. Examples of ICD-10-CM codes and descriptions. Adapted from “The ICD-10-CM Official Coding Guidelines” by the World Health Organization, 2022, Source: https://www.cms.gov/medicare/icd-10/2022-icd-10-cm.

CPT Codes

According to the AMA, CPT codes were created to provide a uniform language to report medical procedures and services to insurance carriers (AMA, 2022). The AMA first introduced CPT as a method for coding surgical procedures in a standard language to insurance companies in 1966 after Medicare was enacted (Deeken-Draisey et al., 2018; Hennig-Schmidt et al., 2019). At the time CPT was introduced, it was not the mandated code set for use within the United States. HIPAA called for the requirement of a national standard code set to encourage organizations to exchange medical information electronically. The AMA took the passing of HIPAA into law as an opportunity to revise CPT to meet the requirements for adoption as the national standard. From there, CPT was implemented in 2000 by CMS as the standard for federal insurance programs (Deeken-Draisey et al., 2018). Since its enactment by federal programs, numerous private insurers have embraced the CPT code set system as their method for reporting healthcare procedural services (Dotson, 2013).

CPT codes are broken into three separate categories, Category I, Category II, and Category III codes. The most used CPT codes are within Category I; these codes are reported for services performed by physicians and are used for reimbursement. Category II CPT codes are used for reporting performance measures. Category III are temporary codes used for reporting emerging technology that has not yet been given a Category I code. Category III codes will be accepted into Category I placement and become billable services if the technology is utilized enough to justify a new Category I CPT creation (AMA, 2022). Since Category III codes are temporary and reflect innovative technology, they are often priced by the insurance carrier and are not a part of the Medicare Physician Fee Schedule (MPFS). The MPFS is the annual regulatory rule released by CMS that updates the standards for physician reimbursement and policies related to the delivery of healthcare (CMS, 2022a). All future references to CPT will mean Category I only.

Relative Value Units

During the time frame of 1972-1987, prior to the time that CPT was being revised to meet national needs, the United States was also working to solve the issue of Medicare physician payments increasing at a rate higher than the gross national product (Aiello et al., 2016). On average during this time Medicare physician payments increased at a rate of 15% per year, which clearly indicated a need for Congress to attempt to reduce rising costs (Aiello et al., 2016). In 1992 to combat these rising payments, Congress created the resource-based relative value system (Shah et al., 2014). The resource-based relative value system is a schema that determines how much medical goods and services should cost by assigning each a relative value unit, which is then adjusted by geographic region and multiplied by a conversion factor (Aiello et al., 2016; Beck et al., 2020; Shah et al., 2014).

The creation of relative value units and the use of the relative value system, which began in 1992, fundamentally changed the way that provider services were reimbursed (Shah et al., 2014). Each CPT code is assigned a certain number of relative value units that are comprised of three components: physician work, practice expense, and professional liability insurance (Deeken-Draisey et al., 2018). The relative value units for each CPT code are then multiplied by a conversion factor, a number determined annually by CMS, to establish what reimbursement will be received for each CPT code. Reimbursement also varies depending on the location of the Medicare contractor (MAC) (Shwayder et al., 2019). CMS developed the geographic practice cost index for each Medicare payment locality to assist with reflecting varying practice costs across areas. The geographic practice cost index is applied to all three of a procedure’s relative value unit components and helps to determine the reimbursement rate across different regions. Examples of different reimbursement for varying geographic areas for a laparoscopic cholecystectomy surgery can be found in Table 3, including a breakdown of each individual RVU component.

Table 3

RVU Example from the Medicare Physician Fee Schedule Look-Up Tool

CPT Code	Short Description	Mac Locality	Facility Price	GPCI Work	GPCI PE	GPCI MP	Work RVU	PE RVU	MP RVU	Facility Total
47562	Laparoscopic cholecystectomy	111205	$738.82	1.077	1.329	0.458	10.47	6.68	2.61	19.76
47562	Laparoscopic cholecystectomy	111209	$754.21	1.096	1.383	0.414	10.47	6.68	2.61	19.76
47562	Laparoscopic cholecystectomy	111253	$705.82	1.044	1.22	0.504	10.47	6.68	2.61	19.76
47562	Laparoscopic cholecystectomy	111254	$687.14	1.036	1.065	0.726	10.47	6.68	2.61	19.76
47562	Laparoscopic cholecystectomy	111255	$672.23	1.027	1.065	0.597	10.47	6.68	2.61	19.76

Note. Relative Value Unit example for laparoscopic cholecystectomy surgery. MAC = Medicare Contractor; GPCI Work = Geographic Price Index Work Relative Value Unit; GPCI PE = Geographic Price Index Practice Expense; GPCI MP = Geographic Price Index Malpractice; Work RVU = Work Relative Value Unit; PE RVU = Practice Expense Relative Value Unit; MP RVU = Malpractice Relative Value Unit. Adapted from “Medicare Physician Fee Schedule Tool” by the Centers for Medicare and Medicare Services, 2022, Source: https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/PFSlookup.

Coding Errors

There are varying types of errors that occur during the coding process due to the enormous number of codes available and the complex guidelines that surround application of these code sets. With nearly 70,000 CPT and ICD-10-CM codes available for selection by providers and coders that undergo annual updates, it is apparent that accuracy would be a legitimate concern (Owji et al., 2022).

Upcoding

One of the most prominent and risky error types is referred to as upcoding (Burks et al., 2022). Upcoding has been one of the costliest examples of healthcare fraud in the United States (Coustasse et al., 2021). The AMA's news editor Kevin O'Reilly defines upcoding as reporting a higher level of service than warranted in the documentation (O'Reilly, 2018). CMS further defines upcoding as an attempt to increase reimbursement by submitting a higher level of service on a procedural code than what was performed (CMS, 2021). This can be done to secure higher reimbursement and work relative value unit credit for compensation. Furthermore, up-coding may occur when coders lack the understanding of the surgical procedure being performed and select the incorrect CPT code from the documentation (Roberts et al., 2018). According to Coustasse et al. (2021), physician compensation models that are based off production oftentimes encourage upcoding practices. A study performed by Drabiak and Wolfson in 2019 found that out of the 720 physicians they surveyed, 39% had upcoded claims to secure a higher level of reimbursement.

Unbundling

Another common coding error called unbundling occurs when a provider or coder reports various CPT codes when a singular code would capture the service performed. The AMA defines unbundling as using multiple CPT codes for individual parts of the procedure when one singular code would describe the full service (O'Reilly, 2018). This could occur due to a lack of understanding of the coding guidelines or to increase reimbursement (Drabiak & Wolfson, 2019). CMS created the National Correct Coding Initiative (NCCI) to curb improper payments related to coding errors such as unbundling

(CMS, 2022b). The NCCI manual outlines appropriate codes that can be reported together to mitigate unbundling. If a combination of codes is prohibited from being reported together in the NCCI manual, then submitting a claim with these codes listed individually would be an example of unbundling.

Rising Healthcare Costs: How Coding Inaccuracies Can Have an Impact

Medical Coding Fraud and Abuse

Depending on the situation and the intent behind the provider or coder's actions, unbundling and/or upcoding could be perceived as either fraudulent or abusive actions. Spending money on fraudulent and abusive claims diverts money from the United States healthcare system and away from patient care (Price & Norris, 2009). Annual dollar amounts spent on fraud and abuse vary between sources but range from $82 billion to $95 billion and upwards of $272 billion, all staggering numbers (Coustasse et al., 2021; Herland et al., 2018). The Federal Bureau of Investigation stated that in 2017 nearly 3-10% of bills submitted to CMS were fraudulent (Clemente et al., 2018). There is a fine line between what constitutes fraud versus abuse with the defining factor being the intent of the persons committing the act (CMS, 2021).

Medicare abuse is commonly the result of poor medical practices and lack of understanding, and is not a willful act but one committed from unawareness (Clemente et al., 2018). Medicare fraud occurs when an individual knowingly chooses to violate CMS policy. CMS further defines healthcare abuse as "practices that may directly or indirectly result in unnecessary costs to the Medicare program" (p. 7). There are several coding scenarios listed by Medicare that are abusive, including billing for unnecessary medical services, excessive charges for services or supplies, and misusing codes on a claim such as upcoding or unbundling. CMS defines Medicare fraud as “knowingly submitting, or causing to be submitted false claims or making misrepresentations of fact to obtain a Federal healthcare payment for which no entitlement would otherwise exist” (p. 8).

Numerous efforts exist to combat fraud and abuse at the governmental level. One of the most notable being the creation of the Health Care Fraud Prevention and Enforcement Action Team (HEAT) in 2009, which is a joint task force between the Department of Health and Human Services and the Department of Justice (Chen et al., 2020; Clemente et al., 2018). In 2011 alone, the Healthcare Fraud and Prevention team charged more than 1,400 defendants for billing Medicare an excess of $4 billion inappropriately (Clemente et al., 2018). In addition to the creation of the HEAT team, Medicare employs the Medicare Fraud Strike Force and Medicaid Fraud Control Units whose sole purpose is to re-gain improper payments made for healthcare services. In 2017, the Medicare Fraud Strike Force and Medicaid Fraud Control Units filed charges on over 1,500 defendants and the Office of the Inspector General excluded 3,244 healthcare providers from providing Medicare services due to improper billing practices (Chen et al., 2020). These reasons for errors come at a high price. It has been estimated that out of the one trillion dollars spent on healthcare, $95 billions of this was for improper payments connected to claims submitted fraudulently (Herland et al., 2018).

False Claims Act

Physicians and corporations that commit healthcare fraud typically are prosecuted under the False Claims Act (FCA). At a high level, the FCA is a series of federally enacted statutes to address fraud against the government. Any person who falsely obtains money from the government is subject to prosecution under the FCA (Baccaro et al., 2022). The FCA imposes a civil penalty to any person who submits, or causes to be submitted, a false or fraudulent claim to the federal government (Chen et al., 2020). The False Claims Act has been through many iterations. The FCA was put in place during the Civil War to protect the Union Army against people attempting to profit from the war itself by selling substandard equipment (Mehta, 2021). Initially, the law was written to include provisions for whistleblowers and conditions, which state any overpayments received by the U.S. government must be repaid within 60 days. The original verbiage of the law stated that any false claim submission had to be completed "knowingly" by the defendants; since then, revisions have removed this language (Clemente et al., 2018). The lack of definition for "knowingly" versus "un-knowingly" committing a prosecutable offense under the FCA is one of the more convoluted areas of the law when taken in context that the driving factor between fraud and abuse is willful committing of the act.

Administrative Burden and Cost

Healthcare administrative costs are driven by the complexity of the coding and reimbursement system (Reid, 2010) and much like fraud and abuse cost numbers they continue to rise to enormous levels. In 2017, the United States spent $2,497 per person on administrative healthcare costs, totaling $812 billion (Himmelstein et al., 2014) with reports that many hospitals have more billing specialties employed than they have beds in the hospital (Gottlieb et al., 2018). In the United States, administrative costs are higher than other developed nations since each hospital and physician organization must bargain their reimbursement rates with multiple insurance companies that all have their own billing and documentation requirements (Himmelstein et al., 2014). These billing requirements include specific coding conditions for each payer, which in turn requires medical coders and providers to learn the specific coding requirements of each insurance company in addition to the standard guidelines for CPT and ICD-10-CM.

Medical billing and coding are not the only administrative burden, but they are one of the costliest, with estimates that physician offices within the United States collectively spend a total of $30 billion on billing costs annually (Gottlieb et al., 2018). If the complexity of the billing system within the United States were to decline, it could have lasting impacts on healthcare. Providers would be more productive with patient visits, and savings from insurance companies could be used to reduce premiums for patients. Reducing patient premiums is a necessary task since health insurance premiums have increased 28% faster than wages since 2010 and continue to rise (Keckley, 2021a). The American College of Physicians recently called for a reduction in administrative burdens on physicians (Erickson et al., 2020), citing a study from Sinsky et al. (2016) that stated that physicians on average spend 8.7 hours per week on administrative tasks, which is a main contributor to physician burnout.

The Job Demands-Resource Theory

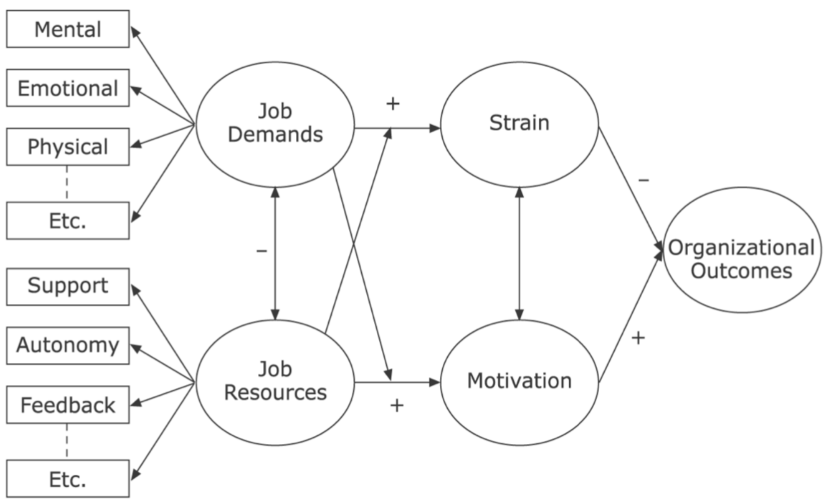
The job demands-resource (JD-R) theory, which was originally published by Bakker et al. (2005), provides evidence that access to better job resources can decrease the negative impact of various job demands on employee burnout. JD-R theory states that every occupation has two factors that can impact job stress: job demands and job resources. Job demands refer to the aspects of one’s job that require sustained physical and/or psychological effort. Two common examples are work pressure and emotional interactions with patients. Job resources refer to aspects of the job that function to achieve goals, reduce work demands, and stimulate personal learning (Bakker et al., 2005). JD-R theory postulates that burnout occurs when there is an imbalance between the demands and resources within a person's employment (Edú-valsania et al., 2022). According to Bakker and de Vries (2021), job stress of repetitive work activities, work pressure, and role conflicts can contribute to turning a meaningful job into a demanding and worrying experienceClick or tap here to enter text..

Job resources are vital to coping with job demands because job demands and resources have unique and independent effects on employee well-being (Bakker, n.d.). The existence of job resources has been shown to decrease the depersonalization characteristic of burnout as individuals with superior resources do not use depersonalization as a coping mechanism (Edú-valsania et al., 2022). Bakker and de Vries (2021) argued that when job strain accumulates, the risk of burnout is much more likely when employees do not have their own personal resources while simultaneously not having access to stable organizational resourcesClick or tap here to enter text.. Job resources exist on multiple levels, including the organizational level (job security, pay scale), the interpersonal and social level (team culture, supervisor relationship), the organization of work (role clarity, decision-making opportunities), and at the level of the task itself (autonomy, performance feedback, skill variety) (Bakker & Demerouti, 2017).

Since JD-R theory has been published, several additional studies exist that explore the relationship between job demands and job resources (Bakker, n.d.; Bakker et al., 2005, 2007). A study by Bakker, Demerouti, Schaufeli, and Xanthopoulou, found that job resources oftentimes predicted an employee's personal resources as well such as their optimism levels, self-esteem, and self-efficacy (Bakker et al., 2007). Ultimately, engaged individuals are motivated to stay engaged and often create their own mechanisms for engagement when needed (Bakker & Demerouti, 2017). Since job resources contribute to work in a positive and motivating way, they can buffer the impacts of job demands, thus making work more enjoyable. (Bakker, n.d.). See Figure 1 below.

Figure 1

The Job Demands Resource Theory



Note. The Job Demands Resource Theory Figure. Bakker, A. B., Demerouti, E., & Euwema, M. C. (2005). Job resources buffer the impact of job demands on burnout. *Journal of Occupational Health Psychology*, *10*(2), 170–180. https://doi.org/10.1037/1076

Research that outlines job demands and job resources for administrative tasks in healthcare such as medical coding accuracy and its impact on burnout has not been uncovered. However, JD-R theory can be used to explain the chronic fatigue and burnout that comes with an imbalance of medical coding resources and medical coding demands for both medical providers and medical coders. Throughout the literature, common themes appeared that medical providers in residency do not feel equipped with the appropriate knowledge to apply codes correctly, thus lacking this job-resource (Balla et al., 2016; Murphy et al., 2014; Owji et al., 2022). Furthermore, medical coders shared a common complaint that they felt they required more education in their field for code selection to be accurate (Alonso et al., 2020). Medical providers exist in a high-stress, high job demand environment and administrative work has been shown to impact provider burnout levels (Himmelstein et al., 2020).

Since job resources play a motivating role in decreasing job demands, increasing job resources around coding accuracy, such as robust education programs for providers and coders, would help alleviate chronic fatigue from this job-demand. Furthermore, accurate code selection directly impacts provider compensation as an organizational level resource and inaccurate coding can negatively impact providers' livelihoods, further impacting their personal resources. Increasing coding accuracy for medical providers and medical coders would allow the creation of better job resources in these areas, therefore decreasing the job demand of coding and further decreasing burnout levels.

This study aims to take the first step in determining which group of individuals is inherently more accurate at CPT selection, what factors impact this, and the financial cost of these errors. It is for future studies to determine the appropriate job and personal resources that can be offered to medical coders and provider to decrease burnout and increase motivation in their roles. By researching which group is more accurate at CPT code selection currently, institutions will be able to tailor their proposed job resource solutions to increase motivation and examine how their coding process can contribute to burnout.

Physician Burnout

There is a plethora of literature on the numbers of physician burnout in the United States; however, the studies did not directly address how coding accuracy impacted burnout (Chesak et al., 2020; Dyrbye & Shanafelt, 2011; Edú-valsania et al., 2022; Patel et al., 2019). Even with this gap in the literature, it is vital to recognize the severity of burnout in physicians in hopes to explore with this research how coding accuracy impacts these numbers. A recurring idea throughout the literature is that the increase in administrative work is a key contributor to physician burnout; therefore, it would be helpful to determine a method for easing medical coding requirements on physicians to maintain a robust workforce. There are numerous contributing factors to which physician burnout could be attributed including loss of autonomy and respect, inadequate time with patients, chronic overwork, heavy administrative workload without support, excessive work hours, and difficulty integrating personal and professional life. These factors lead to a reduced sense of personal achievement, which according to JD-R theory is the main culprit of individuals losing job motivation (Anandarajah et al., 2018; Patel et al., 2019). Often implemented to assist with billing purposes, the electronic health record is one of the largest contributing factors to burnout (Anandarajah et al., 2018; Chesak et al., 2020; Patel et al., 2019).

There are differing numbers of burnout estimated amongst U.S. physicians. According to Dyrbye and Shanafelt (2011), an estimated 30% - 40% of physicians experience burnout. It is further projected that nearly half of practicing physicians meet the criteria for burnout and the prevalence of burnout in physicians is nearly twice as much as the general population (Chesak et al., 2020; Shanafelt & Noseworthy, 2017;

Yakes et al., 2020). Measuring physician burnout has become a key metric for healthcare leadership, as engaged physicians have been shown to be more productive while making fewer medical mistakes and are less likely to leave the organization (Keller et al., 2019). In addition to more medical mistakes, physician burnout contributes to increased physician turnover, reduced productivity, job dissatisfaction, higher absenteeism, difficulties in interpersonal relationships, and early retirement (Patel et al., 2019).

Areas That Are Impacted by Coding Errors

Provider Compensation

Providers that are paid using a productivity-based model that counts physician work relative value units (wRVUs) rely on accurate CPT coding to determine their productivity numbers (Beck et al., 2020). Even during high stress times, such as the COVID-19 pandemic, most physicians continued to be compensated by productivity-based models (Zigrang, 2022). A study by JAMA in 2022 found that 68.2% of compensation models for primary care physicians and 73.7% of compensation models for specialty physician organizations are volume based, utilizing wRVUs as their production indicator (Reid et al., 2022).

Data Collection

Claims data including CPT and ICD-10-CM codes are widely used to create health databases requiring a high-level of precision to ensure accurate data collection (Bajaj et al., 2007; Coustasse et al., 2021; Dick, 2020). The National Center for Health Statistics lists several spaces where coded data is used, including the following: tracking public health conditions, improving data for epidemiological research, measuring patient outcomes, clinical decision making, fraud and abuse identification, and designing future payment systems (Centers for Disease Control and Prevention, 2015).

Reimbursement

Medical claims, which are coded using diagnoses and procedures, directly impact the level of reimbursement a service receives (Howard & Reddy, 2018). Therefore, effective coding and billing practices such as lower rates of medical coding denials from insurance companies and high provider coding accuracy rates can influence the financial stability of an organization (Burks et al., 2022). The United States revenue cycle system continues to pay a set reimbursement fee for each service rendered using CPT codes which relies on correct coding. In fact, in the year 2018, over 95% of healthcare payments received were fee for services (Keckley, 2021b). Even with healthcare working to set into place a reimbursement system that focuses on value over volume, most payments fall under fee-for-service indicating there is still a paramount significance on accurate CPT selection.

According to Howard and Reddy (2018), incorrectly coded documentation will result in a loss of revenue that can affect negatively how care is delivered. As the United States begins to evaluate new models of value-based payment methodologies that focus on the value of care provided instead of the volume of services rendered, value models will continue to depend intrinsically on accurate documentation and code selection. The process for payment may be shifting to value over volume, but coding will continue to drive how physicians are reimbursed for services as the code selection moves from being driven by CPT procedural codes to ICD-10-CM diagnosis codes (Aiello et al., 2016). Code selection also is used by insurance companies to determine whether a service is medically necessary, which will determine whether the service is paid or denied (Dick, 2020). Furthermore, inaccurate code selection can open providers up to significant risk such as legal investigation, exclusion from Federal payment programs such as Medicare and Medicaid, and even criminal investigations (Burks et al., 2022).

Contributing Factors of Coding Errors

Coder Risks

Medical coders often sit for exams through the American Academy of Professional Coders and American Health Information Management Association to become certified. The United States does not mandate that coders are certified to process medical claims; however, many medical coders seek certification to increase their education and salaries. The experience and education of a medical coder directly impact the accuracy of the documentation they are coding (Heywood et al., 2016; Roberts et al., 2018; Suleiman et al., 2020). Additionally, the title of clinical coder can cause confusion as medical coders are not required to have any clinical training and typically do not have contact with patients. This lack of clinical training can lead to coders omitting codes or applying the incorrect code due to their misunderstanding of the disease process (Roberts et al., 2018; Suleiman et al., 2020). The challenging environment to which coders are exposed also can cause mistakes to occur. Many employment opportunities for medical coders come with a productivity standard that must be met (Bajaj et al., 2007), which at times does not allow coders to absorb fully the documentation they are coding (Suleiman et al., 2020). Moreover, the language of the guidelines for CPT coding do not align with the typical terminology used by physicians, leading to assumptions by the coders.

Several studies have been completed on coding inaccuracies by medical coders. A recent study on inpatient coding data showed that out of 2,210 records from January 2016 to February 2018, 68% of these episodes had a missing code. Even though this study took place in the inpatient space, which focuses more on Diagnosis Related Groups as opposed to CPT, it is vital to recognize how easily coding errors can occur across all areas of healthcare (Suleiman et al., 2020). A study performed by Heywood et al. in 2016 found that coder error was the most common cause of incorrect coding. Coders missed information within the clinical notes or wrongly identified procedures and diagnoses. The authors of this study outline several reasons that medical coder inaccuracies existed including failure to follow national standards, inexperience, gaps in training, and increased pressure on tighter deadlines. Additionally, Lygrisse et al. (2020) found in their work on orthopedic coding cases that medical coders who lacked clinical orthopedic knowledge were unable to apply appropriate codes to the surgeon's documentation.

Physician Risks

Physicians are oftentimes pulled in two opposing directions between reimbursement rules and patient care. External reimbursement protocols imposed by insurance companies coupled with internal employment performance requirements rooted in productivity and quality metrics place physicians in a grim dilemma. Berenson and Rich (2010) found in their study on primary care physicians that this group has a long history of frustration with the insurance company reimbursement protocols and process combined with their employment performance expectationsClick or tap here to enter text.. Many physicians even argue that they are working in an unjust environment and by bending the insurance rules to secure payment and treatment, by upcoding and exaggerating patient diagnoses, for their patients they are acting in the best interest of the patients themselves, thus fulfilling their Hippocratic Oath (Wynia et al., 2000). Physicians feel they have a moral duty to protect patients from the system, even when this has repercussions.

This constant strain between providing exceptional patient care, compliance with insurance company reimbursement rules, and meeting employer mandated production rules has physicians feeling rushed, prone to burnout, and professionally dissatisfied (Drabiak & Wolfson, 2019). It is difficult to determine if these physicians are unknowingly being trained to commit fraud through contractual incentives within their organizations to see more patients and optimize the billing process (Drabiak & Wolfson, 2019). The 2016 report by the Healthcare Fraud Abuse and Control program reported that organizations are oftentimes disciplining providers that do not meet their production goals while simultaneously rewarding providers with cash bonuses tied to procedural revenue (Health Care Fraud and Abuse Control Program, 2016). This increased corporatization of medicine comes at an expense and has been argued to encourage fraudulent reimbursement behaviors (Drabiak & Wolfson, 2019). Healthcare costs are growing, fraud and abuse numbers continue to increase, medically unnecessary services are on the rise, patient safety is at risk due to adverse effects, and physician burnout numbers are the highest the United States has ever recorded (Berenson & Rich, 2010; Chesak et al., 2020; Health Care Fraud and Abuse Control Program, 2016; Patel et al., 2019; Wynia et al., 2000).

The Office of Inspector General (OIG) states that the ultimate responsibility for coding accuracy lands with the providers themselves, even if coding is completed by other departments within an organization (O'Donnell et al., 2020). This places an undue amount of stress on the providers given the high pace clinical environment in which they are working. Physicians are required to see more patients, to provide complex medical services, and to complete comprehensive documentation in an efficient manner, leaving a small amount of time left for the process of billing and coding (Burks et al., 2022).

Oftentimes documentation completed by the physicians is subpar for coding purposes. This can be attributed to the lack of education that providers receive during their training. Additionally, as discussed by Burks et al. (2020), many organizations lack formal education programs for practicing physicians. Given this lack of official training in residency and beyond, many physicians are not aware of how their procedures are being coded and therefore do not write operative notes that are easily understood from a coding perspective (Burks et al., 2022; Lygrisse et al., 2020; Roberts et al., 2018). Compensation plans that are salary based for physicians but include productivity bonuses based on relative value units also have shown to increase coding inaccuracies amongst physicians (Shah et al., 2014). The AMA states that 19% of providers that are under a salary model are at risk for aggressive coding practices to meet their production incentives (O'Reilly, 2018).

Graduate Medical Education (GME) Training

One of the most common subjects throughout the literature was that formalized training for physicians during residency is necessary to increase coding accuracy (Abdulla et al., 2020; Burks et al., 2022; Howard & Reddy, 2018; Murphy et al., 2014; Nicholls et al., 2017; Owji et al., 2022). During residency training most physicians do not receive any official structured education on financial and business concepts of medical practice (Bajaj et al., 2007) even though medical billing and coding is designated as one of the six core competencies by the Accreditation of Graduate Medical Education (ACGME) (Owji et al., 2022). Howard and Reddy in their 2018 study surveyed surgical residents and found that 92% believe that medical billing and coding will be a critical piece of their practice with 82% also believing that they are novices at coding (Howard & Reddy, 2018). Burks et al. (2022) found that amongst residents, fellows, and post-training providers there is a widespread feeling of being ill prepared and unfamiliar with the concepts of medical coding due to a lack of education received. Owji et al. (2022) conducted a recent survey of dermatology residents that discovered only 37% of residents had confidence in their coding abilities.

Medical coding in residency is also an indicator of resident operative experience (Balla et al., 2016; Murphy et al., 2014). The ACGME requires a recording of resident's operative experience in a case log. A study from Balla et al. (2016) found a review of case log entries by general surgery residents yielded an overall low correct selection rate of CPT codes billed. The ACGME case log represents the only objective measure of resident operative experience; therefore, an accurate case log is critical to representing competency in surgical residents. New limitations for resident work hours have created a sense of urgency for residents to learn to be efficient documenters, including documentation within the ACGME case log.

Other studies focusing on evaluation and management coding reveal a low level of accuracy. Evaluation and management codes are a section of CPT codes that define when a provider is involved with evaluating and managing a patient. According to Howard and Reddy (2018), student documentation is more likely to be coded at a lower level of service, which can also be attributed to a lack of formal evaluation and management training in medical school. A study from King et al. (2001) showed that evaluation and management coding between family physicians and expert coders found that they only agreed on 52% of established patient CPT codes and 17% of new patient CPT codes. Another study by Owji et al. (2022) found that even with education provided to residents that their evaluation and management coding remained unchanged from pre and post education while their procedural coding improved significantly.

Ambiguity in Guideline Application. Studies show that one of the most common causes of inaccuracies within the literature that plagues both physicians and coders is the complexity of the CPT coding guidelines (Aiello et al., 2016; Beck et al., 2020; Campbell & Giadresco, 2020; Cremeans et al., 2019). This lack of standardized easy-to-follow guidance costs the U.S. healthcare system billions annually (Cremeans et al., 2019). Assigning CPT codes in a consistent accurate manner is difficult and time intensive (Beck et al., 2020) due to the subjective nature of the guidelines for procedural coding (Aiello et al., 2016). Without a basic mechanism for coding, variability exists across institutions as coders and providers have difficulties interpreting the guidelines for the vast numbers of codes available for selection. It is not uncommon to see varied results for the same documentation between professional coders and providers (Beck et al., 2020; Nouraei et al., 2015).

Several different confusing areas within the guidelines presented themselves within the literature that make decision-making on the appropriate code difficult. Murphy et al. (2014) with their study on accuracy of foot and ankle CPT selection attribute the low accuracy rates to vague and imprecise terminology between how providers document and the language within the CPT guidelines. Coders are taught procedures and diagnosis codes using only the supplied lists from CPT and ICD-10-CM while physicians are not constrained by these types of lists and may use any number of names for a procedure or diagnosis that do not line up with the coders list to select from (Tang et al., 2017). Nouraei et al. (2015) found comparable results; these authors were able to improve coding accuracy by over 40% with a focus on bridging the language divide between clinical coders and medical professionals with regards to CPT guidelines. There is a basic issue with attempting to translate provider's "clinical" language into the specific "coding" language of standardized diseases and procedures that are necessary for data collection and code selection.

Documentation Concerns. Unclear documentation is a large driver of inaccurate coding according to the literature reviewed. Medical records begin as a narrative written by the physician and are converted to alphanumeric codes prior to insurance submission. It has been proven that frequently the narrative documentation physicians provide is insufficient for the needs of the coders and can be hinder claim submission (Alonso et al., 2020). Health professionals are not educated on the importance of medical documentation to the activity of medical coding, and it is not uncommon for documentation to be lacking in the necessary components for CPT selection (Bajaj et al., 2007). A study from Mahbubani et al. (2018) reinforced that poor clinical documentation is a major source of coding inaccuracies Click or tap here to enter text.. A recent trend in healthcare is the implementation of clinical documentation improvement departments that aim to assist physicians with improving their documentation using trained specialists. A recent study by Castaldi and McNelis (2019) found $1,792,591.91 in potential revenue opportunities and $65,097.30 in lost revenue opportunities when they implemented a multi-disciplinary clinical documentation improvement project.

A focus-group study in Portugal illustrates that poor documentation is an issue that occurs in other countries as well. Portuguese medical coders revealed that two of the most severe problems that hinder their job production are the lack of information within the medical record and unclear documentation (Alonso et al., 2020). Poor documentation impacts revenue and can lead to medical coding errors. Comprehensive documentation reduces coding errors, claim denials, and boosts revenue (Heywood et al., 2016). Furthermore, complete documentation is a core competency of medical education and serves other purposes outside of medical coding (Howard & Reddy, 2018).

Documentation can assist with quality measurements and prediction of patient outcomes (Burks et al., 2022). A study from Tang et al. (2017) that reviewed diagnosis codes in Canada revealed that they experience similar documentation barriers as the United States including incomplete and nonspecific physician documentation, discrepancies within the documentation, different terminology between providers and coders, and barriers to communication between providers and coders.

Proposed Solutions in the Literature

Physician Involvement in the Coding Process

Within the literature, several common solutions present themselves to ensure more accurate coding is being produced. The main recurring theme was that physicians should be involved in the coding process (Abdulla et al., 2020; Britton et al., 2009; Heywood et al., 2016; Mahbubani et al., 2018; Roberts et al., 2018). Even as the landscape of healthcare reimbursement changes to value-based payments, accountable care organizations, and risk adjustment, coding providers' knowledge will be as useful to ensure accurate ICD-10-CM code selection (Aiello et al., 2016). Since the OIG places coding accuracy squarely on the shoulders of the providers, it is important that they have a voice in this process and do not heavily rely on electronic health record tools and coding staff (Burks et al., 2022).

A multidisciplinary study performed by Aiello et al. (2016) found that reimbursement and relative value units for physicians were increased significantly when providers and coders collaborated on code selection. Likewise, coder to coder collaboration also has proven beneficial (Abdulla et al., 2020). Britton et al. (2009) called for coder and provider partnerships for medical coding that include coders dedicated to specific specialties to narrow down their knowledge in the same manner as physicians, as opposed to having professional coders working across all specialtiesClick or tap here to enter text..

Coders often make errors due to their lack of clinical knowledge and including providers in the coding process would allow mutual education to take place. Providers will learn more about the coding guidelines and process while coders will absorb more clinical knowledge (Mahbubani et al., 2018). The benefits of having all parties included in the coding process is clear throughout the literature, although this would require physician buy-in, and their already hectic schedules could prove prohibitive. For a successful collaboration between coders and providers, administrators would need to work to remove other administrative tasks from physician's schedules. The ICD-10-CM Official Coding Guidelines also call for the collaboration between medical coder and provider for accurate claim selection. The guidelines states:

> A joint effort between the healthcare provider and the coder is essential to achieve complete and accurate documentation, code assignment, and reporting of diagnoses and procedures. The importance of consistent, complete documentation in the medical record cannot be overemphasized. Without such documentation accurate coding cannot be achieved. The entire record should be reviewed to determine the specific reason for the encounter and the conditions treated. (p. 17)

Coding Education

As evident from the information provided previously on the lack of coding education for medical students, it is crucial that a formal medical coding education program be implemented for healthcare professionals. Barring a full overhaul of the coding process, creating education on the guidelines is the most obtainable method to increase coding accuracy. Feedback loops between providers and coders would work to educate both parties on procedures being performed and prevent recurrent billing errors from both sides (Burks et al., 2022). Educating clinical staff on the importance of medical coding would be a straightforward exercise that would show quick results. Heywood et al. (2016) found in their study that medical coding accuracy by providers can be improved by one single focused education session.

Gaps in the Literature

Many articles assessed focused on ICD-10-CM diagnosis coding with occasional mention of CPT coding in the United States. Also, there were significantly more articles surrounding inpatient coding, which uses a separate set of coding guidelines than coding in the professional space for physician reimbursement. Also, the CPT accuracy literature that was located centered around resident physicians with little discussion of post-training physicians and physicians that have been practicing for a significant amount of time. There was inadequate information on seasoned providers perceptions on the medical coding process as all surveys conducted were on medical students and residents. There was also no information on how the medical coding process specifically impacted physician burnout levels. The literature reviewed only referred to administrative responsibilities broadly as a contributing factor, which could be a variety of tasks.

Few studies presented themselves that showed a comparison between CPT selection by professional coders versus medical providers to determine which group has a higher accuracy rate, which is the focus of this study. Furthermore, numerous studies focused on coding requirements from CMS and not on guidelines from individual insurance payers, which is where most of the misinterpretation occurs. There was also an absence of a standard definition of what constituted an accurate code versus an inaccurate code. A uniform definition would give organizations the ability to audit and perform documentation reviews in a standardized manner, thus increasing coding accuracy.

Chapter Three

Methodology

Study Design

This study was a secondary data analysis of three datasets, each dated February 2022 – March 2022. The original proposed dates of analysis were February 2022 – May 2022; however, the Coding Quality Dataset provided by the Enterprise only included claims through the month of March due to the coding quality audits being performed on claims dating back 60 days. February and March dates of service provided a statistical relevant sample and were used. Coding Changes Log Dataset (PCCL) and the Coding Quality Dataset (CQR) were made available from a large nationwide multi-specialty enterprise of provider clinics. This enterprise of provider clinics will be referred to as Enterprise throughout this text. The third dataset was the Medicare Physician Fee Schedule (MPFS), which can be obtained from CMS.gov website. These data sources were combined using Excel and then analyzed in SPSS software to determine the answers to the research questions proposed.

Target Population

As stated, this study examined the coding accuracy of medical data that has been entered by various types of coders, including physicians and certified professional coders, and what variables impact these accuracy rates. Furthermore, the cost impact of these errors was calculated using the work relative value units obtained from the Medicare Physician Fee Schedule. The accuracy data reviewed was provided from the Enterprise and these data was contained in the Datasets 1 - PCCL and Dataset 2 - CQR generated from the Enterprise’s data warehouse. The target population for this study included physicians and certified professional coders employed at the Enterprise. The Enterprise provided written permission for use and analysis of these datasets with the agreement that all patient and employee information be redacted. The Enterprise providing the data has requested also that their company name not be used in the study. For analysis, physicians were divided into their specialty grouping to indicate if they are quantified as a medical specialty or a surgical specialty. A listing of the provider specialties in each grouping can be found in Appendix A.

Dataset 1 - PCCL showed the physician-selected CPT codes for any given date of service, and whether the certified professional coder agreed with the CPT selection or made any changes and what changes were made. An example of this dataset and a description of the columns can be found in Appendix B. Dataset 2 - CQR included a compilation of claims that have been reviewed by the Coding Quality team for the 408 certified professional coders that make up the Centralized Coding Unit and are employed at the Enterprise or provided coding services for the Enterprise but are employed by a third-party vendor. The Coding Quality team is comprised of certified coding auditors that are trained in the AMA guidelines and function to provide coding quality audits to the Centralized Coding Unit. Dataset 2 - CQR included the original CPT that was selected by the certified professional coders and whether the Coding Quality reviewer agreed or disagreed with the selection and what changes were made. An example of this dataset and a description of the columns can be found in Appendix C.

Dataset 2 - CQR did not include the work relative value unit (RVU) information for each CPT code. This information was obtained from Dataset 3 - MPFS, which is publicly available on the CMS website. RVU information was extracted from Dataset 3 -

MPFS and merged, along with information from the other two datasets, into a final comprehensive dataset. RVU information was needed to determine if the any codes that were changed resulted a financial impact to the Enterprise.

Sampling Criteria

The Enterprise comprises over 2,000 sites of care including ambulatory surgery centers, physician clinics, radiology clinics, urgent care clinics, and stand-alone emergency rooms. There was not a singular facility that was the focus of this study; all sites of care had the potential to have records for the time-period examined. The researcher extracted all records from February 2022 through March 2022 for both Datasets 1 - PCCL and Dataset 2 - CQR. These data included the entire provider (> 6,000) and medical coder (> 400) populations but only included claims that existed in both datasets.

Inclusion and Exclusion

All claims from the datasets that had a CPT selected by the physician, reviewed by the coder, final assessment by the Coding Quality team, and took place from February 2022 through March 2022 were reviewed. Furthermore, any claims that had been changed by any persons not within the coding group were excluded. This was evident in the dataset as a data point that showed if a change was made by the practice or other group not within the "Centralized Coding Unit."

Sample Size

The sample size included any claims that meet all three criteria of provider selected CPT, CPT reviewed by the coder, and final assessment by the Coding Quality team from February 2022 through March 2022. Dataset 2 - CQR included 6,535 claims that have been reviewed by the Coding Quality team. Dataset 1 - PCCL included 2,598,503 claims that were processed by the coders during this time frame. Individual case was the unit of observation and required a line to be created for each case for the provider and for the coder. This duplication of each case increased the observations once the datasets were combined and finalized.

The final number of cases that matched between Dataset 1 - PCCL and Dataset 2 CQR was 1,014 cases comprised of 4,036 individual CPT codes. Four hundred ninety-one medical providers had claims that matched between datasets (282 surgical providers and 209 medical providers). One hundred twelve certified professional coders had claims that matched between datasets (93 domestically employed coders and 23 third-party vendor coders). This number of cases was less than originally anticipated, although still significant, due to Dataset 1 - PCCL not containing data from one of the electronic medical records used by the Enterprise.

Data Cleanup Steps

Patient names were removed from Dataset 1 - PCCL and the provider, coder identification number, practice number (referred to as COID), and date of service were used as the identifier for comparison between datasets. Next Dataset 1 - PCCL required filtering of the “CCU Flag” Column to only show “CCU,” all “non-CCU” were removed from the dataset. This was done to include only claims that had been modified by the coders in the Centralized Coding Unit (CCU). Example provided in Appendix B of this column. Dataset 2 - CQR required combination with Dataset 3 - MPFS to insert the Work RVU information for each CPT code prior to the final merge. The Work RVU was added by using “VLook Up” Excel function for the CPT Code between the Dataset 3 - MPFS and Dataset 2 - CQR, column title “Total RVU Coder.” The same procedure was followed to add Total RVU for the QA CPT code to column titled “Total RVU QA.” The MPFS Look Up Tool from the year 2022 can be downloaded from https://www.cms.gov/medicaremedicare-fee-service-paymentphysicianfeeschedpfs-relative-value-files/rvu22c.

The “Vlookup” function was used on the date of service from Dataset 2 - CQR to initially narrow down claims, an additional “Vlookup” on provider identification number and then coder identification number was performed to find the final subset of claims to be reviewed. The merged dataset was saved into a new spreadsheet titled “Final SPSS Upload of Merged Claims Data.” The new dataset required manipulation and recoding prior to the analysis. Since individual case was used as the unit of observation, two rows were created for each case being analyzed. The first row was for the physician selected codes for the case and a column was added titled “Index” to indicate that this was a “physician” error rate for this case. The second row was the certified coder’s selected codes for the case and a column was added titled “Index” to indicate that this is a “coder” error rate for this case. To ensure the independence assumption was not violated prior to analysis, any coder and/or physician that had multiple cases within the datasets required an additional column to be added to the final dataset to indicate the number of cases per individual coder and/or physician; the cases were counted within this column.

On the new dataset, variables were recoded for upload into SPSS for analysis. All columns that match data between datasets but are named differently were renamed identically for matching within SPSS. Unique identifiers for the providers and certified professional coders were created. The provider’s specialty “PROV” was recoded dichotomously and titled "PROV_RC" to indicate if they practice in a (1) surgical specialty or (2) medical specialty. The certified professional coder's "CPC" was recoded dichotomously and titled "CPC_RC" to indicate if the coder is (1) domestically employed or (2) third-party vendor employed. An additional column was added titled "CODEMATCH" to indicate the impact of the error and within this column the data was recoded to indicate (-1) Down-code, (0) Match, (1) Over-code.

The CPT Category for the initially selected CPT code was recoded to "CPTCat_RC" from 1-10 to indicate the category within CPT that the error occurred:

1) 00000-09999: Anesthesia Services
2) 10000-19999: Integumentary System
3) 20000-29999: Musculoskeletal System
4) 30000-39999: Respiratory, Cardiovascular, Hemic, and Lymphatic System
5) 40000-49999: Digestive System
6) 50000-59999: Urinary, Male Genital, Female Genital, Maternity Care, and Delivery System
7) 60000-69999: Endocrine, Nervous, Eye and Ocular Adnexa, Auditory System
8) 70000-79999: Radiology Services
9) 80000-89999: Pathology and Laboratory Services
10) 90000-99999: Evaluation & Management Services

An example of the final merged dataset prior to variable recoding is in Appendix D.

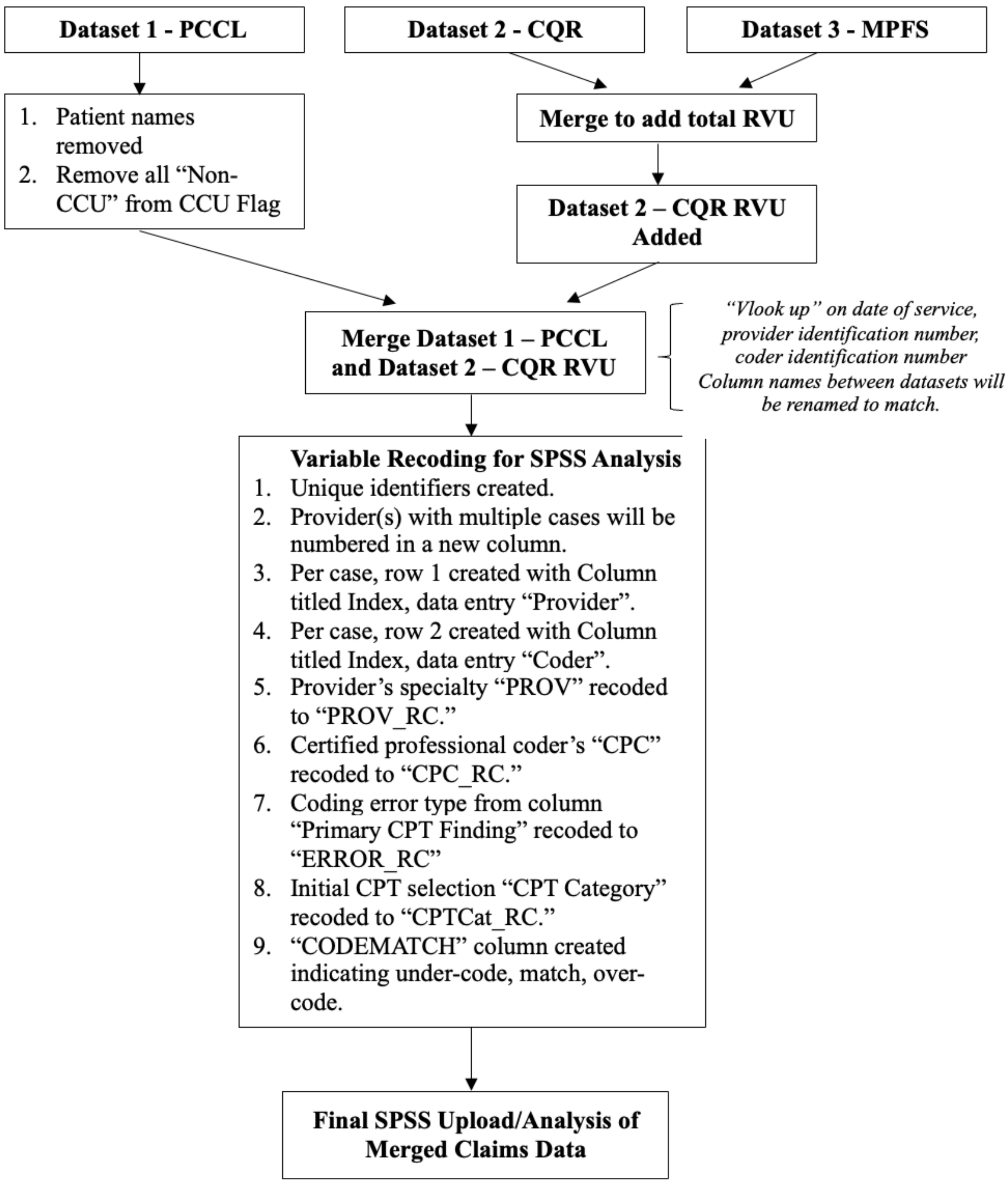
Data Collection

Datasets 1 - PCCL and Dataset 2 - CQR were downloaded to Excel from a Microstrategy Dashboard of Reports made available by the Enterprise from within their data warehouse. To determine the accuracy rate of the population groups, the "gold standard" for accuracy was the code selected by the certified Coding Quality team; this code is depicted on Dataset 2 - CQR as the variable "ErrorType_RC."

Prior to data analysis, the datasets were combined to find claims that met the criteria of having CPT selection by the provider, medical coder, and final review by the Coding Quality team. Therefore, the datasets were into one dataset within SPSS to create the final consolidated dataset (Figure 2). That final merged dataset was analyzed in SPSS in using mix model analysis to determine accuracy rates.

Figure 2

Graphic of Combined Dataset Outcome



Data Analysis

As a test for the accuracy of the data merge and recoding process, after the data merge had taken place and the columns were added to the final dataset, the resulting dataset was examined by a third party. No errors were detected, and the data was determined to be "clean" for analysis to occur. The final merged dataset was analyzed in SPSS v29 to answer the research questions and determine accuracy rates, types, and variables that impacted accuracy among the various groups. Mixed-model analysis was used to evaluate the results. The resulting output from SPSS provided tables indicating the Estimated Marginal Means and Estimated Fixed Effects, which were used to determine accuracy. To determine the financial impact of coding errors, analysis also occurred in Excel utilizing the MPFS work relative value unit information located at https://www.cms.gov/medicaremedicare-fee-service-paymentphysicianfeeschedpfs-relative-value-files/rvu22c. This showed the overall financial impact of any errors that took place quantified using work relative value units.

Research Questions and Variables

RQ1: What group between providers and certified professional coders has a higher rate of upcoding CPTs for claims data?						
	Hypothesis	**IV**	**IV Data Type**	**DV**	**DV Data Type**	**Statistical Test**
1	Surgical providers will have a higher rate of upcoding services than certified professional coders.	PROV_RC CPC	Categorical (Nominal)	CODE MATCH	Categorical (Dichotomous Nominal)	Mixed Model Analysis

RQ2: What groups between providers and certified professional coders has a higher rate of unbundling CPTs for claims data?						
	Hypothesis	**IV**	**IV Data Type**	**DV**	**DV Data Type**	**Statistical Test**
2	Surgical providers will have a higher rate of unbundling services than certified professional coders.	PROV_RC CPC	Categorical (Nominal)	CODE MATCH	Categorical (Dichotomous Nominal)	Mixed model analysis

RQ3: Is there a statistical significance between coding accuracy for groups of providers and certified professional coders for CPT selection for claims data?						
	Hypothesis	**IV**	**IV Data Type**	**DV**	**DV Data Type**	**Statistical Test**
3	Surgical providers will be more accurate at CPT code selection than certified professional coders.	PROV_RC CPC	Categorical (Nominal, dichotomous)	CODE MATCH	Categorical (Nominal)	Mixed model analysis

RQ4: Is there a statistical significance between coding accuracy for certified professional coders employed domestically and certified professional coders employed by third-party vendors?						
	Hypothesis	**IV**	**IV Data Type**	**DV**	**DV Data Type**	**Statistical Test**
4	Certified professional coders employed domestically will be more accurate than third-party vendors.	CPC_RC	Categorical (Nominal, dichotomous)	CODE MATCH	Categorical (Nominal)	Mixed model analysis

RQ5: Is there a statistical significance between coding accuracy for providers in medical specialties and providers in surgical specialties?						
	Hypothesis	**IV**	**IV Data Type**	**DV**	**DV Data Type**	**Statistical Test**
5	Surgical providers will have a higher accuracy rate for CPT selection than medical providers.	PROV_RC	Categorical (Nominal, dichotomous)	CODE MATCH	Categorical (Nominal)	Mixed model analysis

RQ6: Is there a statistical significance of the category of CPT codes where providers and certified professional coders have the most errors?						
	Hypothesis	**IV**	**IV Data Type**	**DV**	**DV Data Type**	**Statistical Test**
6.1	Medical providers will have the most errors within the evaluation and management CPT code category (90000-99999).	PROV_RC	Categorical (Nominal)	CPTC_RC	Categorical (Ordinal)	Mixed model analysis
6.2	Certified professional coders will have the most errors within the Respiratory, Cardiovascular, Hemic, and Lymphatic System (30000-39999) category of CPT codes.	CPC	Categorical (Nominal)	CPTC_RC	Categorical (Ordinal)	Mixed model analysis

RQ7: Which group has the highest cost impact for medical coding errors?						
	Hypothesis	**IV**	**IV Data Type**	**DV**	**DV Data Type**	**Analysis**
7.1	Providers will have the largest cost impact from medical coding errors.	PROV	Categorical (Nominal)	FIMPACT	Continuous	+SUM function in Excel

Institutional Review Board

The applicable Institutional Review Board (IRB) forms were completed, and all guidelines followed once proposal approval occurred on February 28, 2023. An application was submitted to the IRB office at Radford University Carilion with appropriate input from the Enterprise including a Letter of Cooperation from the Assistant Chief Operating Officer. A copy of the IRB approval can be found in Appendix G.

Chapter 4

Results

This study analyzed the medical coding accuracy rates of medical providers and certified professional coders by secondary data analysis of two datasets provided by the Enterprise during the timeframe of February 2022 – March 2022 and the Medicare Physician Fee Schedule. Mixed model and Chi Square statistical analysis was used to determine the overall accuracy of both groups comparatively as well as the subgroups that were defined within each larger group. Mixed model analysis was selected for use due to the presence of both fixed and random variables. Chi Square tests were also utilized to test for statistical significance and define the frequency in which errors occurred by type. Datasets were downloaded from the Enterprise's data warehouse within Microstrategy to Microsoft Excel. The datasets were merged to find claims that met the criteria of: (a) provider selected CPT code, (b) medical coder selected CPT code, and (c) final review by the Coding Quality team. Once the dataset merge was completed, the data were cleaned, and variables were re-coded for statistical analysis with SPSS version 29. Included in this chapter is the examination of the research questions proposed, and the statistical analysis used for determination.

Sample

Dataset 1 -PCCL contained 2,958,503 claims that were processed by the coders from February 2022 – March 2022. Dataset 2 (CQR) contained 6,535 claims that were reviewed for accuracy by the Coding Quality team. Random sampling was not performed since the entire month of February and March were reviewed. The data merge took place to find claims on both datasets that contained provider selected CPT, coder review of provider selection, and final review by the Coding Quality team. After the data merge was completed to create the final spreadsheet for SPSS analysis, the following sample was used:

- 1,014 cases matched between datasets
- 4,036 individual CPT codes were contained within the matched claims between datasets (2018 for providers and 2018 for medical coders)
- 491 medical providers had claims that matched between datasets
  - 282 surgical providers
  - 209 medical providers
- 112 certified professional coders had claims that matched between datasets
  - 93 domestically employed coders
  - 23 third-party vendor coders

The Medicare Physician Fee Schedule was used to find the work relative value unit information for the CPT codes to determine what work relative value unit impact the errors caused. The Medicare Physician Fee Schedule contains information for the 17,602 HCPCS/CPT codes present in the CPT Coding System from the American Medical Association.

Results of the Study

Mixed model statistics revealed the accuracy of the groups defined in addition to the categories within the CPT coding book where the errors occurred. Microsoft Excel was used to determine the overall financial impact (quantified in work relative value units) for the number of CPT codes that were down coded or over-coded incorrectly by the defined groups. For mixed model analysis, the data required a vertical recoding process to occur after cleaning was complete to give a score for the provider selected CPT and coder selected CPT individually. The score system for each CPT was (-1) down-code, (0) match, (1) over-code. Furthermore, to ensure the independence assumption was not violated during the statistical analysis, due to the presence of repeated measures from the same provider and medical coder, the coders and providers were consecutively numbered to account for multiple coding incidences attributed to one individual. Additionally, Pearson Chi-Square test were run to show the frequencies in which coding errors were occurring and by whom.

Research Question 1

RQ1: What group between providers and certified professional coders has a higher rate of upcoding CPTs for claims data?

> H1: Surgical providers will have a higher rate of upcoding services than certified professional coders.
>
> $H1_0$: Surgical providers will not have a higher rate of upcoding services than certified professional coders.

Using the Type III Tests of Fixed Effects table on the variable Entry_Type2 (surgical providers medical providers, and all certified professional coders) it was determined that there is a relationship between the person who entered the code and their accuracy. Significance was shown with value of 0.003 ($p < 0.05$) (Table 4). The dependent variable used was CODEMATCH and the scoring methodology of (-1) down-coding, (0) match, (1) over-coding with a confidence interval of 95%. Additionally, to show the frequencies in which over-coding occurred within the sample population, Chi-Square tests were performed. Figure 3 shows the graph of Coding Input by Entry_Type2. The frequency at which upcoding occurred was higher within the surgical provider subgroup (Table 5) and significance was found with a p value = < .001 (Table 6). Therefore, the null hypothesis was rejected.

Table 4

Type III Tests of Fixed Effects[a] - Entry Type 2

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	4036.000	63.626	<.001
EntryType_2	2	4036.000	5.912	.003

Note. Dependent Variable: CodeMatch. (p<0.05), EntryType_2 = surgical providers, medical providers, and all certified professional coders

Table 5

*EntryType_2 * CodeMatch Crosstabulation*

Count		Down-code	Match	Over-code	Total
EntryType_2	CPC	18	1936	64	2018
	Medical	46	797	84	927
	Surgical	71	879	141	1091
Total		135	3612	289	4036

Table 6

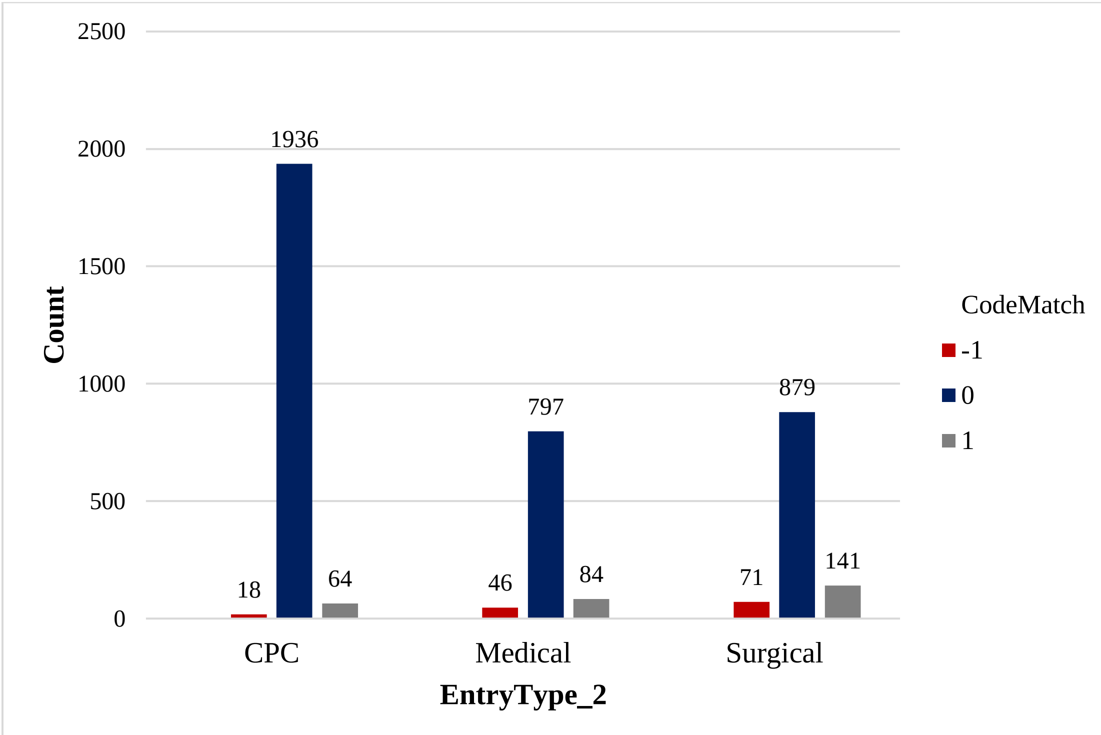
Chi-Square Tests – Entry_Type2 & CodeMatch

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	196.666[a]	4	<.001
Likelihood Ratio	205.539	4	<.001
N of Valid Cases	4036		

Note. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 31.01.

Figure 3

Bar Graph – CODEMATCH Input by CPCs and Provider Subgroups



Note. CPC = all certified professional coders. CodeMatch (-1) down-code, (0) match, (1) over-code

Furthermore, Mixed Model analysis and Chi-Square tests were performed on the overall groups of providers and coders. Chi-Square test noted significance (< .001) for provider to coder groups (Table 7) and found the coders have a lower frequency of upcoding than providers (Table 8). All groups tended to over-code.

Table 7

Chi-Square Tests – Coder Group to Provider Group

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	181.007[a]	2	<.001
Likelihood Ratio	194.886	2	<.001
N of Valid Cases	4036		

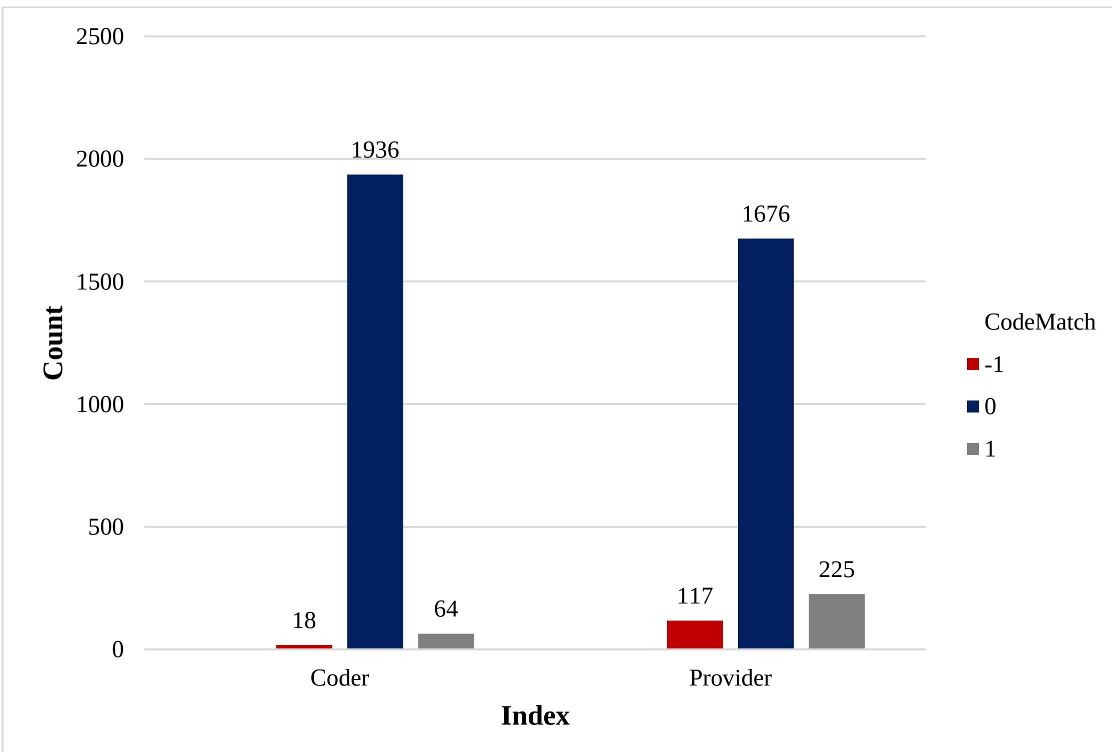
Table 8

*Index * CodeMatch Crosstabulation*

Count		Down-code	Match	Over-code	Total
Index	Coder	18	1936	64	2018
	Provider	117	1676	225	2018
Total		135	3612	289	4036

Figure 4

Bar Graph - CODEMATCH Input by All Groups



Note. CodeMatch (-1) down-code, (0) match, (1) over-code

Research Question 2

RQ2: What groups between providers and certified professional coders has a higher rate of down-coding CPTs for claims data?

H2: Surgical providers will have a higher rate of down-coding services than certified professional coders.

$H2_0$: Surgical providers will not have a higher rate of down-coding services than certified professional coders.

Using the Type III Tests of Fixed Effects on the variable Entry_Type2 (surgical providers medical providers, and all certified professional coders) it was determined that there is a relationship between the person who entered the code and their accuracy. Significance was shown with value of 0.003 ($p < 0.05$) (Table 4). The dependent variable used was CODEMATCH and the scoring methodology of (-1) down-coding, (0) match, (1) over-coding with a confidence interval of 95%. Additionally, to show the frequencies in which down-coding occurred, Chi-Square tests were performed. Figure 3 shows the graph of Coding Input by Entry_Type2. The frequency at which down-coding occurred was higher within the surgical provider subgroup (Table 5). Therefore, the null hypothesis was rejected.

Research Question 3

RQ3: Is there a statistical significance between coding accuracy for groups of providers and certified professional coders for CPT selection for claims data?

H3: Surgical providers will be more accurate at CPT code selection than certified professional coders.

$H3_0$: Surgical providers will not be more accurate at CPT code selection than certified professional coders.

Using the Type III Tests of Fixed Effects (Table 9) on the variable Index (all providers, all CPCs) it was determined that there is a relationship between the person who entered the code and their accuracy within all groups analyzed ($p = .002$). The Estimated Marginal Means – Index shows means values for the coders (0.021) and providers

(0.052). Therefore, certified coders are -0.031 more accurate than providers (Table 10). Furthermore, Chi-Square analysis (Table 5) shows surgical providers were shown to have the highest frequency of errors out of the groups surveyed (Figure 3). Therefore, the null hypothesis failed to be rejected.

Table 9

Type III Tests of Fixed Effects[a] - Index

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	880.875	38.950	<.001
Index	1	3159.060	10.057	.002

Note. (a) Dependent Variable: CodeMatch.

Table 10

Estimated Marginal Means - Index[a]

				95% Confidence Interval	
Index	Mean	Std. Error	df	Lower Bound	Upper Bound
Coder	.021	.008	2215.584	.006	.036
Provider	.052	.008	2213.142	.037	.067

Note. (a) Dependent Variable: CodeMatch.

Research Question 4

RQ4: Is there a statistical significance between coding accuracy for certified professional coders employed domestically and certified professional coders employed by third-party vendors?

> H4: Certified professional coders employed domestically will be more accurate than third-party vendors.
>
> $H4_0$: Certified professional coders employed domestically will not be more accurate than third-party vendors.

The Type III Test of Fixed Effects – CPC_RC (Table 11) showed no statistical significance between subgroups of certified professional coders on accuracy (p = 0.792).

Furthermore, Estimated Marginal Means (Table 12) show domestic employed coders mean value of 0.036 and third-party vendor coders with a mean value of 0.040. Domestic employed coders are only slightly more accurate (-.004) than third-party coders. However, results are not significant. It must be noted that out of the sample size of certified professional coders there were only 23 third-party vendors within the population. Therefore, the null hypothesis failed to be rejected.

Table 11

Type III Tests of Fixed Effects[a] – CPC_RC

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	1010.609	21.165	<.001
CPC_RC	1	1042.112	.070	.792

Note. (a) Dependent Variable: CodeMatch. CPC_RC = domestically employed coders, third-party vendor coders.

Table 12

Estimated Marginal Means - CPC_RC[a]

				95% Confidence Interval	
CPC_RC	Mean	Std. Error	df	Lower Bound	Upper Bound
1	.036	.006	867.338	.023	.048
2	.040	.015	1057.215	.010	.070

Note. (a) Dependent Variable: CodeMatch. CPC_RC (1) domestically employed coders (2) third-party vendor coders

Research Question 5

RQ5: Is there a statistical significance between coding accuracy for providers in medical specialties and providers in surgical specialties?

H5: Surgical providers will have a higher accuracy rate for CPT selection than medical providers.

$H5_0$: Surgical providers will not have a higher accurate rate for CPT selection than medical providers.

The Type III Test of Fixed Effects – PROV_RC (Table 13) showed no statistical significance between subgroups of providers (p = .120). Furthermore, Estimated Marginal Means (Table 14) show surgical providers tendency to upcode with a mean value of 0.045. This was also shown in Chi-Square results (Table 5, Figure 3). Estimated Marginal Means further showed that medical providers (p = 0.026) were slightly more accurate than surgical providers (p = 0.045), although results are not significant. Therefore, the null hypothesis failed to be rejected.

Table 13

Type III Tests of Fixed Effects[a] – PROV_RC

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	865.459	36.788	<.001
PROV_RC	1	865.459	2.426	.120

Note. (a) Dependent Variable: CodeMatch. PROV_RC = Surgical Providers, Medical Providers

Table 14

Estimated Marginal Means – PROV_RC[a]

				95% Confidence Interval	
PROV_RC	Mean	Std. Error	df	Lower Bound	Upper Bound
1	.045	.008	948.356	.029	.060
2	.026	.009	805.059	.009	.043

Notes. (a.) Dependent Variable: CodeMatch. PROV_RC = (1) Surgical Providers, (2) Medical Providers

Research Question 6

RQ6: Is there a statistical significance of the category of CPT codes where providers and certified professional coders have the most errors?

> H6.1: Medical providers will have the most errors within the evaluation and management CPT code category (90000-99999).

$H6.1_0$: Medical providers will not have the most errors within the evaluation and management CPT code category.

H6.2: Certified professional coders will have the most errors within the errors within then Respiratory, Cardiovascular, Hemic, and Lymphatic System (30000-39999) category of CPT codes.

$H.6.2_0$: Certified professional coders will not have the most errors within the errors within then Respiratory, Cardiovascular, Hemic, and Lymphatic System (30000-39999) category of CPT codes.

Use the Type III Test of Fixed Effects – Index and CAT_RC (Table 15) show that there is no relationship between the variable Index (Provider or Coder) and CAT_RC (what category of CPT the error occurs in). These results indicate there is no significance to carry the main effect. Estimated Marginal Means – CAT_RC (Table 16) show that there are categories within CPT that are significant, however, the overall effect of all categories is not significant. This is also seen in the Estimated Marginal Means – Index*CAT_RC (Table 17), which shows that there are categories of CPT in which the providers and coders are making significant errors; however, overall, the results of all categories are not significant. This is illustrated in Figure 4 below.

Table 15

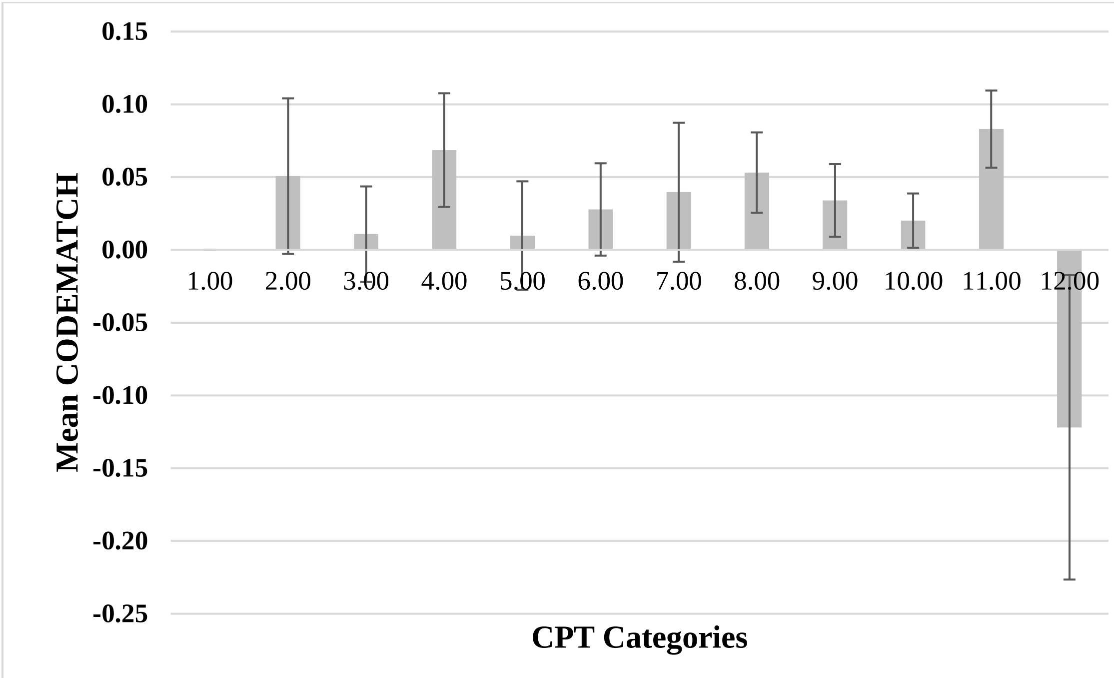
Type III Tests of Fixed Effects[a] – Index and CAT_RC

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	2318.116	2.186	.139
Index	1	3271.190	.164	.685
CAT_RC	11	2653.264	.918	.522
CAT_RC * Index	11	3870.222	.895	.544

Notes. (a) Dependent Variable: CodeMatch. CAT_RC = CPT Categories, Index = All Providers, All CPCs

Figure 5

Simple Bar Mean of Coding Errors by CPT Category



Notes. (a) Dependent Variable: CodeMatch.
This Figure shows the means for all groups (provider and coders) for CPT categories.

1. 00000-09999 (Anesthesia)
2. 10000-19999 (Integumentary System)
3. 20000-29999 (Musculoskeletal System)
4. 30000-39999 (Respiratory, Cardiovascular, Hemic, and Lymphatic System)
5. 40000-49999 (Digestive System)
6. 50000-59999 (Urinary, Male Genital, Female Genital, Maternity Care, and Delivery System)
7. 60000-69999 (Endocrine, Nervous, Eye and Ocular Adnexa, Auditory System)
8. 70000-79999 (Radiology Services)
9. 80000-89999 (Pathology and Lab Services)
10. 90281 – 99199; 99500-99607 (Medicine Section)
11. 99202 – 99499 (Evaluation and Management Section)
12. HCPCS (Drugs, biologicals, and non-drug/non-biological items not included in 0000-99499)

Table 16

Estimated Marginal Means - CAT_RC[a]

CAT_RC	Mean	Std. Error	df	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	2.776E-17	.167	2537.045	-.328	.328
2	.054	.024	1984.907	.007	.101
3	.056	.018	2046.861	.021	.092
4	.036	.019	2445.040	-.002	.073
5	.035	.020	2096.029	-.004	.074
6	.041	.017	1909.422	.007	.075
7	.019	.034	2608.838	-.048	.086
8	.026	.019	2790.403	-.010	.063
9	.037	.024	2951.847	-.009	.083
10	.030	.011	1517.229	.009	.052
11	.043	.013	2613.879	.018	.068
12	-.100	.051	3781.476	-.200	.001

Notes. (a) Dependent Variable: CodeMatch.
This table shows the means for all groups for CPT Categories.

1. 00000-09999 (Anesthesia)
2. 10000-19999 (Integumentary System)
3. 20000-29999 (Musculoskeletal System)
4. 30000-39999 (Respiratory, Cardiovascular, Hemic, and Lymphatic System)
5. 40000-49999 (Digestive System)
6. 50000-59999 (Urinary, Male Genital, Female Genital, Maternity Care, and Delivery System)
7. 60000-69999 (Endocrine, Nervous, Eye and Ocular Adnexa, Auditory System)
8. 70000-79999 (Radiology Services)
9. 80000-89999 (Pathology and Lab Services)
10. 90281 – 99199; 99500-99607 (Medicine Section)
11. 99202 – 99499 (Evaluation and Management Section)
12. HCPCS (Drugs, biologicals, and non-drug/non-biological items not included in 0000-99499)

Table 17

*Estimated Marginal Means - Index * CAT_RC[a]*

Index	CAT_RC	Mean	Std. Error	df	95% Confidence Interval	
					Lower Bound	Upper Bound
Coder	1	2.776E-17	.227	3916.368	-.445	.445
	2	.034	.034	3354.256	-.033	.100
	3	.017	.024	3298.825	-.030	.063
	4	.018	.027	3580.769	-.035	.072
	5	.026	.026	3460.136	-.025	.076
	6	.023	.024	3367.553	-.024	.069
	7	.037	.050	3688.187	-.060	.135
	8	.007	.027	3748.010	-.045	.059
	9	.017	.031	3764.108	-.043	.077
	10	.026	.014	2925.394	-.002	.054
	11	.018	.018	3661.168	-.017	.052
	12	-.013	.074	3986.474	-.159	.132
Provider	1	2.776E-17	.227	3916.368	-.445	.445
	2	.074	.030	3303.433	.015	.134
	3	.096	.025	3427.839	.047	.146
	4	.053	.025	3506.962	.004	.102
	5	.044	.028	3461.895	-.010	.099
	6	.060	.023	3389.955	.014	.106
	7	.000	.043	3631.692	-.084	.085
	8	.046	.025	3692.005	-.003	.095
	9	.057	.034	3798.785	-.010	.123
	10	.035	.015	3036.741	.005	.064
	11	.068	.017	3610.454	.035	.102
	12	-.186	.069	4022.978	-.321	-.051

Notes. (a) Dependent Variable: CodeMatch.
This table shows the means broken down by coder and provider (Index) for CPT Categories (CAT_RC)

1. 00000-09999 (Anesthesia)
2. 10000-19999 (Integumentary System)
3. 20000-29999 (Musculoskeletal System)
4. 30000-39999 (Respiratory, Cardiovascular, Hemic, and Lymphatic System)
5. 40000-49999 (Digestive System)
6. 50000-59999 (Urinary, Male Genital, Female Genital, Maternity Care, and Delivery System)
7. 60000-69999 (Endocrine, Nervous, Eye and Ocular Adnexa, Auditory System)
8. 70000-79999 (Radiology Services)
9. 80000-89999 (Pathology and Lab Services)
10. 90281 – 99199; 99500-99607 (Medicine Section)
11. 99202 – 99499 (Evaluation and Management Section)
12. HCPCS (Drugs, biologicals, and non-drug/non-biological items not included in 0000-99499)

Research Question 7

RQ7: Which group between certified professional coders and medical providers has the highest cost impact for medical coding errors?

Using Microsoft Excel sum function, the variable for impact in work relative value units for both providers and certified professional coders was summed to determine financial impact. Since this study is focused on provider professional services and does not consider facility versus non-facility reimbursement values the impact has been quantified using work relative value units. Work relative value units are the primary indicator of physician productivity and are the basis of many physician compensation models (Beck et al., 2020).

This number is of interest from a financial perspective to determine if productivity and/or compensation for providers is being under or overestimated. Providers in this study down-coded claims for a total of -270.25 wRVUs and over-coded claims for a total of 558.19 wRVUs. Interestingly, out of the numbers above surgical providers accounted for -216.84 of the under-coding and 431.33 of the over-coding (Table 18). This illustrates that all groups are over-coding.

Table 18

Financial Impact in Work Relative Value Units – All Groups

Error Type	Surgical Providers	Medical Providers	Domestic CPC	Third Party CPC
Over-code	431.33	126.86	141.97	60.58
Down-code	-216.84	-53.41	-18.03	-27.54
Net wRVU	214.49	73.45	123.94	33.04

Summary

In summary, after a thorough review of the data, the following results were found by using mixed model and Chi-square statistical analysis.

Table 19

Research Questions and Hypotheses Table

Research Question	Hypothesis	Null Hypothesis	Result
RQ1: What group between providers and certified professional coders has a higher rate of upcoding CPTs for claims data?	**H1.1:** Surgical providers will have a higher rate of upcoding services than certified professional coders.	**H1.1$_o$:** Surgical providers will not have a higher rate of upcoding services than certified professional coders.	The null hypothesis was rejected.
RQ2: What groups between providers and certified professional coders has a higher rate of down-coding CPTs for claims data?	**H2.1**: Surgical providers will have a higher rate of down-coding services than certified professional coders.	**H2.1$_o$:** Surgical providers will not have a higher rate of down-coding services than certified professional coders.	The null hypothesis was rejected.
RQ3: Is there a statistical significance between coding accuracy for groups of providers and certified professional coders for CPT selection for claims data?	**H3.1:** Surgical providers will be more accurate at CPT code selection than certified professional coders.	**H3.1$_o$:** Surgical providers will not be more accurate at CPT code selection than certified professional coders.	Failure to reject the null.
RQ4: Is there a statistical significance between coding accuracy for certified professional coders employed domestically and certified professional coders employed by third-party vendors?	**H4.1:** Certified professional coders employed domestically will be more accurate than third-party vendors.	**H4.1$_o$:** Certified professional coders employed domestically will not be more accurate than third-party vendors.	Failure to reject the null.
RQ5: Is there a statistical significance between coding accuracy for providers in medical specialties and providers in surgical specialties?	**H5.1:** Surgical providers will have a higher accuracy rate for CPT selection than medical providers.	**H5.1$_o$:** Surgical providers will not have a higher accurate rate for CPT selection than medical providers.	Failure to reject the null.
RQ6: Is there a statistical significance of the category of CPT codes where providers and certified professional coders have the most errors?	**H6.1:** Medical providers will have the most errors within the evaluation and management CPT code category (90000-99999).	**H6.1$_o$:** Medical providers will not have the most errors within the evaluation and management CPT code category.	Failure to reject the null
	H6.2: Certified professional coders will have the most errors within the errors within then Respiratory, Cardiovascular, Hemic, and Lymphatic System (30000-39999) category of CPT codes.	**H6.2$_o$:** Certified professional coders will not have the most errors within the errors within then Respiratory, Cardiovascular, Hemic, and Lymphatic System (30000-39999) category of CPT codes.	Failure to reject the null

Chapter 5

Discussion

The primary purpose of this research was to determine who has more accurate CPT selection between providers and certified medical coders, what additional factors impact error rates, and what the cost of these errors are using two datasets provided by the Enterprise and information from the Medicare Physician Fee Schedule. The data analyzed from the two datasets provided were used to evaluate the accuracy among the providers and certified professional coders and the accuracy of the defined subgroups (surgical providers, medical providers, domestically employed coders, and third-party vendor coders). It was determined that there is a relationship between the person who entered the code and their accuracy. The secondary data analysis of these datasets found that certified professional coders have a higher accuracy than providers. Within the provider subgroups of analysis, significance was not found between medical providers and surgical providers. All groups tended to upcode. Surgical providers did upcode and down-code more than medical providers and certified professional coders. Within the coder subgroup of analysis, there was no significance found between domestically employed coders and third-party vendor coders.

Although no significance was found for errors within all the CPT categories, there were specific categories that showed significance. Determining the accuracy rates between certified professional coders and providers, and the areas in which errors occurred will allow educational programs to be created that are more specific than the broad programs in place currently. Additionally, this study could spearhead Federal policy changes that call for individuals to be certified to participate in the medical coding process, requirements for physician training on coding during their graduate medical education training and encourage organizations to hire certified professional coders for their coding needs.

Discussion of the Results

It was determined that there is a relationship between the person who entered the code and their accuracy. Significance was shown with value of 0.003 ($p < 0.05$) (Table 4). Within all groups (providers and certified professional coders) studied, certified professional coders were found to be more accurate than providers. Within all subgroups (surgical providers, medical providers, domestically certified professional coders, third-party vendor coders) studied, medical providers had the highest accuracy. Furthermore, surgical providers were found to have the lowest accuracy for CPT selection within all groups studied. All groups reviewed upcoded services; however, surgical providers did this at the highest rate.

Statistical significance for the following individual CPT categories was noted, although no significance was found for entry type and all CPT categories combined.

- Radiology (70000-79999)
- Pathology and Lab Services (80000-89999)
- Evaluation and Management Services (99202-99499)
- HCPCS (Codes not included in 0000-99499)

Additionally, the surgical provider group proved to have the most financial impact (shown in work relative value units) on coding errors by upcoding 431.11 wRVUs and under-coding -216.84 wRVUs from February – March 2022. As stated previously, providers on productivity-based compensation models use wRVU as the unit of measurement for production. Therefore, increases and decreases in wRVUs that correspond with upcoding and down-coding have a direct impact on provider compensation and organizational revenues spent on provider salaries. While coding and compensation are often factors in coding error, causes of error were not part of this study.

Relationship of the Findings to Prior Research

Coder Error Size

This study is one of the first to study certified professional coders only and not coders performing coding functions without a certification. Even though other studies (Heywood et al., 2016; Lygrisse et al., 2020) found that coding errors can be predominately attributed to coders, there is no clear mechanism to determine if the coders in these studies possessed a certification. This study found that overall certified professional coders are more accurate than providers for CPT selection. Furthermore, this study looked at all categories of CPT codes to determine accuracy rates and did not focus on one singular category of interest. Further studies are necessary to determine what variables cause errors to occur within these specific categories.

Education and Training

Since statistical significance was shown for coding errors across all groups, this study further solidifies that both certified professional coders and providers require more education for CPT selection (Burks et al., 2022; Howard & Reddy, 2018; Owji et al., 2022; Roberts et al., 2018; Suleiman et al., 2020). These findings also make clear the necessity for a standardized education program for physicians during residency and a more formal education process for certified professional coders. Former studies call for a collaboration between providers and medical coders that allows for mutual education to occur (Abdulla et al., 2020; Britton et al., 2009; Heywood et al., 2016; Mahbubani et al., 2018; Roberts et al., 2018). This study found statistical significance for coding errors across all groups; therefore, the argument for including providers and coders in the process collectively is a valid one. Mutual education needs to occur between groups to increase accuracy rates of all involved in the coding process. This inclusion of both providers and coders in the process of medical coding would not only allow for mutual education to occur but also create an environment of trust between both parties working together on accurate code selection (Abdulla et al., 2020; Britton et al., 2009; Heywood et al., 2016; Mahbubani et al., 2018; Roberts et al., 2018).

Previous studies focused on the Evaluation and Management section of CPT (CPT Codes 99202 – 99499) with findings that show providers and coders rarely agree on Evaluation and Management CPT codes (Howard & Reddy, 2018; King et al., 2001). While this study included Evaluation and Management codes, it did not show that out of all CPT categories either group had the most errors in this category of CPT coding. For coding to be accurate, organizations must not focus all their resources and attention on building coding education programs that focus solely on Evaluation and Management coding. Programs need to include anesthesia (where this service line occurs), medicine, and surgical CPTs to show an increase in overall coding accuracy.

This study found that surgical providers had the lowest CPT accuracy out of all groups studied and performed down-coding and upcoding at the highest frequency. This is of particular concern as CPT codes are the basis of a surgical resident experience while they are in their training years (Balla et al., 2016; Murphy et al., 2014). Surgical providers showing the highest coding errors and the highest rate of upcoding could mean they are reporting CPTs that they have not performed or over/under inflating their CPT case log inadvertently due to misinterpretation of the CPT guidelines. This is further cause for specific training and education programs to providers during their residency and training.

Job Demands-Resource Theory

The job demands-resource theory provides evidence that access to better job resources can decrease the negative impact of various job demands on employee burnout (Bakkar et al., 2005). This study shows that providers and coders alike continue to make coding errors during the CPT selection process. These errors could be partially attributed to the lack of standardized educational resources for medical coding. Provider burnout levels are at epidemic proportions in recent years (Chesak et al., 2020; Dyrbye & Shanafelt, 2011; Edú-valsania et al., 2022; Patel et al., 2019). Although no study exists currently that shows that the medical coding process directly relates to provider burnout, one could make the argument that given the complexity of coding guidelines and the relation to provider compensation that coding does add undue stress to physicians. Again, based upon job demands-resource theory, this stress combined with the lack of uniform resources available during residency and post-training years for physicians, could be a contributor to physician burnout levels. Additionally, the OIG puts the responsibility of accurate coding directly on the physicians (O'Donnell et al., 2020). This could be a misplaced responsibility since providers do not have adequate access to education programs, and the results of this study show they are less accurate than certified professional coders.

Implications for Future Practice, Research, and Policy

Federal Mandate for Certification

Given the findings of this study, certifications for persons performing the coding process should be required at a national level. Currently, there is no federal requirement that defines who is required to complete the coding process, and the National Correct Coding Initiative Manual, which defines the payment of services under Medicare and published by CMS, only uses the terminology of provider/supplier regarding the coding process (CMS, 2022b).This study did not compare non-certified coders to coders with a certification directly; however, the results showing that certified professional coders have a higher accuracy than providers (who are un-certified) give weight to necessity of certifications. As stated previously, medical coding errors cost the United States billions of dollars annually (Cremeans et al., 2019), certifications could help reduce this exorbitant cost, which would divert money back to patient care. Future research is essential to show the cost of non-certified individuals processing claims to determine the true financial impact of certification versus non-certification.

Given these findings, organizations should seek out to hire and retain certified professional coders due to their higher-accuracy rate than their provider counterparts. The results of this study did show that domestically employed coders had a slightly higher accuracy than third-party vendor coders; however, other studies on the actual impact of these different coding models are necessary. Cost containment within coding staff is an important factor for an organization's budget and many organizations are turning towards outsourcing to decrease their spending on coding salaries. This study only scratched the surface of the dialogue on domestic versus third-party vendor coding. Potential studies are crucial to determine if outsourcing is beneficial in the long term if the third-party coder’s accuracy is costing the organization due to errors.

Standardized Training and Education

The order of results shows that certified professional coders are more accurate than providers; however, both still had a significant number of errors between them. The results are clear that more education is needed for both providers and certified coders for CPT selection. For providers to be successful truly in the business of medicine they need a solid foundation of medical coding that is provided when they are in clinical training. This is especially pertinent since the ultimate responsibility of accuracy as defined by the OIG lies with the physicians themselves (Cremeans et al., 2019). It is a worthwhile endeavor to train physicians on appropriate CPT coding as it impacts reimbursement, their compensation, and healthcare datasets. Furthermore, additional resources for medical coding potentially could decrease the alarming physician burnout numbers in the United States today.

For coders to be successful at their jobs, continuing education on the annual changes within the CPT book are a necessity. Training programs must include all areas of CPT since significant errors were seen across all categories and not focus solely on Evaluation and Management coding. This study is only the start of drilling into the areas that errors occur and by what groups. More research is needed that investigates providers by specialty and not only a breakdown between surgical and medical. Drilling into what categories of CPT that individual specialties, such as orthopedics, general surgery, etc., are making errors would allow individual education to occur. With the knowledge of where errors occur, the question of using artificial intelligence, such as computer assisted coding, arises. Finding where errors occur and by whom could allow artificial intelligence to be programmed in more detail, adding in an additional layer of coding support to provider and medical coders. Further research is also needed that investigates what impact the level of coder education and experience has on CPT accuracy. Multiple certifications are offered in varying specialties for coders and determining if these influenced a coder's accuracy would support the case for certification mandates.

Provider Compensation Models

This is not the first study to recognize that providers participate in upcoding practices whether intentional or by a misunderstanding of the guidelines (Coustasse et al., 2021; Drabiak & Wolfson, 2019). Surgical providers had a higher rate of upcoding than their medical peers. Arguments exist in the previous literature that this can be tied to provider compensation models that base productivity off CPT coding (Coustasse et al., 2021). Providers that are paid using a productivity-based model that counts physician work relative value units (wRVUs) rely on accurate CPT coding to determine their productivity numbers (Beck et al., 2020). This study did not delve into the reasons for upcoding practices. Further research is needed to discover the reasons for upcoding by physicians and whether this practice correlates to a provider's compensation model. The question of the relevancy of productivity-based compensation models for physicians must be explored at a deeper level than this study permitted to determine if these models encourage the practice of upcoding to secure increased compensation whether deliberate or through a provider's gap in knowledge on coding guidelines.

Limitations

Several study limitations existed prior to the start of the study and additional limitations presented themselves as the data analysis occurred. First, the data reviewed was from one singular employer and the researcher could not account for the coding education delivered by this one organization. Inaccurate CPT selection could have occurred because of misinterpretation of a coding guideline shared from the organization to the medical providers, medical coders, and Coding Quality team. Additionally, there was not a fourth level review for accuracy and the assumption was made that the auditors who make up the Coding Quality team had selected the correct code.

Furthermore, this study only looked at certified professional coders who were already reviewing a CPT that was selected by the physician. This study could not account for any claims that required the coder to completely select the CPT code from the documentation without initial provider selection. Further research is needed to find the accuracy rates for coders without initial provider CPT selection.

Lastly, the study only reviewed CPT code selection since this is the driver of provider compensation and reimbursement. This study did not review modifier placement or ICD-10-CM diagnosis coding as the datasets provided did not have this information available. Future studies incorporating all three variables would add to the dialogue around medical coding accuracy for professional services.

Delimitations

The datasets were intentionally pared down to only include claims that met all three outlined criteria of selection of CPT by the physician, CPT code reviewed by the certified coders, and final assessment by the Coding Quality team. Any claims that did not meet these criteria were not included in the sample for analysis.

Conclusion

The secondary data analysis of coding accuracy amongst providers and certified professional coders highlights the need for more education for both groups to increase their CPT selection skillsets. Certified professional coders showed a higher accuracy than providers'; however, both groups still had significant coding errors occur within the data reviewed. This study laid the foundation for future research to study in greater detail the difference in accuracy between domestically employed coders and third-party vendor coders. Policy changes that require persons performing coding functions to obtain certification are necessary to decrease the overwhelming amount of money spent on coding errors annually in the United States. Organizations should look towards hiring persons with coding certifications while providing robust education programs to the coders that are already employed. Certified professional coders and providers need to engage in the coding process together to build a foundation of trust between the two groups and to allow reciprocated education to occur. This study was one of the first to look at all CPT categories for error rates as opposed to only one section within CPT. Determining errors across all categories of CPT for each group can help build meaningful education and begin to pave the way for more significant technology use in the medical coding field.

This study builds on the already abundant research calling for providers to obtain education during their residency and training. Providers receive little to no education during their graduate medical education experience in residency. Educational programs are necessary for physicians during their residency for them to feel comfortable and equipped for CPT selection in their future roles as practicing physicians. CPT selection is of utmost importance as it impacts not only reimbursement but physician compensation and healthcare dataset creation. Physician compensation issues and the high stress environment that providers work in can lend itself to burnout easily (Himmelstein et al., 2020). Providers not having access to education early, lacking educational resources from their employers, and having their livelihood all tied to the coding process clearly indicates the necessity for code selection to be accurate to keep burnout levels low. Providers are also held responsible for accurate code selection by the OIG and to lack educational programs during training impedes providers from meeting this responsibility.

A key finding of this study was that surgical providers upcode CPT codes more frequently than other groups, which calls for additional research to determine if this practice is related to productivity-based compensation models. Findings from this study supplement the existing body of knowledge that there is a concern for CPT selection accuracy no matter the group performing the function and will require collaboration amongst the groups as well as extensive education programs for all parties to decrease the amount of money spent on coding errors annually.

References

Abdulla, S., Simon, N., Woodhams, K., Hayman, C., Oumar, M., Howroyd, L. R., & Sethi, G. C. (2020). Improving the quality of clinical coding and payments through student doctor-coder collaboration in a tertiary haematology department. *BMJ Open Quality*, *9*(1). https://doi.org/10.1136/bmjoq-2019-000723

Aiello, F. A., Judelson, D. R., Messina, L. M., Indes, J., FitzGerald, G., Doucet, D. R., Simons, J. P., & Schanzer, A. (2016). A multidisciplinary approach to vascular surgery procedure coding improves coding accuracy, work relative value unit assignment, and reimbursement. *Journal of Vascular Surgery*, *64*(2), 465–470. https://doi.org/10.1016/j.jvs.2016.02.052

Alonso, V., Santos, J. V., Pinto, M., Ferreira, J., Lema, I., Lopes, F., & Freitas, A. (2020). Problems and barriers during the process of clinical coding: A focus group study of coders' perceptions. *Journal of Medical Systems*, *44*(3). https://doi.org/10.1007/s10916-020-1532-x

American Academy of Professional Coders. (2021). *What is ICD-10?* https://www.aapc.com/icd-10/#structureofICD10Codes

American Academy of Professional Coders. (2022). *What Is ICD-11?* https://www.aapc.com/icd-11/

American Medical Association. (2022). *CPT Codes*. https://www.ama-assn.org/topics/cpt-codes

Anandarajah, A. P., Quill, T. E., & Privitera, M. R. (2018). Adopting the quadruple aim: The University of Rochester Medical Center experience. *The American Journal of Medicine*, *131*(8), 979–986. https://doi.org/10.1016/j.amjmed.2018.04.034

Baccaro, S. T., Candidate, J. D., & Hall, S. (2022). A gap in the healthcare industry. *348*(May 2007), 73–104.

Bajaj, Y., Crabtree, J., & Tucker, A. G. (2007). Clinical coding: How accurately is it done? *Clinical Governance*, *12*(3), 159–169. https://doi.org/10.1108/14777270710775873

Bakker, A. B. (n.d.). Multiple levels in job demands-resources theory: Implications for employee well-being and performance.

Bakker, A. B., & de Vries, J. D. (2021). Job demands–resources theory and self-regulation: New explanations and remedies for job burnout. *Anxiety, Stress and Coping*, *34*(1), 1–21. https://doi.org/10.1080/10615806.2020.1797695

Bakker, A. B., & Demerouti, E. (2017). Job demands-resources theory: Taking stock and looking forward. *Journal of Occupational Health Psychology*, *22*(3), 273–285. https://doi.org/10.1037/ocp0000056

Bakker, A. B., Demerouti, E., & Euwema, M. C. (2005). Job resources buffer the impact of job demands on burnout. *Journal of Occupational Health Psychology*, *10*(2), 170–180. https://doi.org/10.1037/1076

Bakker, A. B., Hakanen, J. J., Demerouti, E., & Xanthopoulou, D. (2007). Job resources boost work engagement, particularly when job demands are high. *Journal of Educational Psychology*, *99*(2), 274–284. https://doi.org/10.1037/0022-0663.99.2.274

Balla, F., Garwe, T., Motghare, P., Stamile, T., Kim, J., Mahnken, H., & Lees, J. (2016). Evaluating coding accuracy in general surgery residents' accreditation council for graduate medical education procedural case logs. *Journal of Surgical Education*, *73*(6), e59–e63. Elsevier Inc. https://doi.org/10.1016/j.jsurg.2016.07.017

Beck, C. M., Blair, S. E., & Nana, A. D. (2020). Reimbursement for hip fractures: The impact of varied current procedural terminology coding using relative value units. *Journal of Arthroplasty*, *35*(12), 3464–3466. https://doi.org/10.1016/j.arth.2020.06.088

Berenson, R. A., & Rich, E. C. (2010). US approaches to physician payment: The deconstruction of primary care. *Journal of General Internal Medicine*, *25*(6), 613–618. https://doi.org/10.1007/s11606-010-1295-z

Britton, E., Chambers, C., & Ashmore, A. (2009). Orthopaedic procedure coding: Does accuracy matter? *International Journal of Health Care Quality Assurance*, *22*(4), 441–447. https://doi.org/10.1108/09526860910964870

Burks, K., Shields, J., Evans, J., Plumley, J., Gerlach, J., & Flesher, S. (2022). A systematic review of outpatient billing practices. *SAGE Open Medicine*, *10*, 205031212210990. https://doi.org/10.1177/20503121221099021

Campbell, S., & Giadresco, K. (2020). Computer-assisted clinical coding: A narrative review of the literature on its benefits, limitations, implementation, and impact on clinical coding professionals. *Health Information Management Journal*, *49*(1), 5–18. SAGE Publications Inc. https://doi.org/10.1177/1833358319851305

Castaldi, M., & McNelis, J. (2019). Introducing a clinical documentation specialist to improve coding and collectability on a surgical service. *Journal for Healthcare Quality*, *41*(3), E21–E29. https://doi.org/10.1097/JHQ.0000000000000146

Centers for Disease Control and Prevention. (2015). *International Classification of Diseases, (ICD-10-CM/PCS) Transition - Background*. https://www.cdc.gov/nchs/icd/icd10cm_pcs_background.htm

Centers for Medicare and Medicaid Services. (2021). *Medicare fraud & abuse: Prevent, detect, report*. *January* 1–23.

Centers for Medicare and Medicaid Services. (2022a). *Documentation and files - National physician fee schedule*. https://www.cms.gov/medicare/physician-fee-schedule/search/documentation

Centers for Medicare and Medicaid Services. (2022b). *National correct coding initiative edits | CMS*. Centers for Medicare and Medicaid Services. https://www.cms.gov/Medicare/Coding/NationalCorrectCodInitEd/index%0Ahttp://files/1330/index.html

Centers for Medicare and Medicaid Services, & National Center for Health Statistics. (2021). *ICD-10-CM official guidelines for coding and reporting.* https://www.cms.gov/files/document/fy-2022-icd-10-cm-coding-guidelines-updated-02012022.pdf

Chen, Z. X., Hohmann, L., Banjara, B., Zhao, Y., Diggs, K., & Westrick, S. C. (2020). Recommendations to protect patients and health care practices from Medicare and Medicaid fraud. *Journal of the American Pharmacists Association*, *60*(6), e60–e65. https://doi.org/10.1016/j.japh.2020.05.011

Chesak, S. S., Cutshall, S., Anderson, A., Pulos, B., Moeschler, S., & Bhagra, A. (2020). Burnout among women physicians: A call to action. *Current Cardiology Reports, 22*(7), 45. https://doi.org/10.1007/s11886-020-01300-6

Clemente, S., McGrady, R., Repass, R., Paul, D. P., & Coustasse, A. (2018). Medicare and the affordable care act: Fraud control efforts and results. *International Journal of Healthcare Management*, *11*(4), 356–362. https://doi.org/10.1080/20479700.2017.1401277

Coustasse, A., Layton, W., Nelson, L., & Walker, V. (2021). Upcoding Medicare: Is healthcare fraud and abuse increasing? *Perspectives in Health Information Management*, *18*(4), 1–15.

Cremeans, K., Marcum, S., Followay, C., Oldaker, J., & Coustasse, A. (2019). Implications of upcoding on Medicare. *Paper Presented at BHAA Annual Conference*.

Deeken-Draisey, A., Ritchie, A., Yang, G. Y., Quinn, M., Ernst, L. M., Guttormsen, A., Ella Simionov, G., & Maniar, K. P. (2018). Current procedural terminology coding for surgical pathology: A review and one academic center's experience with pathologist-verified coding. *Archives of Pathology and Laboratory Medicine*, *142*(12), 1524–1532. https://doi.org/10.5858/arpa.2017-0190-RA

Dick, M. (2020). Welcome to the industry: The medical coder's role in the healthcare system. *AAPC: Healthcare Business Monthly*, 20–23.

Dotson, P. (2013). CPT® codes: What are they, why are they necessary, and how are they developed? *Advances in Wound Care*, *2*(10). https://doi.org/https://doi.org/10.1089/wound.2013.0483

Drabiak, K., & Wolfson, J. (2019). AMA Journal of Ethics 2019. *AMA Journal of Ethics*, *21*(1), E78-85. www.amajournalofethics.org

Dyrbye, L. N., & Shanafelt, T. D. (2011). Physician burnout. *JAMA*, *305*(19). https://doi.org/10.1001/jama.2011.652

Edú-valsania, S., Laguía, A., & Moriano, J. A. (2022). Burnout: A review of theory and measurement. *International Journal of Environmental Research and Public Health*, *19*(3). MDPI. https://doi.org/10.3390/ijerph19031780

Erickson, S. M., Outland, B., Joy, S., Rockwern, B., Serchen, J., Mire, R. D., & Goldman, J. M. (2020). Envisioning a better U.S. health care system for all: Health care delivery and payment system reforms. *Annals of Internal Medicine*, *172*, S33–S49. American College of Physicians. https://doi.org/10.7326/M19-2407

Gottlieb, J. D., Shapiro, A. H., & Dunn, A. (2018). The complexity of billing and paying for physician care. *Health Affairs*, *37*(4), 619–626. https://doi.org/10.1377/hlthaff.2017.1325

Health Care Fraud and Abuse Control Program. (2016, February 26). *Fact sheet: The Health Care Fraud and Abuse Control Program protects consumers and taxpayers by combatting health care fraud* [Press release]. Office of Public Affairs. https://www.justice.gov/opa/pr/fact-sheet-health-care-fraud-and-abuse-control-program-protects-consumers-and-taxpayers

Hennig-Schmidt, H., Jürges, H., & Wiesen, D. (2019). Dishonesty in health care practice: A behavioral experiment on upcoding in neonatology. *Health Economics (United Kingdom)*, *28*(3), 319–338. https://doi.org/10.1002/hec.3842

Herland, M., Khoshgoftaar, T. M., & Bauder, R. A. (2018). Big Data fraud detection using multiple medicare data sources. *Journal of Big Data*, *5*(1), 1–21. https://doi.org/10.1186/s40537-018-0138-3

Heywood, N. A., Gill, M. D., Charlwood, N., Brindle, R., Kirwan, C. C., Allen, N., Charleston, P., Coe, P., Cunningham, J., Duff, S., Forrest, L., Hall, C., Hassan, S., Hornung, B., al Jarabah, M., Jones, A., Mbuvi, J., Mclaughlin, T., Nicholson, J., … Wilkinson, J. (2016). Improving accuracy of clinical coding in surgery: Collaboration is key. *Journal of Surgical Research*, *204*(2), 490–495. https://doi.org/10.1016/j.jss.2016.05.023

Himmelstein, D., Jun, M., Busse, R., Chevreul, K., Geissler, A., Jeurissen, P., Thomson, S., Vinet, M.-A., & Woolhandler, S. (2014). A comparison of hospital administrative costs in eight nations: US costs exceed all others by far. *Health Affairs*, *33*(9), 1586–1593. https://doi.org/10.1337/hlthaff.2013.1327

Himmelstein, D. U., Campbell, T., & Woolhandler, S. (2020). Health care administrative costs in the United States and Canada, 2017. *Annals of Internal Medicine*, *172*(2), 134–142. https://doi.org/10.7326/M19-2818

Hirsch, J. A., Nicola, G., McGinty, G., Liu, R. W., Barr, R. M., Chittle, M. D., & Manchikanti, L. (2016). ICD-10: History and context. *American Journal of Neuroradiology, 37*(4), 596–599. American Society of Neuroradiology. https://doi.org/10.3174/ajnr.A4696

Howard, R., & Reddy, R. M. (2018). Coding discrepancies between medical student and physician documentation. *Journal of Surgical Education*, *75*(5), 1230–1235. https://doi.org/10.1016/j.jsurg.2018.02.008

Keckley, P. (2021a). Affordability: It is more than insurance. *Healthcare Executive*, 38–39.

Keckley, P. (2021b). The agenda for value based care. *Healthcare Executive*, 32–33.

King, M. S., Sharp, L., & Lipsky, M. S. (2001). Accuracy of CPT evaluation and management coding by family physicians. *Journal of the American Board of Family Practice*, *14*(3), 184–192.

Lygrisse, K. A., Roof, M. A., Keitel, L. N., Callaghan, J. J., Schwarzkopf, R., & Bedard, N. A. (2020). The inaccuracy of ICD-10 coding in revision total hip arthroplasty and its implication on revision data. *Journal of Arthroplasty*, *35*(10), 2960-2965.e3. https://doi.org/10.1016/j.arth.2020.05.013

Mahbubani, K., Georgiades, F., En, B., Goh, L., Chidambaram, S., Sivakumaran, P., Rawson, T., Ray, S., Hudovsky, A., & Gill, D. (2018). Process and systems clinician-directed improvement in the accuracy of hospital clinical coding. *Future Healthcare Journal*, *5*(1).

Mehta, J. (2021). Government enforcement and review of managed Medicare programs: A glimpse of historical practice and forthcoming trends. *Public Policy & Aging Report*, *31*(2), 53–56. https://doi.org/10.1093/ppar/prab005

Murphy, R. F., Littleton, T. W., Throckmorton, T. W., & Richardson, D. R. (2014). Discordance in current procedural terminology coding for foot and ankle procedures between residents and attending surgeons. *Journal of Surgical Education*, *71*(2), 182–185. https://doi.org/10.1016/j.jsurg.2013.07.005

Nicholls, S. G., Langan, S. M., & Benchimol, E. I. (2017). Routinely collected data: The importance of high-quality diagnostic coding to research. *Canadian Medical Association Journal*, *189*(33), E1054–E1055. Canadian Medical Association. https://doi.org/10.1503/cmaj.170807

Nouraei, S. A. R., Hudovsky, A., Frampton, A. E., Mufti, U., White, N. B., Wathen, C. G., Sandhu, G. S., & Darzi, A. (2015). A study of clinical coding accuracy in surgery: Implications for the use of administrative big data for outcomes management. *Annals of Surgery*, *261*(6), 1096–1107. https://doi.org/10.1097/SLA.0000000000000851

O'Donnell, H. C., Suresh, S., Webber, E. C., Alexander, G. M., Chung, S. L., Hamling, A. M., Kirkendall, E. S., Mann, A. M., O'Donnell, H. C., Sadeghian, R., Shelov, E., Suresh, S., & Wiesenthal, A. M. (2020). Electronic documentation in pediatrics: The rationale and functionality requirements. *Pediatrics*, *146*(1). https://doi.org/10.1542/peds.2020-1682

O'Reilly, K. B. (2018). *8 medical coding mistakes that could cost you*. AMA Journal of Ethics. https://www.ama-assn.org/practice-management/cpt/8-medical-coding-mistakes-could-cost-you

Owji, S., Tassavor, M., Han, J., Golant, A., Svidzinski, C., & Ungar, J. (2022). Impact of coding curriculum on dermatology resident billing. *Cureus, 14*(4). https://doi.org/10.7759/cureus.24148

Patel, R. S., Sekhri, S., Bhimanadham, N. N., Imran, S., & Hossain, S. (2019). A review on strategies to manage physician burnout. *Cureus*, *11*(6). https://doi.org/10.7759/cureus.4805

Price, M., & Norris, D. M. (2009). Health care fraud: Physicians as white-collar criminals? *Journal of the American Academy of Psychiatry and the Law Online*, *37*(3), 286 LP – 289.

Reid, R. O., Tom, A. K., Ross, R. M., Duffy, E. L., & Damberg, C. L. (2022). Physician compensation arrangements and financial performance incentives in US health systems. *JAMA Health Forum*, *3*(1), e214634. https://doi.org/10.1001/jamahealthforum.2021.4634

Reid, T. (2010). *The healing of America: A global quest for better, cheaper, and fairer health care* (P. Press, Ed.).

Roberts, L., Araromi, S., & Peatman, O. (2018). Clinical coding - an insight into healthcare data. *The British Student Doctor*, *2*(2), 36. https://doi.org/10.18573/bsdj.48

Shah, D. R., Bold, R. J., Yang, A. D., Khatri, V. P., Martinez, S. R., & Canter, R. J. (2014). Relative value units poorly correlate with measures of surgical effort and complexity. *Journal of Surgical Research*, *190*(2), 465–470. https://doi.org/10.1016/j.jss.2014.05.052

Shanafelt, T. D., & Noseworthy, J. H. (2017). Executive leadership and physician well-being. *Mayo Clinic Proceedings*, *92*(1), 129–146. https://doi.org/10.1016/j.mayocp.2016.10.004

Shwayder, J. M., Copel, J. A., & Stohl, H. (2019). Coding and legal issues in obstetric and gynecologic ultrasound. *Obstetrics and Gynecology Clinics of North America*, *46*(4), 853–862. W.B. Saunders. https://doi.org/10.1016/j.ogc.2019.07.012

Suleiman, M., Demirhan, H., Boyd, L., Girosi, F., & Aksakalli, V. (2020). A clinical coding recommender system. *Knowledge-Based Systems*, *210*. https://doi.org/10.1016/j.knosys.2020.106455

Tang, K. L., Lucyk, K., & Quan, H. (2017). Coder perspectives on physician-related barriers to producing high-quality administrative data: a qualitative study. *CMAJ Open*, *5*(3), E617–E622. https://doi.org/10.9778/cmajo.20170036

World Health Organization. (2022). *International statistical classification of diseases and related health problems (ICD)*. https://www.who.int/standards/classifications/classification-of-diseases

Wynia, M., Cummins, D., VanGeest, J., & Wilson, I. (2000). Physician manipulation of reimbursement rules for patients: between a rock and a hard place. *JAMA*, *283*(14), 1858–1865.

Yakes, E. A., Dean, S., Labadie, R. F., Byrne, D., Estrada, C., Thompson, R., Kendall, J., & Yarbrough, M. (2020). Factors associated with physician empowerment and well-being at an academic medical center. *Journal of Occupational & Environmental Medicine*, *62*(7), 478–483. https://doi.org/10.1097/JOM.0000000000001874

Zigrang, T. A. (2022). Healthcare compensation plans: Current challenges and novel approaches. *Frontiers of Health Services Management*, *38*(4), 26–32. https://doi.org/10.1097/HAP.0000000000000141

Appendix A

Physician Subgrouping Lists

Physician Grouping – Medical Specialties	
Advanced Heart Failure/Transplant Cardiology	Pediatric Neurology
Cardiac Electrophysiology	Pediatric Pulmonology
Cardiology	Pediatrics
Child and Adolescent Psychiatry	Physical Medicine and Rehabilitation
Critical Care (Intensivists)	Psychiatry
Electrophysiology	Psychiatry, Neurology
Emergency Medicine	Psychiatry, Neurology (Osteopaths only)
Endocrinology	Psychologist, Clinical
Family Medicine	Pulmonary Diseases
Family Practice	Radiology
General Practice	Rheumatology
Geriatric Medicine	Sport Medicine
Geriatric Psychiatry	Transplant Hepatology
Gynecologic Oncology	
Hematology	
Hematology/Oncology	
Hepatology	
Hospice and Palliative Medicine	
Hospitalist	
Infectious Disease	
Internal Medicine	
Interventional Cardiology	
Marriage and Family Therapist	
Maternal Fetal Medicine	
Medical Oncology	
Neonatal-Perinatal	
Neuro oncology	
Neurology	
Neuropsychology	
Oncology	
Pediatric Cardiology	
Pediatric Critical Care Medicine	
Pediatric Endocrinology	
Pediatric Hematology- Oncology	
Pediatric Infectious Diseases	

Appendix A - Continued

Physician Subgrouping Lists Continued

Physician Grouping – Surgical Specialties	
Adult Reconstructive Orthopaedic Surgery	Surgical Oncology
Bariatric Surgery	Thoracic Surgery
Breast surgeon	Transplant Surgery
Cardiac Surgery	Trauma surgery
Cardiothoracic Surgery	Urology
Cardiothoracic Vascular Surgery	Urology/gyn
Cardiovascular Disease	Vascular Surgery
Cardiovascular Surgery	
Colorectal Surgery	
Female Pelvic Medicine and Reconstructive Surgery	
Foot and Ankle Surgery	
Gastroenterology	
General Surgery	
Gynecology	
Hand Surgery	
Nephrology	
Neurological Surgery	
Neurosurgery	
OB - Gynecology	
Ob/gyn/infertility	
Obstetrics	
Oral/maxillofacial surgery	
Orthopaedic	
Orthopaedic Surgery of the Spine	
Orthopaedic Surgery Sports Medicine	
Orthopedic Surgery	
Orthopedic trauma	
Otolaryngology	
Otology, Laryngology, Rhinology	
Pediatric Cardiothoracic Surgery	
Pediatric Gastroenterology	
Pediatric Nephrology	
Pediatric Neurosurgery	
Pediatric Surgery	
Plastic and Reconstructive Surgery	
Podiatry	

Appendix B

Example of Dataset 1 - PCCL and Description of Columns

B	C	D	E	F	I	J	K	L	M	N
ProviderSpeciality	DosProviderUname	EncounterDate	ClaimServiceDate	EncounterProcedureCodeCombined	EMRCptsVsClaimCpts	ClaimCptsNotOnEMR	CodeChangeImpact	CodeChangeImpactDirection	CCUFlag	LastChangedBy34Combined
Neurological Surgery	NZU5590	2022-04-28	2022-04-28	*72110*99205*	MATCH		0	Code Correct/Change No Impact	CCU	*QLA6218*
Cardiovascular Disease	JPZ2674	2022-04-25	2022-04-25	*99214*	MATCH		0	Code Correct/Change No Impact	CCU	*PBU5458*
Internal Medicine	CIJ7418	2022-04-07	2022-04-07	*99204*	MATCH		0	Code Correct/Change No Impact	Non-CCU	*KFA6567*
Nurse Practitioner	BAZ5676	2022-04-15	2022-04-15	*99213*	MATCH		0	Code Correct/Change No Impact	Non-CCU	*BHI8986*
OB - Gynecology	BVM9217	2022-04-07	2022-04-07	*99213*99385*	MATCH		0	Code Correct/Change No Impact	CCU	*SRVCEMCLAIMS*
OB - Gynecology	FLA5351	2022-04-28	2022-04-28	*99385*	MATCH		0	Code Correct/Change No Impact	CCU	*SRVCEMCLAIMS*
Orthopedic Surgery	FXI8634	2022-04-25	2022-04-25	*99204*	MATCH		0	Code Correct/Change No Impact	CCU	*SRVCEMCLAIMS*
Family Medicine	DAX9498	2022-04-27	2022-04-27	*90472*90632*90651*90715*90734*99395*	No Match_Value Impact	*90471*	0.17	Code Raised	Non-CCU	*EZA8942*
OB - Gynecology	KXI6245	2022-04-11	2022-04-11	*99396*	MATCH		0	Code Correct/Change No Impact	CCU	*SRVCEMCLAIMS*
Colorectal Surgery	FIL5334	2022-04-18	2022-04-18	*99204*	MATCH		0	Code Correct/Change No Impact	CCU	*JIO9053*

Provider Coding Changes Log Column Names	**Column Descriptions**
ProviderSpeciality	Provider’s specialty designation
DosProviderUname	Providers identification number
EncounterDate	Date the claim was created
ClaimServiceDate	Date the service took place
EncounterProcedureCodeCombined	CPT codes entered by the provider
EMRCptsVsClaimCpts	Indicates that a change did/did not occur “Match” = No Change “No Match_Value Impact” = Change Occurred with a RVU Impact
ClaimCptsNotOnEMR	CPT Code that was added/deleted by the coder
CodeChangeImpact	RVU Impact
CodeChangeImpactDirection	Indicates if the code was lowered or raised
CCUFlag	Department that made the change “CCU” = Centralized Coding Unit “non-CCU” = Another department
LastChangedBy34Combined	Coder identification number that made the change

Appendix C

Example of Dataset 2 - CQR and Column Descriptions

Claim Creation Date	Coder ID	Provider	Date of Service	Coder CPT	QA CPT	Primary CPT Finding	CCU Status	User Specialty	Coder CPT Category
2/11/22	GVI5469	NZU5590	2/2/22	92934	92938	CPT or HCPCS, overcoded	Non-CCU	Non-CCU	Medicine
2/3/22	EWR6769	JPZ2674	2/1/22	38570	38571	CPT or HCPCS, undercoded	Established	General Surgery	Hemic and Lymphatic
2/8/22	EWR6769	CIJ7418	2/4/22	45380	45378	CPT or HCPCS, overcoded	Established	General Surgery	Digestive System
2/2/22	GCI9390	BAZ5676	1/28/22	45378	G0105	CPT or HCPCS, overcoded	Established	General Surgery	Digestive System
2/8/22	QWU6212	BVM9217	2/2/22	44604	none	CPT or HCPCS, overcoded	Established	Trauma	Digestive System
2/1/22	BHI7353	FLA5351	1/27/22	36556	36556	CPT or HCPCS, agreed	Established	Critical Care: Intensivist	Cardiovascular
2/1/22	GVI5469	FXI8634	1/29/22	93306	93306	CPT or HCPCS, agreed	Non-CCU	Non-CCU	Medicine
2/1/22	FUG6062	DAX9498	1/29/22	49083	49083	CPT or HCPCS, agreed	Non-CCU	Non-CCU	Digestive System
2/2/22	FUG6062	KXI6245	1/31/22	32408	32408	CPT or HCPCS, agreed	Non-CCU	Non-CCU	Respiratory System

Dataset 2 - CQR Column Name	**Column Description**
Claim Creation Date	Date claim was created
Coder ID	Coder identification number
Provider	Provider identification number
Date of Service	Date the service took place
Coder CPT	CPT code selected by the coder
QA CPT	Accurate CPT code selected by the quality reviewer
Primary CPT Finding	Description of error or “Agree” if CPT selection matches
CCU Status	Domestic or third party employed “Established = CCU” “non-CCU = Third Party Vendor”
User Specialty	Primary specialty of coder that coded the claim
Coder CPT Category	Category in the CPT book

Appendix D

Combined Data-Set Example

A	B	C	D	E	F	G	H	I	J	K
CCUFlag	LastChangedBy34Combined	Coder ID	ProviderSpeciality	Provider	DosProviderUname	Date of Service	ClaimServiceDate	Coder CPT	Total RVU Coder	QA CPT
CCU	*GVI5469*	GVI5469	Neurological Surgery	NZU5590	NZU5590	2/2/22	2/2/22	92934	0	92938
CCU	*EWR6769*	EWR6769	Cardiovascular Disease	JPZ2674	JPZ2674	2/1/22	2/1/22	38570	15.35	38571
CCU	*EWR6769*	EWR6769	Internal Medicine	CIJ7418	CIJ7418	2/4/22	2/4/22	45380	13.04	45378
CCU	*GCI9390*	GCI9390	Nurse Practitioner	BAZ5676	BAZ5676	1/28/22	1/28/22	45378	10.19	G0105

L	M	N	O	P	U	V
Total RVU QA	RVU Discrepency	Primary CPT Finding	EncounterProcedureCod	ClaimProcedureCodeCon	CodeChangeImpactDirection	CCU Status
0	0	CPT or HCPCS, overcoded	*72110*99205*	*72110*99205*	Code Correct/Change No Impact	Non-CCU
19.58	4.23	CPT or HCPCS, undercoded	*99214*	*99214*	Code Correct/Change No Impact	Established
10.19	-2.85	CPT or HCPCS, overcoded	*99204*	*99204*	Code Correct/Change No Impact	Established
10.19	0	CPT or HCPCS, agreed	*99213*	*99213*	Code Correct/Change No Impact	Established
25.93	0	CPT or HCPCS, agreed	*99396*	*99396*	Code Correct/Change No Impact	Non-CCU

Blue – Dataset 2 – CQR

Green – Dataset 1 - PCCL

Yellow – Dataset 3 - MPFS

Appendix E

Codebook

Question	Variable Name	Variable Description	Values	Variable Type and Data Type
Providers	PROV	Medical providers entire group	Unique identifier	IV Categorical (nominal)
Providers_RC	PROV_RC	Medical providers grouped by specialty	1. Surgical 2. Medical	IV Categorical (nominal, dichotomous)
Certified professional coders	CPC	Certified professional coders entire group	Unique identifier	IV Categorical (nominal)
Certified professional coders_RC	CPC_RC	Certified professional coders grouped by employment	1. Domestic 2. Third-party vendor	IV Categorical (nominal, dichotomous)
Providers and certified coders (all groups)	Index	Person who entered CPT	Provider Coder	IV Categorical (nominal)
Surgical and medical providers, certified professional coders	Entry_Type2	Person who entered CPT (including provider sub-groups)	Surgical provider Medical provider All CPCs	IV Categorical (nominal)
CPT Category	CAT_RC	Category of CPT Codes where error occurred	1. 00000-09999 2. 10000-19999 3. 20000-29999 4. 30000-39999 5. 40000-49999 6. 50000-59999 7. 60000-69999 8. 70000-79999 9. 80000-89999 10. 90000-99999	DV Categorical (ordinal)
Coding level error	CODEMTCH	Impact of the error	-1: Under-code 0: Match 1: Over-code	DV Categorical (nominal)

Appendix F

Research Question and Results Table

Research Question	**Hypothesis**	**Null Hypothesis**	**Result**
RQ1: What group between providers and certified professional coders has a higher rate of upcoding CPTs for claims data?	**H1.1:** Surgical providers will have a higher rate of upcoding services than certified professional coders.	**$H1.1_o$:** Surgical providers will not have a higher rate of upcoding services than certified professional coders.	The null hypothesis was rejected.
RQ2: What groups between providers and certified professional coders has a higher rate of down-coding CPTs for claims data?	**H2.1**: Surgical providers will have a higher rate of down-coding services than certified professional coders.	**$H2.1_o$:** Surgical providers will not have a higher rate of down-coding services than certified professional coders.	The null hypothesis was rejected.
RQ3: Is there a statistical significance between coding accuracy for groups of providers and certified professional coders for CPT selection for claims data?	**H3.1:** Surgical providers will be more accurate at CPT code selection than certified professional coders.	**$H3.1_o$:** Surgical providers will not be more accurate at CPT code selection than certified professional coders.	Failure to reject the null.
RQ4: Is there a statistical significance between coding accuracy for certified professional coders employed domestically and certified professional coders employed by third-party vendors?	**H4.1:** Certified professional coders employed domestically will be more accurate than third-party vendors.	**$H4.1_o$:** Certified professional coders employed domestically will not be more accurate than third-party vendors.	Failure to reject the null.
RQ5: Is there a statistical significance between coding accuracy for providers in medical specialties and providers in surgical specialties?	**H5.1:** Surgical providers will have a higher accuracy rate for CPT selection than medical providers.	**$H5.1_o$:** Surgical providers will not have a higher accurate rate for CPT selection than medical providers.	Failure to reject the null.
RQ6: Is there a statistical significance of the category of CPT codes where providers and certified professional coders have the most errors?	**H6.1:** Medical providers will have the most errors within the evaluation and management CPT code category (90000-99999).	**$H6.1_o$:** Medical providers will not have the most errors within the evaluation and management CPT code category.	Failure to reject the null
	H6.2: Certified professional coders will have the most errors within the errors within then Respiratory, Cardiovascular, Hemic, and Lymphatic System (30000-39999) category of CPT codes.	**$H6.2_o$:** Certified professional coders will not have the most errors within the errors within then Respiratory, Cardiovascular, Hemic, and Lymphatic System (30000-39999) category of CPT codes.	Failure to reject the null

Appendix G

Institutional Review Board

Protocol:	**2023-036**	**Sponsor(s):**	
Committee:	IRB	**Sponsor Id:**	
Category:		**Grants:**	
Department:			
Agent Types:	Retrospective Review of Secondary Data	**CRO:**	
Title:	An Analysis of Current Procedural Terminology Accuracy for Professional Services: A Comparison Between Certified Professional Coders and Physicians	**Year:**	2023
Exempt Categories:	Exempt Category 4: Secondary research for which consent is not required.		

Comments: Determining which group between medical providers and certified professional coders has a more accurate Current Procedural Terminology medical coding selection for medical claims, what variables impact these error rates, and the overall cost. Current Procedural Terminology (CPT) codes are the co(more...)

Protocol-Site

Site(s):	**RUC - Radford University Carilion**	**PI:**	**Jeannine Everhart PhD, MPH, MBA, CHES**
Status:	Open to Enrollment of New Participants	**Additional:**	N
Approval:	March 24, 2023	**Expiration:**	**Exempt**
Initial Approval:	March 24, 2023	**Other Expirations:**	Exempt & Expedited Protocols Three-Year Check-in Date - 03/23/2026

Protocol-Site Contacts (2) collapse

Name	Role
Jeannine Everhart PhD, MPH, MBA, CHES	Co-Investigator
Kathleen Burris-Fowlkes	Student Researcher