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CHARACTERISTICS OF THE CURRENT CIVIL SERVICE MILITARY HEALTHCARE WORKFORCE AND DETERMINANTS OF WORKFORCE TURNOVER AND ATTRITION

Paone, Stephanie M.

Monterey, CA; Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

CHARACTERISTICS OF THE CURRENT CIVIL SERVICE MILITARY HEALTHCARE WORKFORCE AND DETERMINANTS OF WORKFORCE TURNOVER AND ATTRITION

by

Stephanie M. Paone

March 2020

Thesis Advisor:	Spencer T. Brien
Co-Advisor:	Samuel E. Buttrey
Second Reader:	Jennifer A. Heissel

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Fiscal year 2018 marked the onset of a phased transition of command over the Military Treatment Facilities (MTF) to the recently established Defense Health Agency. As the MTF environment goes through a landmark transition, the optimal future functions and capabilities of each MTF remain under planning and evaluation. Strategic decision making requires complete information for future operational planning.

Currently, little is known about the baseline demographics, determinants of turnover, attrition rates, and general career life cycle of the civil service healthcare workforce. Using civil service human resource workforce data from the years 2014–2018, this study applies quantitative descriptive and regression analysis methods to achieve an in-depth summary of this workforce's current condition and career life cycle. The results not only describe the current MTF civilian healthcare labor force but cite workforce planning vulnerabilities.

The findings indicate potential risks for a manpower gap in the future MTF environment. The implications of these findings not only provide a workforce baseline for a measurable evaluation of the effect of future policy and transition outcomes, they support the notion that changes in the recruitment and retention policies for federal labor hiring are required if the current civilian medical workforce is to be maintained or increased.

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Stephanie M. Paone
Commander, United States Navy
BS, Boston College, 2005
MS, Jacksonville University, 2014

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March 2020

Approved by: Spencer T. Brien
Advisor

Samuel E. Buttrey
Co-Advisor

Jennifer A. Heissel
Second Reader

Marigee Bacolod
Academic Associate, Graduate School of Defense Management

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TABLE OF CONTENTS

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LIST OF FIGURES

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LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

ACS	American Community Survey
BLS	U.S. Bureau Labor and Statistics
CPS	Current Population Survey
CSA	U.S. Combat Support Agency
DA	U.S. Department of the Army
DHA	U.S. Defense Health Agency
DMDC	U.S. Defense Manpower Data
DO	Doctorate of Osteopathic Medicine
DoD	Department of Defense
FERS	Federal Employee Retirement System
HWC	U.S. Health Workforce Chartbook
MD	Doctor of Medicine
MHS	Military Healthcare System
MRC	Military Readiness Command: Medical Readiness and Training Command
MTF	Military Treatment Facility
NCWF	National Center for Workforce Analysis
NDAA	National Defense Authorization Act
OPM	U.S. Officer of Personnel Management
PUMS	Public Use Microdata Sample
RAND	Research and Development Corporation
RN	Registered Nurse

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EXECUTIVE SUMMARY

This master's thesis explores the 2014 cohort of U.S. Department of Defense's civil service healthcare workforce population and captures five years of the attrition behavior using Defense Manpower Data Center data sponsored by the U.S. Office of Personnel Management as part of a greater civilian attrition study. The purpose of this master's thesis analysis of the 2014 civil service healthcare workforce population is to provide the Defense Health Agency, military leaders, and other stakeholders with a detailed catalog and assessment of this workforce for future strategic planning and evaluation of manpower policy and programs. This master's thesis aims to answer the following questions: (1) What are the baseline demographics and professional characteristics of the civil service military healthcare workforce, and which characteristics of this workforce have the greatest impact on the worker's career lifecycle? (2) Within this workforce, do correlations exist among employee characteristics that reveal subpopulations within the healthcare workforce, and what characteristics most likely increase attrition behavior within this workforce, and how does this workforce behave in terms of attrition at retirement eligibility?

The investigative nature of this thesis's analysis and scope of research led to a product that offers a catalog of workforce population information including complete baseline demographics and professional characteristics, descriptions of existing and emerging subpopulations, evidence of associated career lifecycle trends, and an initial causal lifecycle behavior exploration.

The first portion of this thesis provides background information on the urgent need for stakeholders to assess the baseline of this workforce population at the critical juncture of the military healthcare system's landmark organizational transition under the Defense Health Agency. This section continues with an examination of past literature and research on the implications of turnover behavior, organizational behavior's effect on workforce turnover, worker propensity for public service and the external and internal job choice influences, current data available for workforce analysis, benefits of past federal and healthcare workforce population baseline and turnover behavior studies, and criticisms of using turnover intention as a proxy for attrition.

The next portion of this thesis provides details on the process of data acquisition, data structuring, and study methods of univariate, bivariate, and odds ratio analysis to answer the research questions. This section continues with results of this analysis presented in two distinct sections of descriptive statistics and logistic regression odds ratio analysis.

The descriptive statistics section aims to answer the elements of the primary and secondary research questions about the baseline demographic and professional characteristics of this workforce and to identify subpopulations within the workforce. These goals are executed firstly through comparison of differences in age factors and tenure within population demographic groups using density frequency plots for population distribution comparison. Next, population demographics and professional characteristics' prevalence within the workforce population and population groups are assessed using cross-tabulation methods to produce stacked bar graphs of population composition percentages. Additionally, a full demographic table of cross-tabulation results is included in the appendix of this thesis. Lastly, the relationship between the age of an individual at the time of workforce entry and the career lifespan for all individuals who departed the workforce during the study period is assessed through specific age-range histogram distributions.

The odds ratio analysis sections of this thesis aim to answer the elements of the primary and secondary research questions that address the question of which characteristics have the greatest impact on the worker's career lifecycle and attrition at the time of retirement eligibility. The first section of this analysis highlights the process of finding the most appropriate model fit to answer the research question. Next, this thesis identifies the best model fit and further interprets the results through assessment of the changes in the average marginal effect that occur throughout a career lifespan for each characteristic identified in the model. The next section of this analysis considers the effects of income per capita on workforce attrition. However, correlated values of local income per capita exist for only approximately half of the population sample. While local economic effects on workforce turnover behavior is a factor of interest in this study, this thesis does not value the inclusion of the effect over the assessment of the total population. Therefore, this

study includes a separate model with analysis and discussion that includes this economic effect on workforce attrition rates.

The last portion of the analysis chapter aims to assess the effect of different population characteristics on attrition that occurs at specific tenure milestones. Tenure milestones place time limits on attrition events. The benefit of applying this logistic regression model to the data is a clearer picture of which worker characteristics have the most significant effects on turnover at different points of the career lifecycle.

The key findings of this study are:

(1) What are the baseline demographic and professional characteristics of the DoD civil service military healthcare workforce, and which characteristics of this workforce have the greatest impact on the worker's career lifecycle?

- The demographics of the civil service healthcare workforce are similar to the private sector healthcare workforce; it is primarily female and overrepresented by Caucasians, especially in positions that require more education and are associated with increased salaries.

- The civil service healthcare workforce employs a smaller percentage of minorities in the position of a medical officer.

- The civil service healthcare workforce is, on average, are more aged overall than workers in the private sector.

- Age, tenure, retirement eligibility, and income per capita have the greatest effects on a worker's career lifecycle, but the magnitude of impact is dependent on both worker age and tenure values.

- Blue-collar workers remain in the workforce an additional year on average than white-collar workers. Minority workers remain an additional two years on average compared to Caucasian workers.

- Minority workers and workers in the healthcare professional (other) category typically are less likely to attrite during the course of their career

lifespan and are less sensitive to income-per-capita changes in terms of turnover behavior than other groups.

(2) Within this workforce, do correlations exist/occur between employee characteristics that reveal subpopulations within the healthcare workforce, and what characteristics most likely increase attrition behavior within this workforce, and how does this workforce behave in terms of attrition at retirement eligibility?

- Males enter the workforce in two distinct population groups: a younger-than-the-average female entry age and an older-than-the-average female entry age. However, overall, across the civil service community, a late-entry workforce subpopulation exists.

- All populations are more likely to attrite during the first five work years, but the vulnerable populations of females and minority groups are even more likely to attrite during this critical time period. However, these workers also display behavior that suggest they are risk averse when local income per capita is high and are more likely to remain than their group counterparts if they remain in the workforce after the first 5-10 years of tenure.

- The characteristics of an individual most associated with attrition behavior are as follows: recently employed worker (fewer than five work years), young age-at-hire worker who is also recently employed (fewer than five work years), retirement eligible nurse, medical officer, retirement eligible medical officer with an older workforce entry age, medical officer in a high-value income-per-capita location, blue-collar worker, retirement-eligible white-collar, recently employed female worker who is a young age-at-hire, recently employed female in a high-value income-per-capita location, female workers with over 21 work years, retirement-eligible worker if also a late-entry worker, retirement-eligible if also an older age-at-hire.

The significance of these findings is that they provide information that captures actual workforce turnover behavior as opposed to worker intention to attrite. The indications of establishing baseline characteristics of this unique labor force contribute to the current body of knowledge of healthcare workforce behavior. The implications of these findings will provide mission-critical information to decision-makers on the overall potential civilian labor outlook for Military Treatment Facilities and its possible future operating capabilities. However, more importantly, without a baseline measurement of the current workforce, leaders cannot effectively evaluate future manpower policies and solutions during and after the organizational transition. Stakeholders and decision-makers can utilize the findings of this master's thesis not only for the purpose of workforce and policy evaluation but also for the development of targeted recruitment and workforce retainment solutions.

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I. INTRODUCTION

A. BACKGROUND

In fiscal year 2018, the Defense Health Agency (DHA) began a four-year transition plan to assume authority of the Department of Defense's (DoD) Military Healthcare System (MHS) including over 400 military treatment facilities (MTFs) that serve over 9.4 million patients worldwide (Defense Health Agency [DHA], 2019a). The U.S. Congress mandated the formation of a centralized governance of the MHS in 2013, and subsequently, the Deputy Secretary of Defense directed the official establishment of the DHA as a Combat Support Agency (CSA) in March of the same year (DoD Directive: 3000.06, 2013). However, the proposal to integrate military medical services into a joint system to increase quality of care and efficiency is not a new concept and is one experts have been proposing repeatedly since the 1980s. The most recent push and subsequent creation of the DHA followed a 2011 DoD special task force report on MHS governance that cited inconsistencies and inefficiencies in the delivery system (DHA, 2017). Under the previous system, each of the armed services (U.S. Navy, Army, and Air Force), respectively, managed its own medical treatment facilities in a jointly supportive but non-integrated system.

The purpose of the DHA is to ensure the standardization of quality of care to all its military healthcare beneficiaries as part of a larger effort to provide greater integration of services and a more centralized control over purchased care. The DHA reports its mission is to achieve greater integration of direct and purchased care delivery systems, so it can accomplish a "4-point aim"—achieve medical readiness, improve the health of its beneficiaries, enhance the experience of care, and lower healthcare costs (DHA, 2019a). The DHA further establishes its agency goals as follows:

"Empower and Care for Our People

Optimize Operations Across the Military Health System

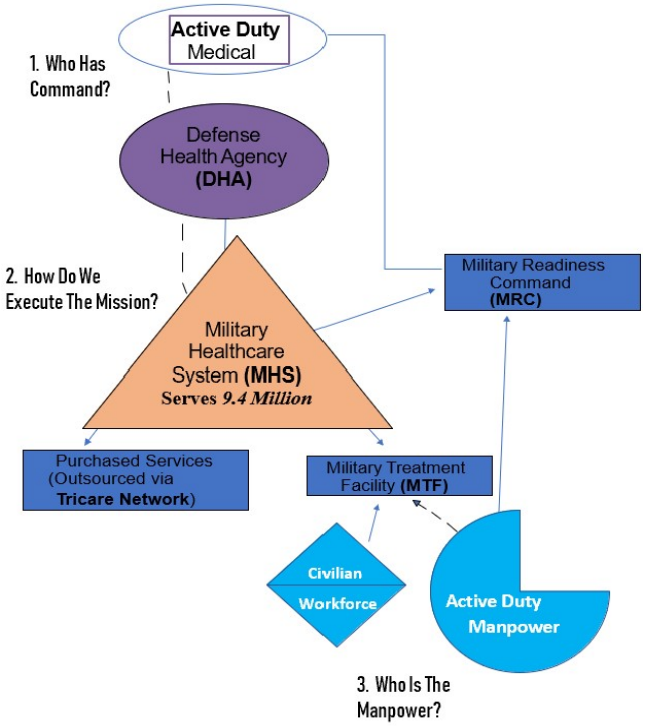
Co-create Optimal Outcomes for Health, Well-Being and Readiness

Deliver Solutions to Combatant Commands" (DHA, 2019a, p. 1).

The DHA is expected to complete a full transition of operations governance before fiscal year 2022 across all armed services and their respective MTFs. At this time, military active duty manpower will fall under the command of a joint readiness center environment which will share a commanding officer with the MTF during the transition. The commanding officer will be accountable to both the DHA and Combatant Commanders. This proposed organizational structure has remained fluid with evolving strategy, and it may continue to change with strategy implementation as this landmark organizational transition continues.

B. PROBLEM AND MOTIVATION

The National Defense Authorization Act (NDAA) for fiscal year 2017 provided the authority and funding for the DHA to begin its transition of control over the MTFs through a phased process. It also provided the DHA the authority to convert military medical and dental positions to civilian positions, as well as adjust medical services, personnel requirements, and infrastructure "to maintain readiness and core competencies of health care providers" (National Defense Authorization Act [NDAA], 2017, p. 1078). The significance of these authorizations is that it signals the change expected to take place for active duty military medical manpower mission to shift focus from the beneficiary healthcare mission to a focus on operational readiness. The overall mission requirement for the MHS is to provide a medically capable military for the readiness mission and a ready military medical manpower (DHA, 2017). In preparation for this change and to maintain mission efficiency, the active service medical communities expect to realign over 17,000 active duty medical billets across the services in the future toward operationally focused billets (Maucione, 2019). Figure 1 describes the former, current, and potential future structure of the command, ways, and means of executing the MHS mission.



The MHS remains the center of the military medical mission. The military medical readiness and training commands will be a third method of MHS mission execution. Active Duty Manpower will fulfill the manning requirements of the MRC. The dashed lines represent what elements of this system are currently in transition and with unknowns attached; what extent of responsibility and authority active duty services leaders will have over the MHS and MTF environment, and how much of the manning requirements will remain under their responsibility to fulfill.

Figure 1. The MHS in Transition

It has not gone unnoticed that this will result in a manpower gap within the MTFs. The 2019 NDAA further guides the reform of the MHS to drive the DHA to demonstrate its ability to establish healthcare market management capabilities through a "conditions-based approach that will require it to meet clear, objective conditions that demonstrate the DHA's capability and capacity for management of the MTFs" (Deputy Secretary of Defense, 2019, p. 1). This statement indicates how the conditions of availability of an outside network, patient population needs, and workforce and system capabilities will dictate the direction of healthcare delivery. Figure 1 highlights the MHS mission and the changes in both command and in additional branches of mission execution. Figure 1 also illustrates the unanswered question of how leaders will distribute active duty manpower between the MTF environment with the addition of Military Medical Readiness and Training Commands.

More recently, the 2020 NDAA authorization bill prohibits the reduction of military billets until leaders conduct a full assessment of future requirements and assess the potential healthcare gaps at each MTF (Maucione, 2019). During the transition, the DHA continues to ensure all beneficiaries will receive uninterrupted care provided through military, civilian, and contract personnel at the MTF, as well as through private outside network partnerships (Cade, 2019). Equally, stakeholder reports and strategy maps published by the DHA specifically include the "workforce" as one of the agency's priorities. More specifically, the DHA plans to empower, value, and care for its employees as part of the ways and means to meet other strategic goals (DHA, 2017).

Currently, the baseline characteristics of the DoD civil service healthcare workforce have not been published. Additionally, stakeholders do not appear to understand at this time how much of the military manpower will continue to be shared to fulfill MTF functions. While the DoD civilian healthcare workforce has been part of the strategy of workforce consistency within the MTF, particularly during critical wartime periods, this workforce has also traditionally been viewed as supplemental and supportive to the active duty manpower staffing model. If the mission of the active duty military various healthcare corps is to improve their wartime skill readiness, the MTF environment may not provide the workload needed to meet this requirement (Garamone, 2019). Even if an impending future exodus of active duty personnel from the MTF environment does not occur, it is clear that future services and requirements will be largely based on a core civilian and contract staffing model and not on military billeting. The next steps to effective workforce strategy planning will require more information about the current civilian workforce and the private healthcare labor market that may or may not be available to the DHA for future operations.

C. PURPOSE OF STUDY

Understanding these baseline characteristics of the current DoD civil service healthcare workforce population in the MTF environment is critical to having timely and accurate knowledge in the strategic decision-making process. The overall military healthcare mission to deliver care to over nine million beneficiaries across the globe

remains unchanged despite the large-scale organizational transition. Over the years of transition, complete information will be required for weighing future options for mission execution. The DHA will decide which MTFs should remain open, which services should be expanded and reduced, which regions have comparable service options available from the private sector, and which method of delivery is the most efficient and effective, while still meeting mission requirements. These decisions will likely be based on a combination of population medical needs and requirements, as well as labor capabilities. For future workforce planning, it is important to identify how stable the current workforce population is in its turnover behavior when the majority are expected to retire and if the DHA can replace the workforce.

The DoD has a vested interest in its civilian workforce and has increasingly become interested in science, technology, engineering, and math (STEM) occupations deemed critical for mission execution (Asch, 2002; National Academies of Science, 2012; Buttrey, Klingensmith, & Whitaker, 2018; Brien, 2019). The civilian healthcare workforce community is undeniably a mission-critical occupational community. The importance of research and assessment of this workforce may extend beyond national security needs and the health of the military active duty members and families: it may also have implications applicable to the wider public and private sector healthcare workforce communities.

It is also important to recognize that any predictions or worker turnover forecasting may have to be adjusted by an analyst when considering extraneous external factors, such as a large organizational disruption. The individual's level of organizational and occupational commitment may also influence traditional labor attrition rates. This knowledge can assist decision makers in considering the consequences of decisions and expected outcomes. Workforce knowledge can help predict which MTF functions remain feasible in the future and how much workforce functions and conditions would need to be improved to meet future or new mission requirements. Even more importantly, accurate baseline workforce knowledge and measurements serve to evaluate the effectiveness of decisions and new policies after the DHA has implemented them. The aim of this study will be to provide a complete descriptive analysis of this workforce between the years 2014–2018 and derive attrition patterns of this population through analysis. The

significance of this information is its ability to provide decision makers and researchers a baseline assessment of this workforce for future assessment and studies.

D. THESIS RESEARCH QUESTIONS

1. Primary Research Questions

The primary research questions for this thesis are:

a. What are the baseline demographic and professional characteristics of the DoD civil service military healthcare workforce?

b. Which characteristics of this workforce have the greatest impact on the civil service military healthcare worker's career lifecycle?

2. Secondary Research Questions

The secondary research questions are:

a. Within this workforce, do correlations exist among employee characteristics that reveal subpopulations within the healthcare workforce?

b. What characteristics most likely increase attrition behavior within this workforce, and how does this workforce behave in terms of attrition at retirement eligibility?

E. SCOPE AND LIMITATIONS OF STUDY

The scope of this research will cover the exploration of the population of civil service healthcare workers employed by the United States DoD. It will not include workers doing a similar job for the DoD at similar locations employed as contractors or active duty military. Furthermore, wage grade and temporary employees are excluded from the study for a more comparable assessment of healthcare workforce employees and the avoidance of artificially inflating attrition rates throughout the assessment.

The data available for this study consists of DoD civilian master file quarterly snapshots. To ensure the data is both the most recent reflection of the population and mature enough so that data entries are as complete as possible, the study focuses on a 2014-01-01 to 2014–12-31 cross-section of the data and follows its future behavior until 2018-09-31.

The intent of this thesis is to study the current demographics of this population and attempt to uncover any characteristic or behavior trends through quantitative analysis only. Univariate descriptive analysis is the primary exploratory method implemented to assess the current population characteristics and structure. Logistic regression methods are the primary analysis applied to assess the workforce attrition behavior. This study captures the true observed behavior and attrition outcomes for a large organizational workforce. However, it does not include opinion or qualitative survey data to better understand the motivation behind individual attrition decisions.

F. ORGANIZATION OF THE THESIS

This thesis is organized into six chapters. Chapter I has introduced the military healthcare organization background and its current transition under the DHA. This chapter further summarizes the potential manpower gap in the MTF environment as a result of this transition and emphasizes the purpose of this thesis. Chapter II is a literature review of current civil service workforce knowledge, public workforce behavior research, and healthcare worker research. Chapter III describes the data source, structure, and methodology implemented in this study's analysis. Chapter IV is a presentation of the study's analysis results and findings. The first portion of this chapter explores the baseline demographics and professional characteristics of the population and investigates correlations between characteristics to reveal subpopulations. The second portion of this chapter aims to provide initial causal exploration between the population characteristics and career lifecycle outcomes through logistic odds ratio analysis. Chapter V offers further discussion of the results in terms of research questions' answers, research limitations, and further indications of findings and results interpretation. Chapter VI concludes the thesis with both recommendations for the use of the thesis results and potential further studies related to the topic of this thesis and the research findings.

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II. LITERATURE REVIEW

A. INTRODUCTION

An assessment of the DoD MTF healthcare workforce requires an understanding of what is known about healthcare workforce turnover behavior and DoD civil service workforce behavior. This knowledge will enable this study to place the results of descriptive and predicative analysis in context of what is known about each of these workforces. While the intent of this study is to provide a baseline of the characteristics and determinants of turnover behavior of this workforce, it is also necessary to consider what type of workforce changes might be expected after an organizational shift of this scale in comparison to this thesis's findings.

B. ORGANIZATIONAL BEHAVIOR AND WORKFORCE TURNOVER

The formation of the DHA will affect 9.4 million patients globally who are eligible for healthcare services at over 50 MTF inpatient hospitals and 381 MTF outpatient clinics (DHA, 2017). Organizational transitions of this scale are rare, and this military healthcare system transition of leadership under the DHA is historic. Large-scale transitions and business mergers can result in unexpected workforce turnover behavior. It is important to assess how transitions and climate can affect the workforce and to explore the organizational characteristics that lead to employee retention. Themes of employee engagement and self-identification with the organization are often considered as possible drivers of retention during organizational transitions, mergers, and general organizational long-term retention. The aim of this section is to explore the existing research in these areas.

1. Employee Engagement

The healthcare system, which is driven by standards of care and changing regulations, is not immune to large-scale changes in systems. One of largest systemic changes the healthcare system has gone through in western medicine is a shift toward a patient-centered treatment method. The intent of this transition is not only cost

effectiveness but to refocus the emphasis on patient needs, perceptions, and self-involvement in the care decision-making process. Avgar et al. (2011) found organizational behavior, culture, efficiency, and patient outcomes decreased the turnover rate of staff members belonging to the British National Health Service during and after their transition to a patient-centered care system. The researchers reported the result of analysis over the four-year transition period to be better patient health outcomes, increased patient and staff satisfaction, and a decrease in workforce turnover intention. Additional findings included that employee engagement was a significant potentiator of the positive effects on worker satisfaction during the transition period (Avgar et al., 2011).

Similarly, Owens et al. (2017) found that an increased degree of employee engagement through a shared emotional and behavioral connection with the organization's mission, vision, and values increased commitment and retention for healthcare workers and physicians. Additionally, Owens et al. reported a strong correlation between patient quality of care and lower nurse turnover rates, and they found that physicians who were cited as being more "engaged" in their work were 26% more productive. These results further promulgate the notion that staff engagement during difficult transitions may be key to overcoming the challenges of productivity and staff retention.

2. Organizational and Occupational Self-Identification and Self-Selection

A study of 599 employees following a large-scale business merger utilized data from pre- and post-organizational transition to explore the merger's effect on the following: individuals' social identity and personal assessment of their role, the value of the merger to organization, and their identification and attachment to the organization following the transition (Sung et al., 2017). This study cites the relationship between all three of these conceptual models as influencing turnover rate during organizational transitions. It further suggests that a key technique to reduce voluntary employee turnover through strategic efforts is to reduce changes in perceived organizational value and the individual's role within it (Sung et al., 2017).

Social and business researchers have performed studies for several decades to develop models and constructs on the psychological aspects of occupational and organizational commitment. However, Blau's (2003) study suggests workers form a stronger sense of commitment to their chosen occupation than a commitment to the organization. Moreover, much of this commitment is related to accumulated costs associated with the occupation against the availability of outside alternatives. Workers in the healthcare profession spend years on their education and years after graduation mastering skills that are often only well paid and appreciated within the healthcare industry. However, this investment in skills is not specific to the organization. Although the worker may experience occupational entrenchment due to lack of comparable alternative career paths, comparable and even competitive employment at other organizations is often readily available for healthcare professionals. It is also important to note that while occupational entrenchment does not necessarily transfer to organizational commitment, organizational commitment is associated with increased commitment to an individual's chosen occupation (Blau, 2003). This finding indicates that organizational climate and the workers' relationships with the organization likely effects the level of satisfaction with their work.

Boekeloo et al. (2015) further support this notion, citing intrinsic characteristics of healthcare occupations as the greatest retention determinant of an individuals in the fields of health sciences due to self-determination theory. The researchers tested their theory of intrinsic versus extrinsic motivators of individuals from minority and low socioeconomic backgrounds as they pursue a career in the health sciences. The results of their analysis of a cohort sample of high school students from 2011–2013 revealed that intrinsic motivators consistently predicted the intent to pursue a career in the health sciences. The value placed on the intrinsic motivation associated with health science occupations is made even more interesting, because it exists as a chosen propensity within individuals despite their genuine future need of a satisfactory salary given their current background and economic status (Boekeloo et al., 2015).

Lastly, Sampurna (2018) performed a meta-analysis of an existing body of research related to talent management. The author used this research to conceptually extract themes and tools utilized in firms that most effectively retain talent and developed a framework

that proposes that an employee's predisposition of value sets is what typically attracts them to the firm. If the firm then strives to enhance the experience and capability of the employee, it will lead to engagement and feelings of loyalty to the firm. This intrinsic motivation is the driver of an increased enduring relationship with the firm, which is believed to lead to higher retention rates (Sampurna, 2018).

As evidenced by these studies, leveraging intrinsic rewards is becoming increasingly important to appeal to the younger labor market overall and workers attracted to fields in healthcare. This review also exposes the concept of matching values of a company to the intrinsic values of a potential worker who self-selects into the agency as potential predictor of predisposition for future organizational loyalty.

C. CURRENT FEDERAL AND HEALTHCARE WORKFORCE DATA COLLECTION RESOURCES

The opportunities and limitations of data systems and sources available has largely dictated the type and extent of previous healthcare workforce and federal workforce research. The next section provides a summary of various types of sources and methods that have been and are currently available for workforce studies in the interest area of this thesis.

The DoD established the Defense Manpower Data Center (DMDC), formally known as the Manpower Research and Data Analysis Center, in 1974 as the primary system of managing, storing, and analyzing its manpower (DMDC, 2019). The DMDC updates the data on a quarterly basis. The data archives are organized as cross-sectional snapshot human resource files, which reveal both personal attributes and the present status of individuals in the DoD military and civilian workforce at the end of each quarter. The strength of this data is the ability to view an individual's accession, career progress, and attrition over time. However, the ability to link several career snapshots to the same individual comes at the cost of personally identifiable information (PII) and therefore is not readily accessible for research utilization.

Another federal data workforce resource is that of U.S. Office of Personnel Management (OPM). The OPM manages a federal human resource data warehouse that

customers can utilize through FedScope online (OPM, 2019). FedScope also provides cross-sectional data and statistics of the civil service federal workforce using human resource file snapshots of each year. The strength in using this data for analysis is that it is highly reliable and easily accessible to an array of customers, agencies, and researchers. However, the data provided by the OPM for analytical use is not linked to PII. Without individual identifiers, analysts cannot link observations across time and therefore cannot use the observations for several types of outcome analysis and forecasting that require the observation of workforce cohorts or individuals over time.

The U.S. Bureau Labor and Statistics (BLS) describes itself as the "principal federal agency responsible for measuring labor market activity, working conditions, and price changes in the economy" (U.S. Bureau Labor and Statistics [BLS], 2019). Its mission is to provide the widest dissemination of collected and organized U.S. workforce data that can be universally utilized for both public and private policy, as well as individual research and organization decision making. While this may be the most comprehensive resource for U.S. national employment and workforce information, its source of information is mainly limited to results from the Current Population Survey (CPS). The CPS is a combination of BLS monthly metrics and U.S. Census Bureau data collected and reported each decade (BLS, 2019). Like OPM FedScope data, the information provided is not linked to personal identifiable information. It is a useful tool in gathering workforce demographics, general labor force characteristics, and even economic mood due to some of its qualitative exploratory data-collection methods. However, it remains limited in its ability to provide data that analysts can utilize to capture workforce behavior or information about the career lifecycle.

Healthcare organizations usually have separate business and human resource analytics that capture workforce behavior within their organization or healthcare system. However, these organizations use their data for its own decision making, and it is not usually shared collectively among facilities unless a mutual agreement exists to participate in research. Additional sources of data for the healthcare workforce may come from private interest groups who often use surveys as their main method of data collection.

D. WORKFORCE TURNOVER STUDIES

While regularly published formal reports on the descriptive statistics at various point in time of the federal labor force exists, limited academic research on the subject is available. Most existing research focuses on job satisfaction and intent to attrite gathered from a combination of surveys and human resource databases. However, very few of these studies have yielded any predictive modeling related to the civil service military healthcare workforce due to limitations of the data bases described in the previous section. Despite these limitations, many studies have provided evidence of possible motivations for healthcare or government workforce turnover.

1. Public versus Private Workforce Population: Intrinsic Motivation, Propensity, and Self-Selection

Research on the federal healthcare workforce could theoretically involve an assessment of a large quantity of observations across several localities of a region or country. This type of data has the potential to yield analysis and results with high external validity. However, some studies suggest fundamental differences exist between those who choose to work and remain in the public versus private sector. Sell and Cleal (2011) conducted an analysis on the conditional likelihood of job satisfaction using combined panel survey data results from the Danish Work Environment Cohort Study from the years 1995 and 2000. The authors identified key demographic and economic variables from the balanced panel comparison of those working in the private versus public sector and extracted indicators of satisfaction from the survey results. The author then developed a model using a logistic odds ratio regression to analyze the outcome of job satisfaction when considering economic, personal, and work environment variable integrations. The model's purpose was to test interactions between rewards and work environment hazards on the outcome of satisfaction. The results of Sell and Cleal's (2011) study indicated rewards of payment were only a significant predictor of job satisfaction in the private sector. Conversely, in the public sector, the only significant predictors of increased job satisfaction were related to work environment factors, such as leadership positions, job tenure, job security, and level of influence.

Leider et al. (2016) used two databases—the 2014 Federal Viewpoint Survey and the 2014 Public Health Workforce Interests and Needs Survey—to draw comparisons between public health staff in different regions to examine drivers of both job satisfaction and intent to attrite. The researchers also used logistic regression analysis to find employment management characteristics that were highly correlated with job satisfaction or intent to depart the organization within the next year. Researchers found contributors to job satisfaction were organization support and employee engagement. Conversely, the primary determinants for dissatisfaction and drivers to seek other employment were salary and other extrinsic factors.

Likewise, Cho and Lewis (2012) used central personnel files from the OPM and information from the U.S. Merit Systems Protection Board's 2005 audit on management practices and workers' intent to leave their place of employment. The chief intent was to assess the effect of human resource management practice on federal employee turnover behavior by using reported turnover intent as a proxy for agency departure. Firstly, the researchers intended to verify if reported intent to leave the workforce was a reliable proxy for behavior. Using demographic and education variables for a white-collar worker subpopulation, they assessed the probability of leaving federal service using logit analysis and compared these results with reported intent. Corresponding with most turnover intent studies, federal workers reported intent to leave within the year at a greater rate than their actual behavior. Also, consistent with other workforce studies, age and tenure within the agency were the characteristics that best predicted attrition over all other demographics (Cho & Lewis, 2012). More specifically, new employees and those approaching retirement are cited to be most at risk for attrition. However, for those with higher education, results pointed to extrinsic rewards having the largest impact on attrition early in the career while intrinsic rewards may have had a larger impact on retention for workers in the mid and later stages of their career (Cho & Lewis, 2012).

The research performed by Cho and Lewis (2012) arms this thesis with some of the most useful previous study analysis because it compares and links employee turnover intention with actual behavior. Cho and Lewis conclude, based on their findings, turnover intention could be a reasonable proxy for actual turnover in that a reported intention to

leave is highly correlated with future employee attrition. However, the aggregation of personal demographics, particularly education and salary as well as specific agency of employment, can have a polarizing effects on turnover behavior that renders the employee intention proxy a less reliable predication. Similar results from Cohen, Blake, and Goodman's (2015) stepwise regression analysis from data evaluation of over 180 U.S. federal agencies suggests intention is only correlated with turnover and not an appropriate proxy for predictive purposes. This study further suggests that unique demographic characteristics may be a more reliable predictors than local employee satisfaction survey results.

Grissom et al. (2016) performed a meta-analysis that echoes many of the findings from the research already discussed. This meta-analysis aimed to study the current literature focused on teacher turnover in the public sector. Grissom et al. report the teacher characteristics most associated with turnover were age and experience, where attrition was highest for the youngest and least experienced teachers, as well as those most experienced. This latter finding is likely due to individuals approaching retirement age or an increased susceptibility to employee poaching or job advancement opportunities given their experience. Grissom et al. also noted that, while females in teaching are found to mimic private sector workforce studies in higher rates of attrition during childbearing years, it is uniquely noted that reentry without loss of pay or position for females in the public sector is also exhibited. What is most relevant from this analysis is the finding that many teachers leave their positions for positions in other public-school districts or agencies. Grissom et al. further suggests the federal workforce and other public sectors may also experience similar behavior of turnover or job mobility from the local agency for personal motives but not true attrition from the occupation within the federal work environment. Grissom et al. noted appropriate data availability as the leading cause of gap in this research to further examine the career longevity of this workforce.

Furthermore, Leider et al. (2016) utilized Federal Employee Viewpoint Survey data, Needs Survey data, and Public Health Workforce Interests data to draw comparisons and correlations related to job satisfaction and intent to leave the public health workforce within the year using logistic regression analysis. The researchers found the largest

contributor to intent to attrite within the year involved dissatisfaction with pay. Conversely, the largest correlates of high job satisfaction included organizational support and staff engagement. This study supports the notion that those most well-fitted with public employment are driven more by intrinsic than extrinsic motivators. However, with 40% of workers reporting an intent to attrite or retire before the year 2020, it is clear more labor is required than there are workers who are driven by intrinsic motivators, and would therefore be a good job match (Leider et al). Decision makers need to address the element of pay dissatisfaction in the public health workforce to manage future talent and meet requirements.

Essentially, these studies suggest those who survive the early stages of attrition in the public sector may have a propensity to serve in the public environment. In turn, the federal environment likely benefits from natural sorting in the early years of an individual's employment that assists in matching the individual with the environment. A fundamental difference may exist for workers in this population who chooses to remain in public service compared to the private workforce. However, if the federal workforce is experiencing a workforce gap, organizations may need to focus on extrinsic rewards to attract and retain workers.

2. Federal Workforce Turnover

One of the more recent large-scale DoD civilian workforce studies utilized the FedScope database for comparative analysis of the entire federal workforce between 1998 and 2008 (Copeland, 2011). The methodology for this study was a univariate descriptive statistics method to gain a baseline of a workforce previously unknown, which is comparable in its intent and methodology to the analysis in this thesis. Some of the notable findings from Copeland's research were that over 35% of the federal workforce was concentrated in California, Texas, and the surrounding U.S. Capitol area. Additionally, traditional blue- and white-collar jobs declined overall, but professional and administrative jobs increased over the study period, signaling an overall rise in a demand for these occupation-types over time in civil service (Copeland). One limitation of the study was the unknown use of contract job and positions that may have increased or been utilized to

replace blue- and white-collar positions that previously existed within the civil service. It is then suggested the increased utilization of a contract "hidden" workforce will make it more difficult to assess a true baseline of the federal workforce in the future (Copeland).

Morgan (2018) performed one of the most relevant federal workforce studies, one which aimed to understand determinants of attrition in DoD STEM occupational fields and how these trends differ from those among employees in other occupations. Utilizing DMDC data, Morgan (2018) extracted a subpopulation of individuals who contained STEM-occupational codes for comparison against those without STEM-occupational codes. Morgan further limited her analysis to a 2009 cohort of Department of the Army (DA) employees and applied a survival analysis method to assess the differences in attrition between demographic groups within the STEM 2009 cohort and those outside the STEM occupations within the DA. Survival analysis methodology yielded predictive indicators of attrition, which remained difficult to obtain in previous federal workforce studies. Morgan's (2018) study results indicate retention increased after the 12-year mark and showed little difference in retention between males and females within the field.

Similarly, Moynihan and Landuyt (2008) also found a trend in their public workforce research that women are increasingly less likely to leave public organizations in general. The results of Morgan's analysis echoes rising literature of a closing attrition rate between men and women in federal service. Even as early as 1995, Kellough and Osuna's federal cross-agency study analysis unexpectedly exposed that sex, minority status, and administrative or professional-level employee populations did not correlate with differences in turnover rates across agencies. Rather, analysts found agencies with the highest density of young workers were the ones with higher annual attrition rates.

Morgan's (2018) results also indicate higher attrition rates for STEM fields in Virginia than in Texas and further concludes this may be attributed to the increased worker demand and competitive pay for STEM workers within the same geographical commuting regions of Virginia versus Texas. The result is increased job opportunity for individual workers and decreased risk and expense in attrition because relocation is usually not required in the high federal employment areas of Virginia. Lastly, like most studies in this literature review, age and tenure continue to be significant predictors of turnover behavior.

3. Healthcare Workforce Turnover

The job of the healthcare worker is unique and diverse. It contains a spectrum of specializations associated with different training, temperance, labor hours, and general job satisfaction. Moreover, planning for a specific mix of healthcare delivery involves specialty practices, such as specialists, critical skills, generalists, technicians, and ancillary staff. Ensuring the right mix of healthcare workers is essential to meet the different MTF healthcare service capabilities. The literature on healthcare provider retention has mainly focused on two distinct areas: worker intent to leave clinical practice compared to actual attrition behavior, and characteristics within an occupation or individual organization that lead to attrition or retention.

The use of cross-sectional survey analysis using mixed methods to highlight covariates and inferential conclusions is common when studying workforce acquisition, retention, and turnover rate. Researchers can obtain data through large-scale collection methods, such as licensure registries, but mostly the preferred method is to collect data through survey reports. Researchers also use qualitative surveys and interviews to compare quantitative descriptive statistics with emerging themes and trends. Another method is to apply self-reported survey data regarding turnover intention as a proxy for turnover behavior. But the limitation remains within any of these methods the ability to follow the same individual throughout time or to consistently validate if the reported turnover intent serves as a good predictor for turnover behavior. This has been particularly difficult in the healthcare industry where feelings of burnout are high, turnover within the same organization is moderate, but departure from the healthcare industry or labor market is relatively low. The most difficult factor in analysis of healthcare occupations in general is the ability to connect these concepts in a meaningful way.

For example, Rambur et al. (2008) performed a U.S. statewide study whose findings reflect both occupational satisfaction and evidence of burnout. This study aimed to compare healthcare workers from different occupations to include technicians, RNs, and ancillary therapists. The study found each profession to report a relatively high satisfaction with their occupation, but, contradictorily, over 20% reported turnover intention rate for each occupation type. Another example was a mixed method analysis Gesesew et al. (2016)

utilized to assess turnover and attrition between 2009 and 2014 of over 300 mixed-skilled healthcare professionals. Employees reported job satisfaction as neutral overall, but almost half the staff departed within the five-year study period, and more than half reported an intention to attrite. The researchers reported they concluded satisfaction measurements were independent of turnover intention, and only some correlation existed between intention and actual employee turnover behavior.

Despite indications of self-selection into a career and sorting through advanced education, a recent McGrail et al. (2017) study found different results. Using logistical data analysis of physician turnover rate using the American Medical Association Physician Masterfile data years 2000–2014 in both rural and urban areas, McGrail et al. found younger physicians aged 45 years or less were almost twice as likely to experience biennial turnover than older physicians. These results suggest both age and tenure have the largest effect on turnover behavior for healthcare providers. This finding further indicates that despite pre-entry sorting through extensive education, some residual sorting after entry occurs, even if it is only to find the correct organizational match.

E. EXPLORATORY WORKFORCE BASELINE LITERATURE

1. Current Healthcare Workforce

While healthcare worker license databases offer a limited amount of information regarding predictive turnover behavior, several private recruitment and retention healthcare firms produce reports and research on both region specific and national healthcare workforce turnover. The most recent Nursing Solutions, Inc. (2019) report acquired its data from voluntary survey participation from 3,000 hospitals across the country. This cooperation likely provides one of the most comprehensive analyses of U.S. nursing workforce turnover. This firm's most recent findings indicate registered nurse (RN) vacancy rates remain relatively steady, but turnover rates at individual facilities continue to increase. The current projected average turnover rate is 19.1%, with the largest turnovers seen at midsize 350–500 bed facilities (Nursing Solutions, Inc., 2019). The results of this report reflect the lowest turnover rates are in the north central and western U.S. regions. The nursing force experiences the highest turnover for individuals with less than one-year

tenure and a second turnover peak before they achieve a five-year tenure. During middle tenure, RNs exhibit the lowest turnover rates; these rates then increase after the 10-year tenure mark. These findings are in keeping with personnel management sorting theory and other workforce turnover studies. The report also finds on average the turnover is higher for RNs compared to all other healthcare employees combined.

Comparing these findings to 2018 turnover rates for other healthcare occupations, healthcare providers of various specialties, including nurse practitioners, exhibit a turnover rate closer to 10% on average (Nursing Solutions, Inc., 2019). Ancillary therapists, such as speech and physical therapy providers, exhibited a turnover rate higher than 10% on average but less than 15% overall. The same was found for medical and radiology technicians. However, technical assistants involved in nursing duties, such as patient-care technicians and certified nurse assistants, had an even larger national turnover rate than were found for RNs, at an impressive approximate average of 30% (Nursing Solutions, Inc., 2019). Overall, these findings are concerning, because the distinctive makeup of general versus firm-specific skills expertise found within the healthcare labor force provides individuals with a surplus of job choice. Because the healthcare labor market remains tight and will continue to remain tight with the onset of baby-boomer retirement, this industry will continue to experience high turnover rates in critical occupations.

2. Baseline DoD Workforce

Limited studies exist on the U.S. Federal workforce population and its turnover behavior, but a recent baseline population study by Schulker and Matthews (2018) reports the DoD employs a disproportionate number of military veterans than the civilian labor market. Additionally, another workforce study indicated that not only do veterans appear to have a higher preference for DoD civilian work than the general population, but their proportion of entry often increases the mean age of entry into the workforce when compared to similar civilian organizations (Kim & Fernandez, 2017; Schulker & Matthews, 2018). This finding may be due to the nature of circumstances where a DoD position is often a second or transitional career for veterans. This is an important

consideration given the evidence of worker age and tenure as the strongest turnover predictors.

Schulker and Mathews also indicate the civilian labor market employs a higher percentage of the female workers on average compared to the DoD workforce. However, this thesis research focuses on the healthcare workforce, which traditionally has different proportions of male-to-female ratios than other work environments. Also notable, Morgan (2018) found while fewer females were represented in DoD STEM fields, their attrition rate did not differ significantly from that of males. Therefore, it is currently unknown if the DoD healthcare workforce will reflect any previous workforce study baselines.

3. Healthcare Gender Workforce Self-Selection

Peters, Ryan, Haslam, and Fernandes (2012) performed a qualitative analysis through a questionnaire of 129 female surgical residents aiming to develop a measurement scale of female association with masculinity, a scale of personal identity association with occupational career, and a scale for intent to attrite from their current career option. On average, the female residents perceived themselves as less masculine than the scaled prototype of a surgeon, as having a high level of occupational identification with their chosen career, and as expressing low levels of a desire to attrite. However, if a female intern reported a scale measurement lower than the overall female average of the prototype of masculinity scale, this female resident was more likely to report a lower self-identification with her occupation and higher-level intent to attrite than the average female.

The results of this survey support two notions: job identification correlates with retention, and female perception of their place in male-dominated careers correlates with increased association with masculinity. It is unknown if this identification is self-imposed, predisposed, or a biased due to a self-reported Hausman effect. This research also does not address the actual environment of this occupation nor the actual attrition of female surgical residents. However, it does suggest the average female may persist in perceiving the occupation of a surgeon as being inherently male, which can affect recruitment and attrition behavior within the profession. The outcome of this study is comparable to STEM-occupation findings by Morgan (2019). It may be that females who enter these

predominantly male-represented fields have already overcome more barriers to entry than other occupations and are therefore less likely to attrite. It also supports the notion that individuals who devote a large portion of time to education and training in their profession self-select into a career path or possibly into an agency or organization that is more difficult to enter. Brien (2019) comments more specifically on Morgan's research in stating while a large difference in attrition rates between sexes did not occur, overall, an underrepresentation of women in STEM fields in the federal government existed, and men were more overwhelmingly likely to join the federal government after leaving active duty service. Brien (2019) further suggests a potential untapped labor market for federal STEM jobs is the recruitment of active duty women in similar roles.

F. SUMMARY OF LITERATURE REVIEW AND IMPLICATIONS OF TURNOVER BEHAVIOR

As previous studies aforementioned, healthcare providers, such as nurses and doctors, do not enter their vocations without considering the circumstances of their future workforce expectations. In theory, many of these individuals likely have a predisposition to serve the public, or at least self-select into the career with intention. Even the most generalist of healthcare providers spend years learning their vocation through both academic and hands-on education. Despite large turnover rates in individual organizations within the healthcare industry, the overall healthcare labor force most likely benefits greatly from a natural sorting process due to the rigorous education and licensure process required of its workforce. However, even with employees' increased propensity for their vocation of choice, many in the labor force suffer high dissatisfaction rates. While limited research on the civil service workforce turnover behavior exists, evidence supports the belief that non-pecuniary factors influence labor decisions beyond monetary valuation. Goldberg (1984) describes in his research concerning labor supply and the retention of enlisted military members that a predisposed "taste" for organization or vocation highly effects the personal discount factors individuals apply when assessing monetary gains of employment. This literature review suggests that value matching and self-identification appear to both be strong predictors of potential successful recruitment of employees who may exhibit a predisposition for future organizational loyalty. This literature review

provides evidence that those who pursue and survive past the first years of work in either healthcare or the government environments are more likely to remain in those types of industries for the length of their career.

This literature review has described the rising research as it relates to retention and the career lifecycle of both healthcare and federal workers. The studies mention both intrinsic motivations, such as job satisfaction, and its association with intent to attrite and external factors, such as pay, compensation, and the organizational environment and its effect on intent or actual attrition. When reviewing specific physician attrition studies, such as Bristol (2006), Lane (1998), Rittenhouse et al. (2004), and Sell and Cleal (2011), personal demographics, such as age, sex, and marital dependent status, have shown mixed results on attrition and intent to attrite, but all suggest they are relevant consideration for an individual making a personal decision to leave a career. However, age and tenure appear to be the overall strongest indicators of turnover behavior, and evidence exists that intrinsic motivators, such as organizational and occupational identification and employee engagement, have a larger impact on both healthcare and public sector workers than those attracted to the private labor market and occupational fields.

Research performed by Cho and Lewis (2012), Cohen et al. (2015), Gesesew et al. (2016), Leider et al. (2016), and Rambur et al. (2008) attempt to debate whether intention and employee satisfaction can suffice as an appropriate proxy for future workforce turnover behavior. However, few workforce studies have robust longitudinal employee data to connect past and current attrition trends and rely heavily on agency internal records and survey data. Persons in high-demand occupations with non-firm-specific skills, such as healthcare, are even more difficult to follow throughout a career lifecycle. Studies from Cho and Lewis (2012), Cohen et al. (2015), Copeland (2011), Kellough and Osuna (1995), Morgan (2018), and Moynihan and Landuyt (2008) reveal the benefit of using federal workforce data to track actual employee behavior.

III. DATA AND METHODOLOGY

A. DATA SOURCE

The OPM sponsored the data utilized for this thesis as part of a larger ongoing civilian attrition study. The data acquisition for this research originated from the DMDC. The data archives are organized as cross-sectional snapshots of civilian master files. These human resource files reveal both personal attributes and the present status of individuals in the DoD workforce during each quarter of the study period (2010–2018). The data resides in the U.S. Army secure network via the U.S. Army Person-Event Data Environment (PDE). Not only does this system allow a high level of data security, but it generates a system for de-identification of personnel records by replacing social security numbers with anonymous identification numbers. The PDE environment is limited to individuals with an approved research project and a DoD research institute, organization, or university sponsored and approved Institutional Review Board (IRB) protocol. This thesis falls under the Naval Postgraduate School IRB: NPS.2018.0101-CR01-EP5-A.

The data source used in this thesis provides information about a federal employee over time while still protecting the individual's identifiable information through the anonymous assignment of unique PDE identification codes. The assignment of these unique codes allows for pooling and merging of multiple data information files on the same individual through their unique identifier within the PDE environment. The two data files pooled for this study are identified in the PDE system as "MASTER_CIVAPF_QTR_V3A" and "TRANS_CIVAPF_30_V3A."

B. DATA PREPARATION AND STRUCTURE

The civilian master file data supplied to researchers through the PDE environment is available in totality across all OPM occupational codes associated with civil service employees who are found within the quarter-year snapshot of the timespan the researcher requested in the Oracle system. The records extracted for this study are OPM 0600 civil service medical series code files of employees who existed during the quarterly snapshot record periods of 2010-01-01 to 2018-09-31. Furthermore, the data is structured by

organizing, compiling, and then compressing observations across cross-sectional observations of individuals of permanent appointment to create 102,042 distinct person observations for this study. This data structure creates variables that both describe the individual and captures career duration and status changes they may experience over time. The result of this reorganization is unbalanced, organized wide-panel data. The data requires further preparation to maintain the integrity of this study's analysis through discarding observations of those expected to have worked for less than 90 days, those with large amounts of essential personal data missing, such as a birthdate, and those not employed in a status of permanent appointment. The study cohort population of interest for this thesis is the 2014-calender-year population. This year is chosen firstly, because it is currently the most recently available population that enables analysis to capture five years of behavior within the available data. Secondly, economic experts consider 2014 to be outside the 2009 U.S. economic recession, and thirdly the federal government did not experience a mass furlough or a hiring freeze during the 2014 calendar year. Figure 2 depicts the steps utilized to produce this study's subpopulation and details as follows:

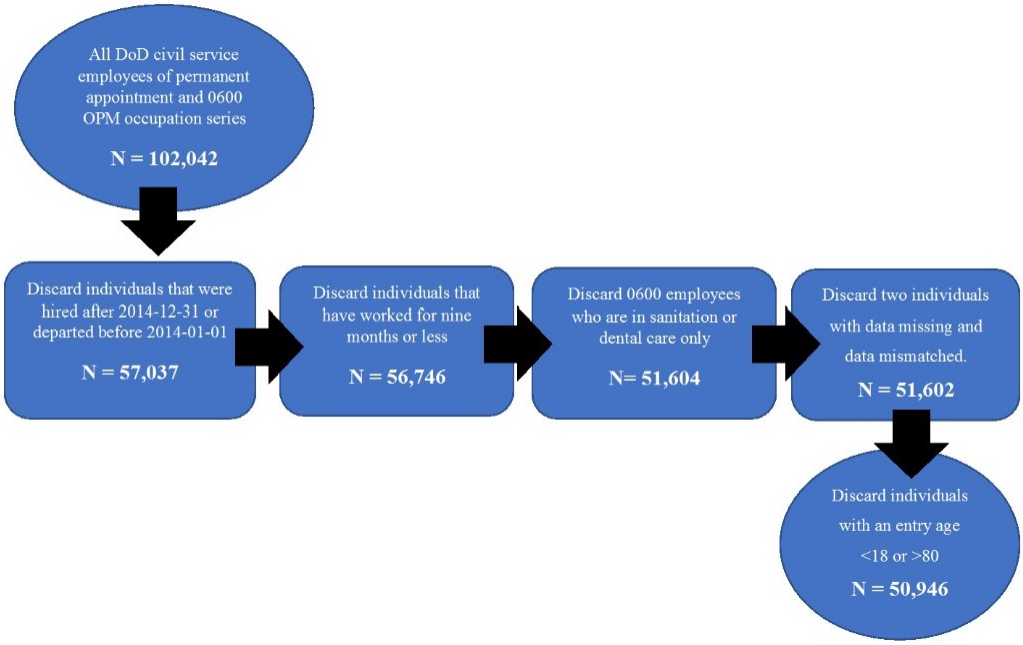
1. Create a 2014 cross-sectional data cohort by including all individuals of permanent appointment in the medical 0600 series and discard individuals hired after 2014-12-31 or departed before 2014-01-01.

2. Discard individuals who cannot be properly observed or counted as a true hired working individual, because their record disappears in less than nine months. The rationale is these individuals may appear in the system as part of the hiring process but fail to complete the process. It also prevents the over inflation of newly hired workers' attributes.

3. Discard individuals who qualified as a healthcare worker, because they are observed with a 0600-series OPM medical code, but their occupation is described as custodial in nature or associated with dental care only.

4. Discard individuals with data missing and data mismatched.

5. Discard individuals with an entry age or age-at-hire below 18 or over 80.



Note: Data structuring for 2014 Cohort follows a methodology to ensure the most complete 2014 civilian military healthcare workforce subpopulation.

Figure 2. Data Structure Methodology Flow Chart

C. DATA MANAGEMENT

Due to the exploratory nature of this study, many variables within the original data set required conversion from categorical variables into dichotomous variables. These actions were necessary for cross tabulation and contingency analysis in order to describe the demographics of the study population. Additionally, this study converts all original date variables from string format to numerical dates for the formulation of time and age-variable calculations.

The primary variable that represents time passing throughout a career is the calculation of total federal work years. This amount is equivalent to years of service within the industry or tenure. The civil service record is unique in that it accounts for time and allows it to accumulate with career interruptions due to individual transfers to different facilities within the DoD or temporary departures and returns. Compared to other healthcare workforce data, which cannot follow an individual's career lifecycle after job relocation, the data for this thesis captures an individual's career lifespan as long they

eventually return to federal service or transfer to another U.S. federal entity. However, a limitation of using DMDC tenure data is that it assumes true time lapse during a career to be equivalent to tenure, whereas an individual could have experienced a career disruption of months or years and then returned. In this case, this assumption would no longer be accurate. Upon calculating the difference between total federal work years and the allotted time between an individual's date of hire and most recent snapshot, a difference of more than 12 months of accumulated time exists in < 1% of the total population. The maximum difference was 21 months for only a single observation within the whole population. Given this small difference, this thesis continues to assume tenure is an appropriate assessment of both total federal working years within the DoD environment as well as proxy of time passing since initial hire.

Because of the nature of transfer and transition of retirement, eligibility indicator variables within the data represent individuals who, through a combination of the age and total federal working years of service, are eligible for one of the three Federal Employee Retirement System (FERS) pathways. Criteria for these pathways are met when an individual's age is 62 years or older with five or more years of federal service, an age of 60 years with at least 20 years of federal service, or 30 years of federal service at any age. Furthermore, individuals eligible for social security (SSN) retirement at an age of 65 years or more are also considered retirement eligible.

Lastly, for the 2014 Cohort subpopulation with duty assignment zip code entries associated with known MTF "community hospital" or "medical center," this study generates an MTF-specific variable. The result is 33 unique MTF-indicator variables as well as a community hospital versus medical center binary variable. Through MTF assignment, this thesis associates the county location of the MTF with a county income-per-capita value. The county income-per-capita value is extracted from reported data on the U.S. Census official website and assigned as the associated county average of income per capita between 2014 and 2018, presented in 2018-dollar value, to each of the 33 MTF variables.

Notably, because there remains a large amount of MTF global, ambulatory, and small clinic facilities and working environments not classified as a U.S. community

hospital or medical center, this variable only includes approximately half the total 2014 Cohort working population. The result is a large generation of missing variable values and smaller subpopulation of only 27,514 observations. Consequently, the primary analysis throughout this thesis does not include income-per-capita assessment to preserve a more complete cohort population demographic assessment. However, the benefit of generating an income-per-capital variable is the ability to compare attrition behavior against varying external economic factors within the population. Therefore, an income-per-capita continuous variable is included in an isolated model for analysis with the knowledge this model does not represent the complete 2014 Cohort population or all possible working environments and circumstances.

The variable of an individual's age in 2014 represents the time between the individual's birthdate and 2014-12-31. A subtraction of time from the end of the year is required to include observations of individuals hired during the 2014 calendar year. However, because the purpose of this study is to observe individuals' behavior during the subsequent years after 2014, the individual's age at the time of entering the federal workforce in conjunction with their tenure before attrition or the study's conclusion in 2018 provides a more complete profile of the individual aging over time than their age in 2014 alone. Additionally, the literature review suggests the entry age of individuals in the federal workforce may occur at a later than average workforce entry age than individuals in the private labor market (Kim & Fernandez, 2017). The literature review also suggests females in the workforce may be more likely to attrite during childbearing years. Therefore, it is important to assess if females are entering the federal organization during or after childbearing years. Moreover, this thesis's emphasis on retirement eligibility and its association with attrition correlates highly with an individual's current age. Due to this methodological reasoning, this thesis accordingly emphasizes age-at-hire over the age in 2014 in its analysis.

D. INDEPENDENT VARIABLES

Independent demographic variables of interest in the study were primarily centered on the individual's sex, race, age-at-hire, tenure, retirement eligibility, specific occupation, and external locality to include economic factors.

1. Sex and Race

In this thesis, exploring the effect of sex and race is not only for the purpose of placing individual demographic controls in the model; they also remain variables of direct interest. This thesis's literature review discusses a trend toward a closing of the traditional attrition rate gap between men and women, particularly in the STEM fields. The sex factor remains important in exploring the field of healthcare, which displays higher female employment compared to other STEM industries.

This study generates and utilizes indicator variables to reflect male and female from the sex categorical variable in the original data. Similarly, the original data set describes race categorically in over 15 unique formats, including multiple variations of self-identified mixed races. Members of mixed race represent <1% of total population and less than 2% of its primary minority subpopulation. Therefore, this analysis represents the race categorical variable with only four indicator variables: Caucasian, African-American, a sub group of minority (other), and a larger minority sub-group that includes both African-American and all other minorities. The third variable of minority (other) includes all other populations not self-identified as African-American or Caucasian and includes individuals who do not identify with a race or report it as "unknown." The Hispanic ethnicity is referred to as an ethnic category in addition to the race category. In the 2014 Cohort, only 1.7% of the total population identified as having an ethnicity of Hispanic. Given the small amount of statistical power of this population, it was largely not included in demographic or regression analysis for this study.

2. Occupations and Working Collars

The impact of differences of job types, even within the same industry, is directly related to an individual's physical labor experience, work satisfaction, employment

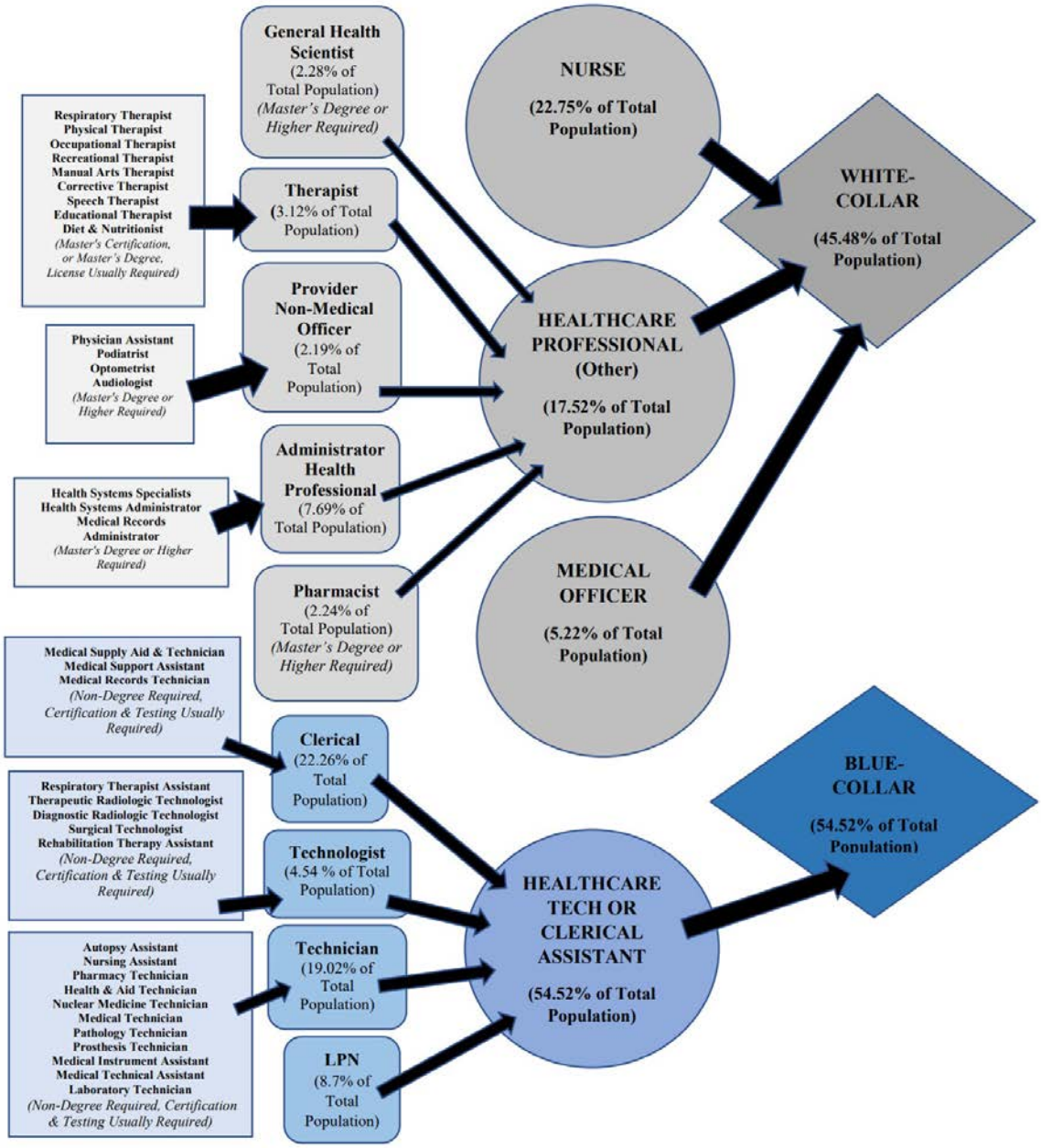
opportunity, and pay scale throughout a career lifecycle. Exploring attrition behavior differences within the healthcare industry provides greater insight into specific recruitment and retainment vulnerabilities for specific federal job type labor markets.

The OPM 0600 medical and healthcare workforce group series includes over 60 specific job codes. After discarding observations of individuals with occupation codes associated with dental or healthcare sanitation and safety, 40 job codes remain within the data. To avoid overfitting analytical models in this research, these 40 codes are narrowed into eleven occupation categories based on professional specificity, level of education, job scope, and expected salary. The nine distinguishable occupational professions are as follows: general health scientist, therapist (various), healthcare provider (non-medical officer type), medical officer, administrator health professional, pharmacist, nurse, healthcare clerical assistant, healthcare technologist (various), healthcare technician (various), and licensed practical nurse (LPN). Figure 3 further depicts the variation within the therapist category. The major difference between a technician and technologist is primarily a more concentrated level of expertise associated with those in the technologist role.

From the nine distinguishable categories, this study further sorts the roles of a clerical assistant, LPN, technologist, and technician into a shared variable indicating a health technician or clerical assistant occupation. These occupations often require specific certification and national testing of competency but do not require higher-education degrees. Both nurses and medical officers have consistent and direct clinical patient care within their profession and usually cope with rotating shift work. However, each occupation performs a distinct duty and scope of care with separate boards of licensure. Therefore, these professions remain their own individual categories. The choice to categorize the remaining occupation types as healthcare professionals (other) is largely due to the similar working hours of these professions and education levels. However, it should be noted that many persons in the therapist occupations and the non-medical provider occupations have regular direct patient contact as opposed to most healthcare administrators, therefore variation in clinician versus administrator exists. Figure 3 further details the original occupation types and sorts them into the four

categories: nurse, healthcare professional (other), medical officer, and healthcare tech or clerical assistant.

Traditional descriptions of occupational working collars have typically described a blue-collar worker as those working in manual labor and a white-collar worker as those who work in an office or professional environment. However, the term most associated with healthcare professionals is pink collar (Howe, 2017). The origins of the pink-collar terminology developed from a rise in primarily female-dominated professions that required higher levels of training and credentialing, such as nursing. However, this term is now more broadly associated with professions for either sex that require a higher level of credentialing but are not categorically associated with manual labor or an office environment. Because most of the healthcare occupations included in this study would primarily fall under the pink-collar terminology, alternatively, for this thesis, the four primary occupation categories are assigned to more traditional blue- and white-collar categories for counterfactual comparison. The method of white-collar assignment is inclusion of occupations considered to be formal professions with high-education degree requirements. The method of blue-collar assignment are those occupations whose workers perform assistive roles to the white-collar professions and do not require a high-education degree. Notably, all observations in the healthcare tech or clerical assistant population are associated with the blue-collar population. The remaining observations as associated with the white-collar category and serve as a counterfactual to blue collar. Figure 3 depicts the sorting process described for the occupation and collar variables for this thesis.



Notes: Original occupation types derived from OPM 0600 Series occupational codes listed in DMDC data. Percent population is percent from total 2014 Cohort population data.

Figure 3. Occupation Variables Sorting Process

3. Service Association and Retirement Eligibility

The analysis includes variables for each MTF service association: the U.S. Navy, Army, and Air Force and a variable for observations whose data reported that

organizational service is not applicable or under a joint command. It is important to acknowledge the civil service healthcare workforce is primarily supplemental to the active duty workforce in the MTF. Therefore, comparisons of occupation distribution across services or commands have no meaningful value in terms of a complete workforce assessment. However, the exploration of the impact of assignment at a facility associated with a specific branch of service may provide information about the service-specific organizational culture impacts on employee attrition rates.

The literature review exposed a variety of individual motivations behind workforce attrition decisions. However, an individual's opportunity to retire with a form of compensation is an external influence that is likely a major contributor to an individual's decision to not only depart a specific organization but to attrite from their occupational field. To account for this effect, this study generates a binary variable associated with an individual's retirement eligibility status.

4. Income per Capita and Locality

In addition to the generation of an income-per-capita continuous variable, this study generates a binary variable to distinguish which MTFs within the county-specific income-per-capita populations reside on the east coast, west coast, or mid-region of the United States to explore any distinguishable differences in workforce attrition between these three regions. The inclusion of variables that relate to the region can assist in controlling for regional-specific individual behavior variance in a model.

5. Age and Time Variables

Continuous variables in this study's data are largely associated with an individual's age or tenure timespan apart from income-per-capita variable values. In this thesis, age and time variables are rounded to quarter years for simplified age classification and timespan interpretation. In addition to calculation of total federal work years, age-at-hire, and age in 2014, and nominal entry age bracket variables are also generated to describe and group observations hired between the ages of 18–25, 26–35, 36–50, 50–64, and 65 and over. Lastly, this study generates polynomial-squared variables for workforce entry age and tenure. The effect of these continuous variables is non-linear over time in their relation to

attrition. The results of past healthcare and workforce studies found in this thesis's literature review consistently find age and tenure to have the largest correlations with attrition behavior. This study would not be complete without these important individual factors of consideration.

E. DEPENDENT VARIABLE

The primary dependent outcome in this thesis is an attrite event for an individual during the period of 2014-01-01 and 2018-09-31. When and if an individual departs the civil service workforce is the primary event outcome of interest and marks the end of a career lifecycle in the organization. However, an individual may attrite because they are retiring or attrite for other reasons, such as involuntary termination or voluntary separation. This thesis's data categorizes all events that result in worker attrition, regardless of source, as a positive attrition event. This study uses a dichotomous dependent variable accordingly in its analysis to mark an attrition event.

Furthermore, this analysis uses dichotomous attrition variables to describe limited attrition events specified within time brackets of an individual's tenure in conjunction with attrition. This study categorizes the brackets in this research as attrition in five or fewer working years, attrition in 6–10 working years, attrition in 11–20 working years, and attrition after 21 working years or more.

F. KNOWN DATA LIMITATIONS

1. Time-Varying Covariates

The data used for this analysis consists of several time-varying covariates. Time-varying covariate values may change over time for an individual as they progress through their career. These variables are associated with education status, occupational code, paygrade, and employer MTF or service association, etc. For this study, time-varying remain relatively constant for most individuals during the 2014–2018 period. For demographic descriptions of the population, this analysis uses the most recent covariate value to describe the individual. This method may result in measurement error of individual demographic descriptors when describing populations in different cohorts if a covariate

value did not actually matriculate at the specified time. For example, when comparing the 2010 Cohort population against the 2014 Cohort population for sensitivity analysis, some individuals may have held a different occupation.

This study also found time-varying covariates, such as level of education, as problematic data inputs. The original data source reports education levels that often reflect a level below the individual's occupational associated minimum educational requirements. This problematic data could be due to input error or a lag in data system processing. Furthermore, the highest level of education recorded stops at the graduate level of a master's degree. In healthcare professions, where varying levels of graduate degrees are relatively commonplace, information regarding percentage of terminal degrees could have provided better information regarding the marginal impact of education beyond the minimum required degree level. However, this study unfortunately cannot appropriately assess the impact of education or other descriptors, such as promotions and collar changes, in a consistent method that could be associated with meaningful interpretation. Despite this limitation, some information from these categories is implied if similar proxies are included in the analysis. For example, grade promotions and promotion frequency are largely associated with blue-collar and entry-level occupations. This is logical in that someone who enters a field at a lower level of entry has room in their career to progress, more than those who enter a field with a terminal degree. Similar rationale applies to the impact of levels of education on the career lifecycle in that many healthcare profession occupations have strict educational requirements. Therefore, much of the impact of an individual's educational achievement is likely captured in the overall average impact of their specific occupation.

2. Variation within Subpopulations

Occupation categorization into four variables was necessary to avoid model overfitting in this analysis. While grouping of occupations considered similarities in minimum education requirements, job scope, working hours, and salary, some variation within the variables is inevitable and could affect the model. Even the nurse-occupation variable contains a variety of individuals with varying levels of scope, expertise, degrees,

and licensure. However, the OPM-occupational codes contained in the DMDC archives does not distinguish specific nurse occupation types within its data files. Consequently, this variation is assumed and accepted in this thesis.

G. METHODOLOGY AND REGRESSION MODELS

After appropriate data preparation and organization, the quantitative techniques implemented to answer the research questions in this thesis support the investigative nature of the study through exploratory analytical methods.

1. Univariate and Bivariate Descriptive Statistics Analysis

Primary Research Question 1a: What are the baseline demographic and professional characteristics of the DoD civil service military healthcare workforce?

Secondary Research Question 2a.: Within this workforce, do correlations exist among employee characteristics that reveal subpopulations within the healthcare workforce?

The principal methods of analysis that intend to answer the first primary and secondary research questions are univariate and bivariate descriptive analysis. This type of analysis produces valuable information regarding general characteristics about the population, such as whether a large percentage of workers are aging, inexperienced, or if a larger percent of a certain sex or race suffered attrition over the study period compared to its counterfactual. This analysis uses both simple univariate descriptive methods to derive total population personal demographic estimates of the 2014 Cohort and more complex cross-tabulation and contingent analysis methods to further confer personal demographic estimations and event behavior within categorical subpopulations of the 2014 Cohort. The two primary events of interest in this analysis is whether the individual is retirement eligible and whether they attrite. However, only an attrition event signifies an active behavior or outcome event, while retirement eligibility is a passive-descriptive event. Additionally, this analysis compares the averages, frequencies, and value distributions of age, tenure, and attrition event occurrences within categorical subpopulations of sex, race, and occupation. Through univariate and bivariate analysis, this study assesses not only the

baseline demographic and professional characteristics of the DoD civil service healthcare workforce, but also identifies demographic and outcome constructs within subpopulations.

2. Logistic Regression Analysis

Primary Research Question 1b: Which characteristics of this workforce have the greatest impact on the civil service military healthcare worker's career lifecycle?

Secondary Research Question 2b: What characteristics most likely increase attrition behavior within this workforce and how does this workforce behave in terms of attrition at retirement eligibility?

To accurately assess the quantitative influence of workforce characteristics on a career lifecycle, regression analysis demonstrates how personal demographics, specific occupations, tenure, and external economic factors influence attrition behavior. To address the second set of primary and secondary research questions, this study identifies a binary outcome of an attrition event as a function of independent personal characteristic factors.

Logistic regression models are not only appropriate when the outcome is binary but are also the most frequently utilized quantitative analysis method in the healthcare workforce studies cited in this thesis's literature review. The purpose of this research is to describe the relevant subset population and its relationship with attrition behavior. When utilizing logistic regression analysis, the researcher's main interest is not on the function's outcome but on the magnitude and direction of the independent variable's association with likelihood an event will occur. Thus, this choice of analysis is a suitable empirical model for this thesis study.

For this thesis, the logistic regression model estimations will utilize odds ratios. The interpretation of this ratio identifies the marginal effect of a change in one of the control variables on the likelihood of an attrition event. The ratio is interpreted to compare the odds of the attrition event occurring given a one-unit change in the control variable relative to the counterfactual odds of the event occurring if the variable had not changed by one unit. The logistic regression odds ratio model is based on the following empirical model.

$$prob\,(y_i\ =\ 1) = \frac{(_e b0\ + b1X1i\ + \cdots + bkXki)}{[1 + (_e b0\ + b1X1i\ + \cdots + bkXki)]}$$

According to Bland and Altman (2000), the odds ratio in logistic regression has the benefit of analyzing a relationship between two discrete variables estimations while also controlling for the effects of other variables in the relationship. Furthermore, the odds ratio has the benefit of interpretation familiar to those accustomed to the practice of betting. Because the odds are ratios, they can never be negative. The result of non-negativity is a limitation in the lower bounds of odds but no limit in the upper bounds of odd predictions (Bland and Altman, 2008). Therefore, the distribution of odds estimations is skewed. However, a standard error and confidence interval are calculable in logistic odds ratio regression analysis. Bland and Altman (2008) further explain the difference in interpreting the standard errors:

> the standard error of the log odds ratio is estimated simply by the square root of the sum of the reciprocals of the frequencies. A 95% confidence interval for the log odds ratio is obtained as 1.96 standard errors on either side of the estimate … The observed odds ratio is not in the center of the confidence interval because of the asymmetrical nature of the odds ratio scale. For this reason, in graphs, odds ratios are often plotted using a logarithmic scale. The odds ratio is 1 when there is no relationship. (Bland & Altman, 2000, p. 1468)

Consequently, this thesis will present all regression results with standard errors using log odds ratios, while graphs of marginal effects will be plotted using a logarithmic scale only.

Because the purpose of this thesis is to explore which factors are most impactful or associated with attrition behavior, the analysis portion does not focus on a specific variable of interest. Rather, the results of the extensive descriptive analysis will not only reveal relationships between category groups but will also justify the inclusion of variables in the logistic regression analysis models. The logistic regression model fitting in the study's analysis is based on variations of the following function.

$$prob\,(attrite) = \frac{(_e b0 + b1 lifecycle\ variables + \cdots + bk\ demographic\ \&\ economic\ controls)}{[1 + (_e b0 + b1 lifecycle\ variables + \cdots + bk\ demographic\ \&\ economic\ controls)]}$$

Lifecycle variables describe an observation's career lifecycle characteristics, such as age, tenure, or retirement eligibility. The demographic and economic controls are factors that remain variables of interest for this thesis's study but remain a constant characteristic for an individual observation over the course of the study. Table 1 provides an organized description of variables that are included in the analysis and results.

Table 1. Description of Variables

OBSERVATION UNIT: Individual Military Medical Federal Employee			
Category	**Variable Name**	**Type**	**Description**
ATTRITE	Attrite	Dependent, Event, Binomial Indicator	If Attrition Occurs
	Attrite in < 5	Dependent, Limited Event, Binomial Indicator	If Attrition Occurs in Less Than 5 Years of Federal Tenure
	Attrite in 6-10	Dependent, Limited Event, Binomial Indicator	If Attrition Occurs in 6-10 Years of Federal Tenure
	Attrite in 11-20	Dependent, Limited Event, Binomial Indicator	If Attrition Occurs in 11-20 Years of Federal Tenure
	Attrite in 20 +	Dependent, Limited Event, Binomial Indicator	If Attrition Occurs in 20 Years or More of Federal Tenure
ATTRITE	Retirement	Descriptive, Binomial Indicator	If Attrition Occurs When Retirement Eligible
	Separation (Other)	Descriptive, Binomial Indicator	If Attrition Occurs Without Being Retirement Eligible
ELIGIBILITY	Retirement Eligible	Independent, Binomial Indictor	If Individual Is Retirement Eligible Under the Social Security System or One Of The Three Federal Eligibility Retirement Systems (FERS)
OCCUPATION	White Collar	Independent, Binomial, Collar-Specific	Healthcare Professionals, Nurses, Or Medical Officers
	Blue Collar		Health Tech or Clerical Positions
	Healthcare Tech or Clerical Assistant	Independent, Binomial Indicator, Job-Specific	All Healthcare Technicians, Technologists, And Clerical Assistants (See Figure 3 For Greater Detail)
	Healthcare Professional (Other)		All Healthcare Professionals That Are Not Nurses or Medical Officers (See Figure 3 For Greater Detail)
	Nurse		All RN-Types
	Medical Officer		All M.D. or D.O Credentialed Medical Officers
RACE	Caucasian	Independent, Binomial Indicator	Employee Self-Reported as Caucasian
	African-American		Employee Self-Reported as African-American
	Minority (Other)		All Other Minorities, Unknowns, N/A, Or Unreported
	Minority		Includes African-American And Minority (Other) Observations (Caucasian Counterfactual)
SEX	Male	Independent, Binomial Indicator	Employee Self-Reported as Male
	Female		Employee Self-Reported as Female
AGE	Age in 2014	Independent, Continuous	Difference Between Employee Birthdate-Date and 2014-01-01
	Age-at-Hire		Difference Between Employee Birthdate-Date of Hire
	Age-at-Hire Squared	Independent, Continuous, Polynomial	Difference Between Employee Birthdate-Date of Hire Squared
	Age-at-Hire: Age Brackets	Independent, Nominal	Level 1: Age 25 Years or Less, Level 2: Age 26 -35 Years, Level 3: Age 36-50, Level 4: Age 51-64, Level 5: Age Greater than 65 Years
TIME	Total Federal Work Years or Tenure	Independent, Binomial Indicator	Total Federal Years Tenured Toward Retirement
	Total Federal Work Years or Tenure Squared	Independent, Continuous, Polynomial	Total Federal Years Tenured Toward Retirement Squared
SERVICE AFFILIATION	U.S. Army	Independent, Binomial Indicator	MTF Under U.S. Army Command
	U.S. Navy		MTF Under U.S. Navy Command
	U.S. Air Force		MTF Under U.S. Air Force Command
	Service N/A or Joint		MTF Under Joint or Non-Service Specified Command
REGION	East	Independent, Binomial Indicator	Duty Location on U.S. East Coast
	West		Duty Location on U.S. West Coast
	Mid		Duty Location in U.S. Mid-West or Non-Coastal Region
INCOME PER CAPITA (IPC) IN $1,000's	Employment Region Average Income per Capita reported in units of $1,000s	Independent, Continuous	Employee Duty MTF Associated County IPC Reported Average Of 2014-2018, Reported In 2018 Dollar-Value

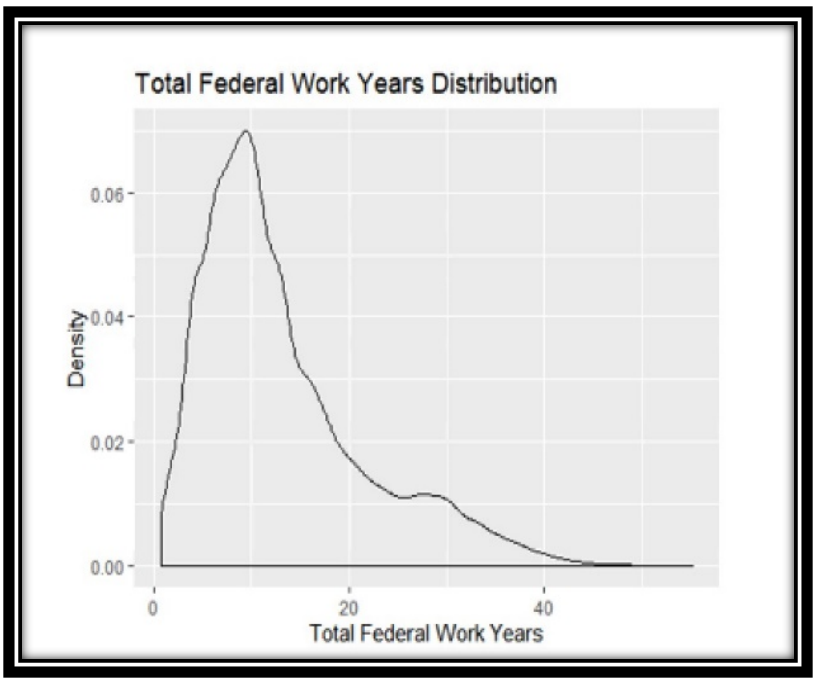
IV. RESULTS AND ANALYSIS

A. DESCRIPTIVE STATISTICS AND ANALYSIS

Descriptive statistics reflect demographics of interest: variables of sex, race, and occupation type. The status of the individual in terms of age, tenure, and retirement eligibility are considered both in terms of population distribution and in association with demographic variables. The event variable of interest remains the occurrence of worker attrition throughout the period of observations

1. 2014 Healthcare Workforce Cohort Total Federal Work Years Distribution

The average tenure of a civil service employee in the military healthcare industry as of 2018, for the 2014 Cohort, is 13.19 total federal working years. As seen in Figure 4, the largest density of population working years distribution occurs before 20 years. This is likely largely due to the large number of workers who, before 2018-09-31, decided to depart in the early years of working. This is also due to the bulk of employees who plan to continue to work until retirement but are still in the earlier to middle stages of their career. A tight peak occurs at the 10-year mark, likely an illustration of the appropriate time where the population reaches its culminating point of both large attrition before the 10-year mark and those in the middle of their career, as discussed earlier. The density plot displays a shallow bump at approximately the 30-year mark, indicating a similar increase in what is likely retirement-related attrition.



Note: Total Population Mean: **13.19** *(N=50,946)*. The density plot depicts distribution of total federal work years of the 2014 Cohort population. In this thesis, observations are limited to those who have worked at least 9 months before they are included in the study. This graph includes tenured years for each observation included within the 2014 Cohort until 2018–09-31 whether they have departed or remain working with the organization before the end of the study period on 2018–09-31.

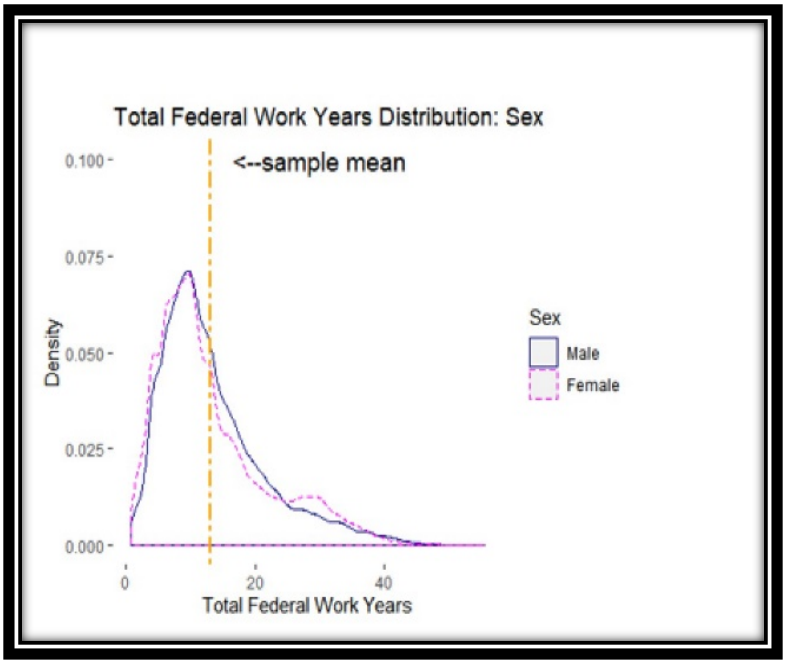
Figure 4. (2014 Cohort) Total Population Federal Work Years

According to Figure 5, the distribution for the male population appears overall smoother than that of the female population. For example, the density plot exhibits two bumps before the 10-year mark in the female population. This may indicate that, in the female population, a greater proportion attrite at these critical times compared to the male population. Women hired in their twenties or early thirties are also in their primary childbearing years, and this may explain the differential in turnover rate. However, it could also be explained by a possible hiring surge of females that occurred five to seven years before the study period, resulting in a larger proportion of females working in those early stages of tenure.

a. Sex

Secondly, the density plot in Figure 5 illustrates a larger but shallower bump in tenure distribution of the female at approximately the 30-year mark. This likely represents

an increased proportion of the female population with 27–33 years of tenure proportionate to the rest of the female population. This bump could also indicate that a large percentage of females retired around the 30-year mark, or it could represent that many females approaching 30 years of service remain in the organization. The distribution of tenure for the female population more steeply descends between the 10- and 20-year mark compared to the male population. This indicates a larger proportion of female workers have achieved less tenure or retired after 10 federal work years compared to their male counterparts. Additionally, female workers who have earned more time or retain to approximately 25 work years appear to linger longer in the labor market than the proportion of their male counterparts.



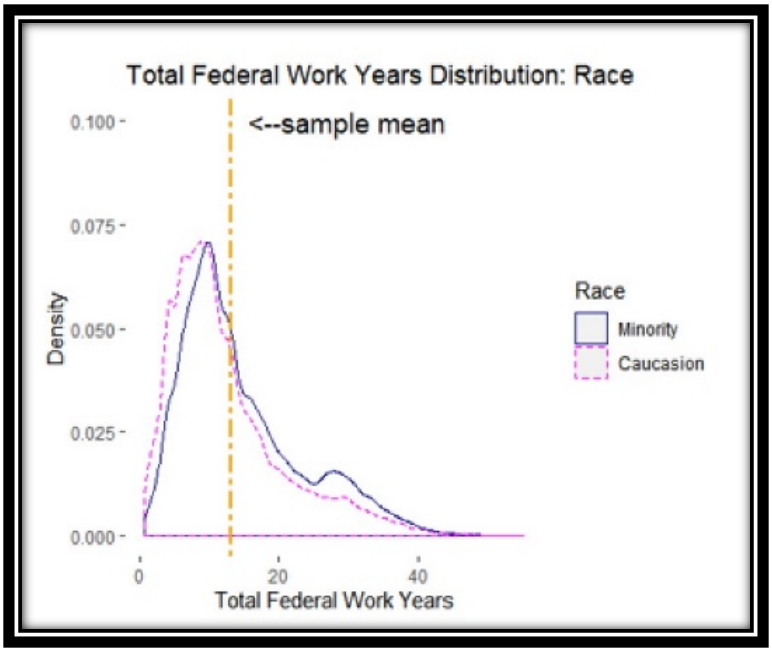
Note: Male Population Mean: **13.37** *(N=14,897).* Female Pop Mean: **13.12** *(N=36,049).* Density plots depict distributions of total federal work years of a sex-specific 2014 Cohort subpopulation. In this thesis, observations are limited to those who have worked at least 9 months before they are included in the study. This graph includes tenured years for each observation included within the 2014 Cohort until 2018–09-31 whether they have departed or remain working with the organization before the end of the study period on 2018–09-31.

Figure 5. (2014 Cohort) Total Population Federal Work Years: Differences in Sex

Various causes for this difference in sex behavior might exist, such as more women retiring with less tenure than men because of late career entry after having children and therefore reaching an advanced age before a comparatively higher tenure is achieved. In situations where a male spouse is older than a female spouse, the results could also indicate women may choose to attrite when their spouse retires and therefore accrue fewer work years. The result could also be attributed to the male work population retiring with fewer federal work years because of previously accrued active duty service time or retirement pension. If less prior-active duty women are in the civil service military healthcare industry proportionate to men, they may feel more pressure than male counterparts to work for 30 years because of viable working age or income needs. This finding is consistent with research and opinion from Schulker and Matthews (2018) and Brien (2019). However, this density plot cannot definitively suggest any of these assumptions or conclusions. Rather, more notably and definitively, the results infer a large difference in total federal work year distributions does not exist between the sex subpopulations.

b. Race

The differences in distribution of tenure earned by 2018-09-31 between race-specific populations within the 2014 Cohort indicate a large variance in overall tenure between the races is unlikely. However, Figure 6 does illustrate a potentially large difference in tenure distribution in the early stages of tenure before the 10-year mark. This difference may indicate the Caucasian population has a larger proportion of their population who attrite within the first years of work due to increased confidence in actual or perceived opportunities in the private market compared to the minority population during the job sorting process. This difference could also be due an increase in hiring of Caucasian workers years several years before, which increased the density of Caucasians with 1–10 federal work years. However, it is more likely that Caucasians have a higher rate of departure in the earlier stages of their career compared to the proportion of the minority subpopulation due to actual or embedded racially associated population differences. For example, perhaps a greater proportion of Caucasians hold critical expert general skills that are in high demand in the labor market as opposed to non-in-demand skills or firm-specific skills that may occur at a higher rate in the minority population.



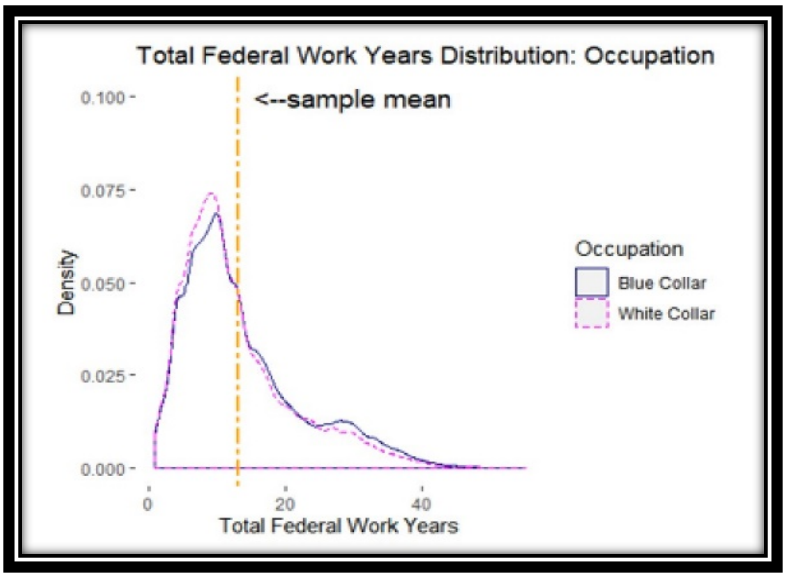
Note: Caucasian Population Mean: **12.36** *(N=31,548).* Minority Population Mean: **13.12** *(N=18,998).* Density plots depict distributions of total federal work years of a race-specific 2014 Cohort subpopulation. In this thesis, observations are limited to those who have worked at least 9 months before they are included in the study. This graph includes tenured years for each observation included within the 2014 Cohort until 2018–09-31 whether they have departed or remain working with the organization before the end of the study period on 2018–09-31.

Figure 6. (2014 Cohort) Total Population Federal Work Years: Differences in Race

c. Occupation

The average difference in total federal work years between white-collar and blue-collar populations in the 2014 Cohort is minor—12.72 versus 13.59. While this difference is not substantial, Figure 7 illustrates two parallel distributions of a career lifecycle between collars but at much higher proportion of achieved or ended tenure at the 10-year mark for white-collar workers compared to blue-collar workers. This could be a similar indication of job sorting in the early stages of work as was proposed to differences in distribution between race populations. However, given the lack of overall variance in distribution density differences during the time leading to 10 work years, it is more likely that a greater proportion of white-collar individuals exist who have achieved retirement-earning careers in other organizations or through prior active duty service than blue-collar workers. This distribution difference could also be explained by a larger approval for newly created white-collar positions between 2004–2008. This time period occurs before the 2009

economic recession, and it is a reasonable possibility that a backfill of new positions would also be gapped due to an increased tempo in active duty medical provider operational deployments associated with wartime. Either of these scenarios could explain the possible proportional inflation of white-collar workers currently employed or having departed the industry with approximately 10 years of earned federal tenure.



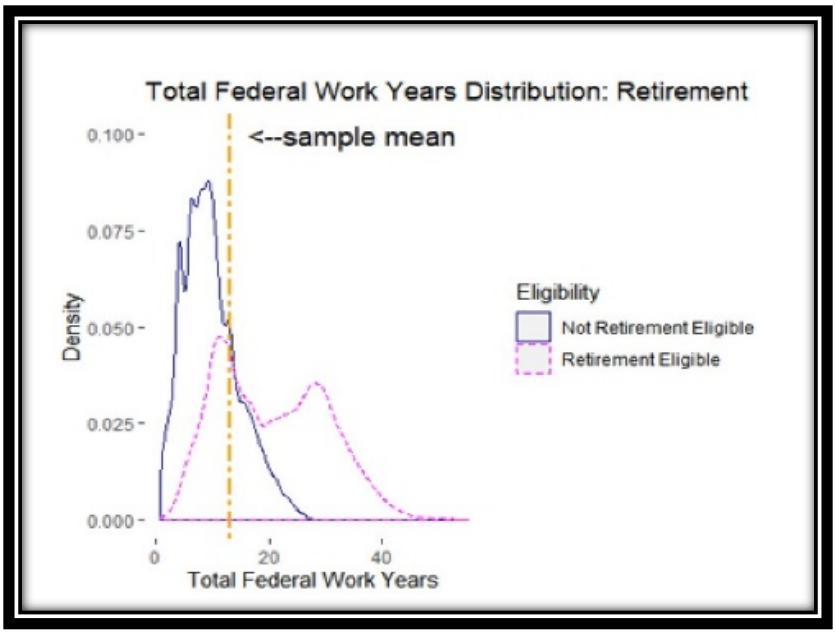
Note: White-Collar Population Mean: **12.72** *(N=23,170).* Blue-Collar Population Mean: **13.59** *(N=27,776).* Density plots depict distributions of total federal work years of a collar-specific 2014 Cohort subpopulation. In this thesis, observations are limited to those who have worked at least 9 months before they are included in the study. This graph includes tenured years for each observation included within the 2014 Cohort until 2018–09-31 whether they have departed or remain working with the organization before the end of the study period on 2018–09-31.

Figure 7. (2014 Cohort) Total Population Federal Work Years: Differences in Work Collar

d. Retirement

A substantial difference exists in total federal work years distribution between the retirement-ineligible and retirement-eligible subpopulations for clear reasons, mainly because earned tenure is linked directly with eligibility for retirement. However, the more thought-provoking observation from Figure 8 is that distinct, overlapping normal distributions of total federal work years exist within the retirement-eligible subpopulation. A tall and narrow peak exists at a little over 10 years of tenure, and a wider but also large

peak occurs at approximately 30 years of federal work. This depiction more specifically suggests a subpopulation within the data exists that has earned tenure through active duty work or through employment with another organization before entering federal service. This finding is consistent with the findings of Kim and Fernandez (2017) in this thesis's literature review.



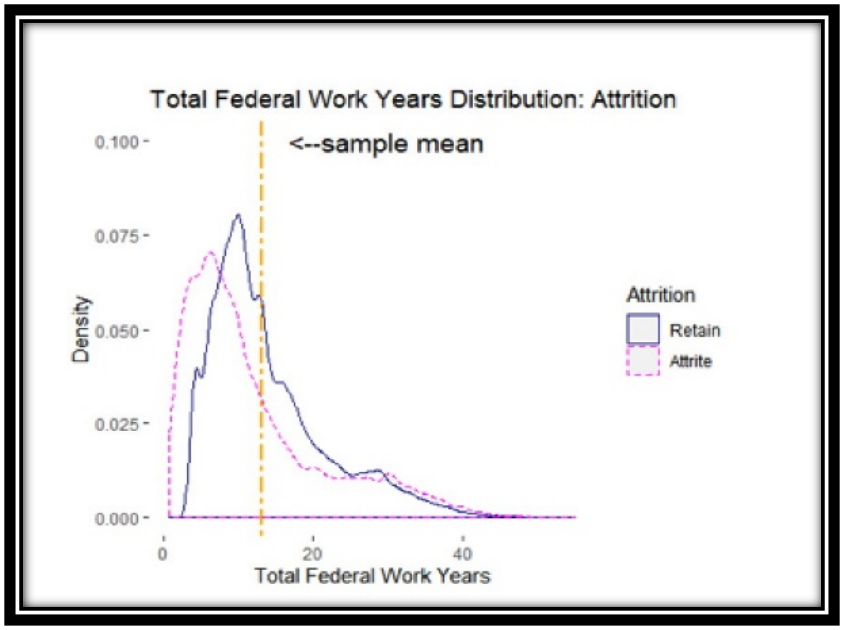
Note: Retirement Eligible Population Mean: **20.58** *(N=16,264).* Non-Retirement Eligible Population Mean: **9.73** (*N=34,682).* Density plots depict distributions of total federal work years of the sex-specific 2014 Cohort subpopulation. In this thesis, observations are limited to those who have worked at least 9 months before they are included in the study. This graph includes tenured years for each observation included within the 2014 Cohort until 2018–09-31 whether they have departed or remain working with the organization before the end of the study period on 2018–09-31.

Figure 8. (2014 Cohort) Total Population Federal Work Years: Difference in Retirement Eligibility

e. Attrition

According to Figure 9, a large difference exists in the average total federal work years between the population of workers from the 2014 Cohort who remain in civil service and those who attrite during the study period. This observation is logical, because those who attrite during a five-year period would have fewer federal working years than those who remain by default. Additionally, the 2014 Cohort contains only the individuals

working during the 2014 calendar year. This means new hires between 2015 and 2018 who did not attrite are not included in the distribution. If this study included these observations in the analysis, the distribution during the first 10 work years would be wider. Despite this inherent flaw, some conclusions can be drawn from Figure 9. The peak of total federal work years for the attrition population is closer to five than 10. Additionally, for the attrition population, the peak steeply declines before plateauing during what is traditionally viewed as the retirement-eligible period after 20 work years. This also indicates the tenure peaks tenure closer to the 10-year mark in prior density plots are more closely related to a large proportion of the working population being hired 10 years prior as opposed to a large proportion of attrition occurring at the 10-year employment mark.

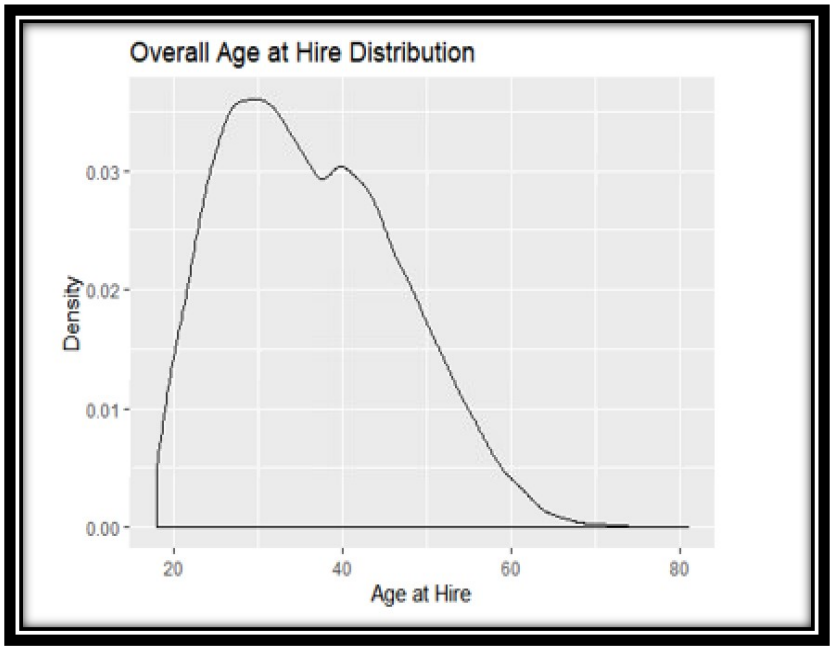


Note: Attrition-Positive Population Mean: **11.91** *(N=18,519).* Retained-Worker Population Mean: **13.93** (*N=32,427).* Density plots depict distributions of total federal work years of an attrition-specific 2014 Cohort subpopulation. In this thesis, observations are limited to those who have worked at least 9 months before they are included in the study. This graph includes tenured years for each observation included within the 2014 Cohort until 2018–09-31 whether they have departed or remain working with the organization before the end of the study period on 2018–09-31.

Figure 9. (2014 Cohort) Total Population Federal Work Years: Difference in Attrition and Retainment

2. 2014 Healthcare Workforce Cohort Age-at-Hire Distribution

The age of the average civil service employee at the time of hire for individuals in the 2014 Cohort is 36.51 years. Figure 10 shows that the largest density of the population is hired in their late twenties and early thirties. However, Figure 10 also hints at the possibility of two overlapping distributions of hiring ages within the population, as a second peak occurs at approximately the age of 40. These two peak hiring ages may occur because of a surge of hires from those entering the civil service workforce as a second career.



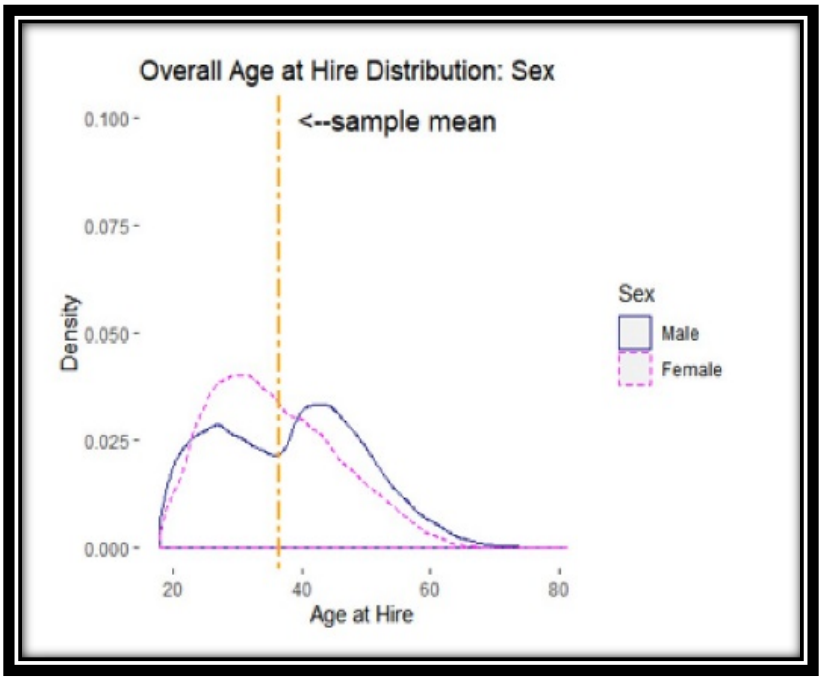
Note: Total Population Mean: **36.51** *(N=50,946)*. The density plot depicts age-at-hire in years distribution within the 2014 Cohort subpopulation. Age-at-hire is generated by calculating the difference between an individual's birthdate and the date of the individual's first transaction. In this thesis observations are limited to those who have worked at least 9 months within the organization. Age-at-hire years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before the end of the study period on 2018–09-31.

Figure 10. (2014 Cohort) Total Population Age-at-Hire

a. Sex

Figure 11 depicts the difference in hiring age distribution between sex subpopulations. The sex subpopulation density plots more clearly illustrate that, while the overall male population average age-at-hire is almost three years higher than the average

hiring age of females, in truth, the male population experiences a larger employment surge approaching the age of 30 and again in the early 40s. Female healthcare workers enter the federal workforce at an average age of 35 and at a frequency more widely and normally distributed compared to their male counterparts' workforce entry ages. While the overall average of the two male population density peaks suggest males enter federal service at a more mature age than females, in fact, if each male density peak is considered, males enter the workforce at ages both younger and older than females on average.



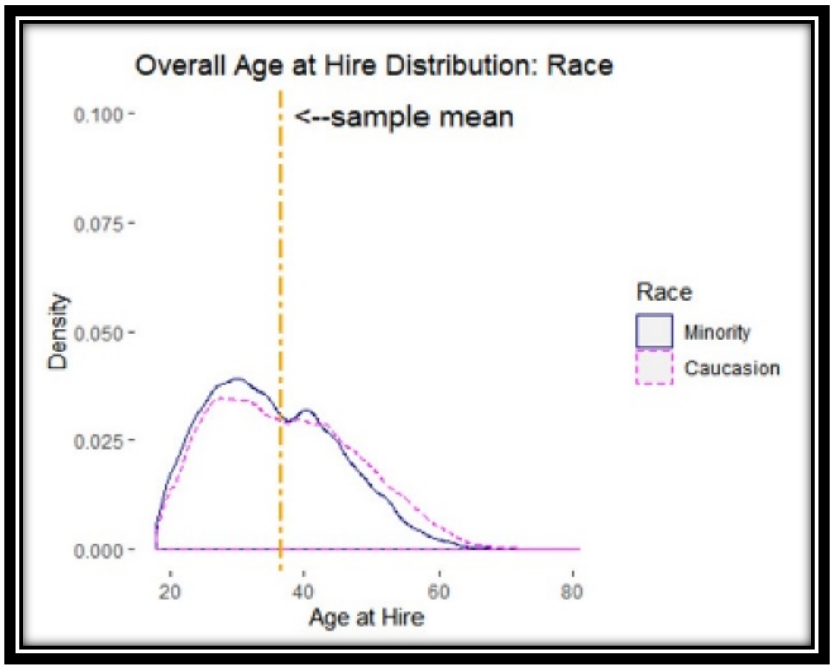
Note: Male Population Mean: **38.29** *(N=14,897).* Female Pop Mean: **35.78** *(N=36,049).* Density plots depict age-at-hire in years distributions within a sex-specific 2014 Cohort subpopulation. Age-at-hire is generated by calculating the difference between an individual's birthdate and the date of the individual's first transaction. In this thesis, observations are limited to those who have worked at least 9 months within the organization. Age-at-hire years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before the end of the study period on 2018–09-31.

Figure 11. (2014 Cohort) Total Population Age-at-Hire: Differences in Sex

b. Race

The results of hiring age distribution density plots in Figure 12 reflect the overlapping twin distribution peaks observed in Figures 10 and 11. However, the two race subpopulations reflect parallel distribution patterns indicating the likely variance of results

is largely due to female and male makeup within the subpopulations rather than a race-specific effect. The only notable difference are density peaks that are taller and narrower in the minority versus Caucasian subpopulations. This result suggests male and female effects are more pronounced in the minority population than in the Caucasian population.



Note: Caucasian Population Mean: **37.20** *(N=31,548).* Minority Population Mean: **35.36** *(N=18,998).* Density plots depict age-at-hire in years distributions within a race-specific 2014 Cohort subpopulation. Age-at-hire is generated by calculating the difference between an individual's birthdate and the date of the individual's first transaction. In this thesis, observations are limited to those who have worked at least 9 months within the organization. Age-at-hire years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before the end of the study period on 2018–09-31.

Figure 12. (2014 Cohort) Total Population Age-at-Hire: Differences in Race

c. Occupation

Figure 13 depicts subpopulation hiring age density plots that present similar findings. The race-specific subpopulation and both collar groups reflect twin peaks that imitate each other in pattern. However, the blue-collar subpopulation density plot is markedly shifted toward a workforce entry age of 20, with an initial density peak in the late 20s and early 30s, followed by a second smaller peak at approximately the late 30s or early 40s. The white-collar population reflects a similar population density distribution

pattern shifted toward ages approximately four to five years older than the blue-collar population. This result is expected, because most white-collar-type healthcare professions require more education than blue-collar-categorized healthcare professions. The minimum requirements for education will inherently increase the average workforce entry age of a worker.

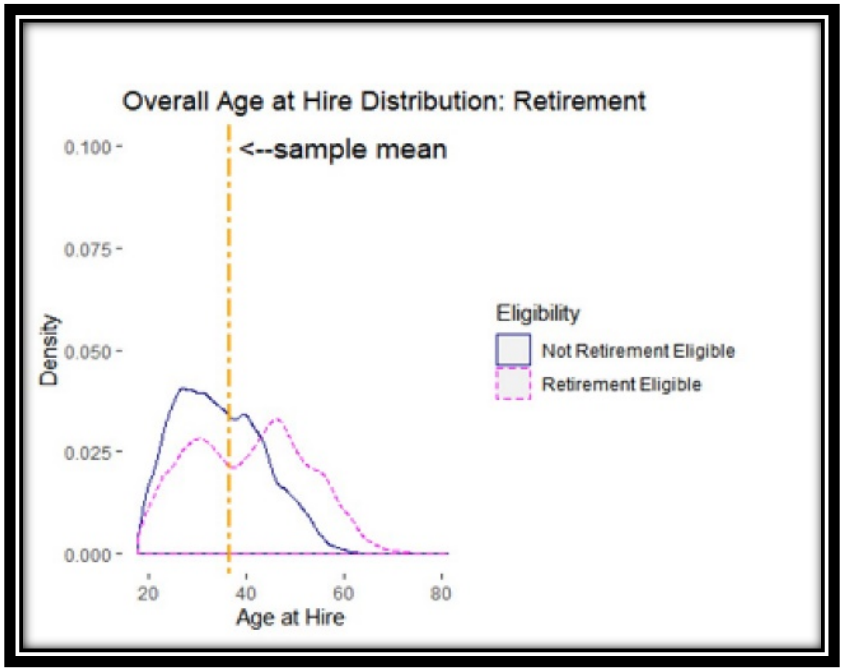
Note: White-Collar Population Mean: **38.86** *(N=23,170).* Blue-Collar Population Mean: **34.56** *(N=27,776).* Density plots depict age-at-hire in years distributions within a collar-specific 2014 Cohort subpopulation. Age-at-hire is generated by calculating the difference between an individual's birthdate and the date of the individual's first transaction. In this thesis, observations are limited to those who have worked at least 9 months within the organization. Age-at-hire years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before the end of the study period on 2018–09-31.

Figure 13. (2014 Cohort) Total Population Age-at-Hire: Differences in Work Collar

d. Retirement

It is logical for comparative workforce entry age distribution results between a subpopulation of retirement-eligible workers versus a subpopulation of retirement-ineligible workers to exhibit a narrower distribution graph because of the relationship between age and retirement eligibility. However, the most interesting finding in Figure 14

is the retirement-eligible subpopulation exhibits more pronounced twin peaks, suggesting distinctly different distributions overlap within this population to mirror the distribution differences found between sexes. This finding further supports the notion that those who plan to remain in the federal workforce until retirement eligibility have two distinct popular average entry ages. Furthermore, it is consistent with the male-to-female results in Figure 11 and is consistent with the conclusions of Brien (2019) that prior active duty men are entering the federal workforce as a second career at a higher rate than female healthcare workers.

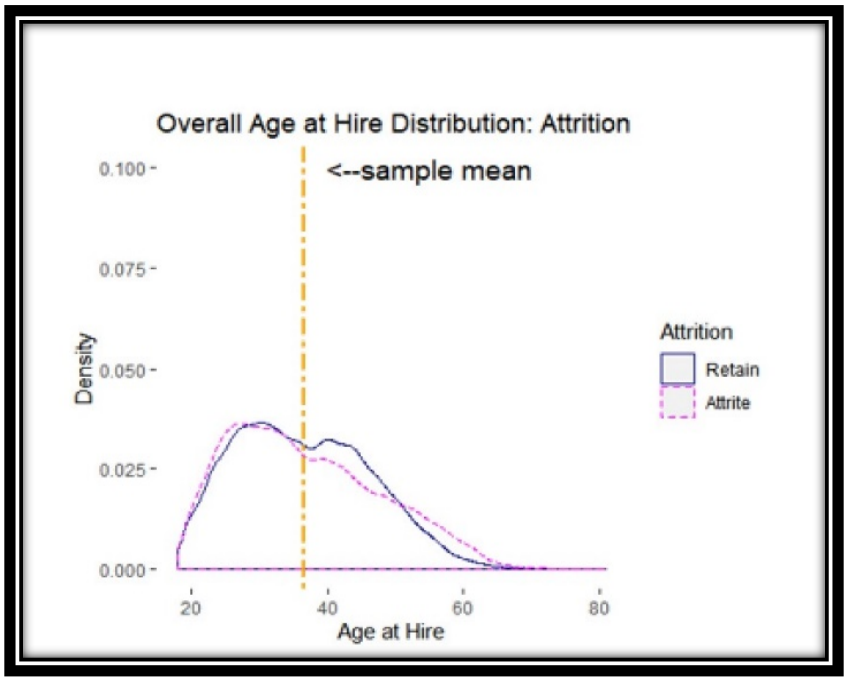


Note: Retirement Eligible Population Mean: 40.53 (N=16,264). Non-Retirement Eligible Population Mean: 34.63 (N=34,682). Density plots depict age-at-hire in years distribution within an eligible-specific 2014 Cohort subpopulation. Age-at-hire is generated by calculating the difference between an individual's birthdate and the date of the individual's first transaction. In this thesis, observations are limited to those who have worked at least 9 months within the organization. Age-at-hire years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before the end of the study period on 2018–09-31.

Figure 14. (2014 Cohort) Total Population Age-at-Hire: Differences in Retirement Eligibility

e. Attrition

The findings in Figure 15 depict the workforce entry age distribution differences between individuals who departed the workforce within the five-year study period and those who remained during the study period. The differences in the density plot distribution placement or pattern does not differ significantly between these subpopulations, except notably where the second density peak is shown to be more pronounced in the population that did not attrite during the study period. This finding is expected, because this study's prior entry age findings suggest a subpopulation of individuals exists who enter the workforce as a possible second retirement-earning career. Individuals who not only have more recently entered the workforce but have also chosen to enter at a more mature age would be more proportionately expected to remain in the workforce as opposed to attrite.

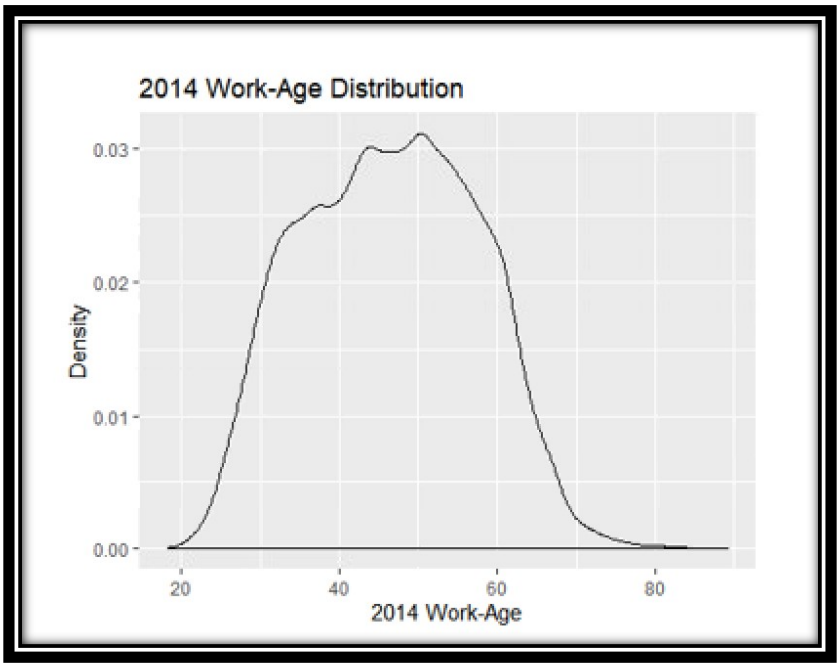


Note: Attrition-Positive Population Mean: **36.71** *(N=18,519).* Retained-Worker Population Mean: **36.40** (*N=32,427).* Density plots depict age-at-hire in years distributions within an attrition-specific 2014 Cohort subpopulation. Age-at-hire is generated by calculating the difference between an individual's birthdate and the date of the individual's first transaction. In this thesis, observations are limited to those who have worked at least 9 months within the organization. Age-at-hire years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before the end of the study period on 2018–09-31.

Figure 15. (2014 Cohort) Total Population Age-at-Hire: Differences in Attrition and Retainment

3. 2014 Healthcare Workforce Cohort 2014-Age Distribution

The average age of a civil service employee in the military healthcare industry as of 2014 for individuals in the 2014 Cohort is 46.37 years of age. Figure 16 shows that the density plot of worker age is approximately normally distributed. However, signs of irregularities that are likely related to increases in age density of workers in their 40s and 50s is possibly related to late entry into federal service for those seeking a second career or pension. The combination of this subpopulation and the existing worker population who entered the workforce at an earlier age contributes to the second and third peaks in the distribution pattern. Given this finding, it is probable that, without this late workforce entry population, the normal distribution of age for this workforce would possibly reflect an average closer to 40 years.

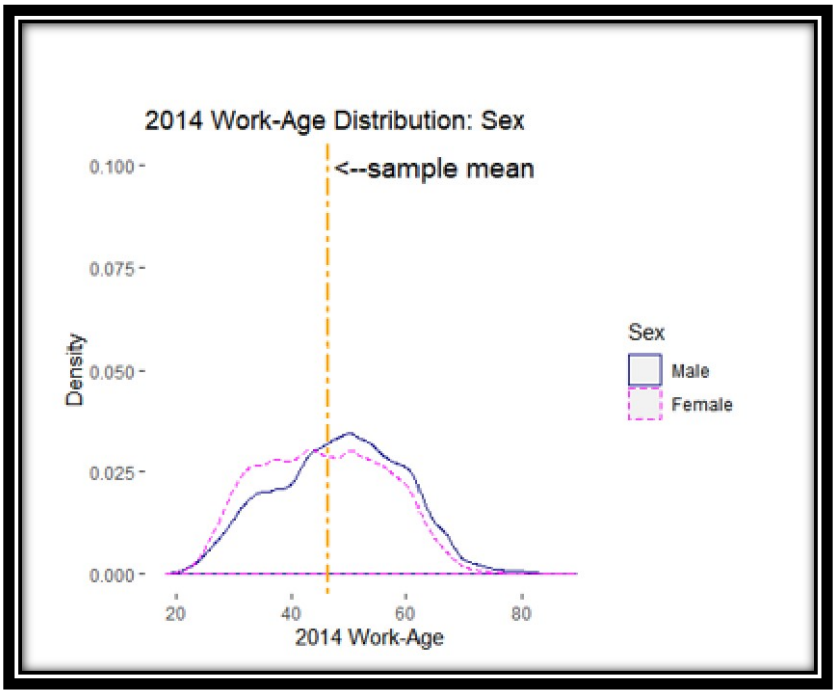


Note: Total Population Mean: **46.37** *(N=50,946)*. The density plot depicts age in 2014 in years distribution within the 2014 Cohort subpopulation. The age in 2014 is calculated from the difference between an individual's birthdate and 2014–12-31. In this thesis, observations are limited to those who have worked at least 9 months in the organization. Age in 2014 years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before 2018–09-31.

Figure 16. (2014 Cohort) Total Population Age in 2014

a. Sex

The distribution pattern difference in Figure 17 corroborates the findings in Figure 16 and suggests the male subpopulation group in the 2014 Cohort is a greater contributor to the later workforce entry surge than the female workforce subpopulation.

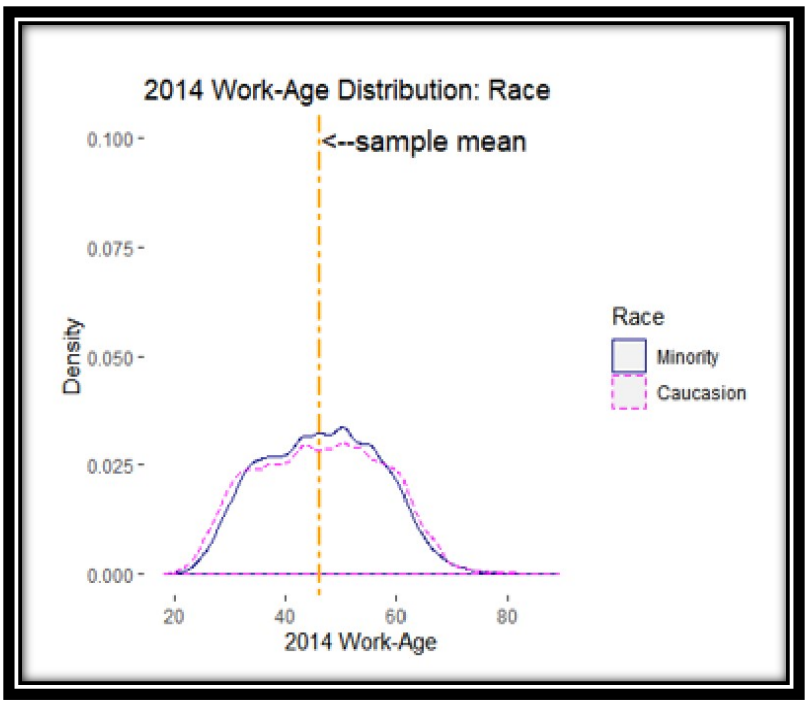


Note: Male Population Mean: **48.25** (N=14,897). Female Pop Mean: **45.59** (N=36,049). Density plots depict age in 2014 in years distributions within a sex-specific 2014 Cohort subpopulation. The age in 2014 is calculated from the difference between an individual's birthdate and 2014–12-31. In this thesis, observations are limited to those who have worked at least 9 months in the organization. Age in 2014 years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before the end of the study period on 2018–09-31.

Figure 17. (2014 Cohort) Total Population Age in 2014: Differences in Sex

b. Race

Comparable to those in Figure 17, the difference in age-distribution patterns between race populations in the 2014 Cohort found in Figure 18 do not appear considerable.

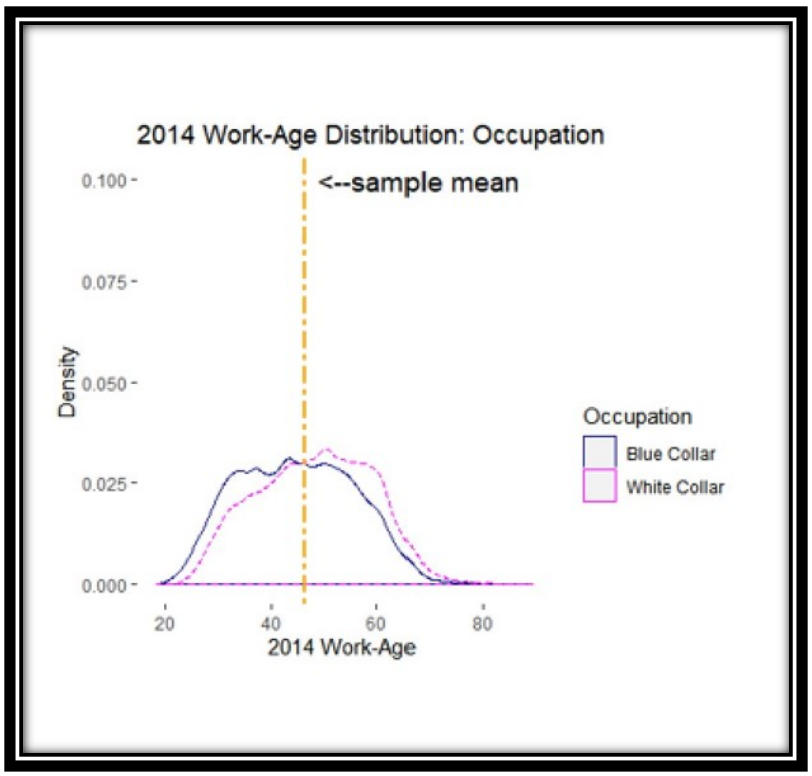


Note: Caucasian Population Mean: **45.59** *(N=31,548)*. Minority Population Mean: **46.48** *(N=18,998)*. Density plots depict age in 2014 in years distributions within a race-specific 2014 Cohort subpopulation. The age in 2014 is calculated from the difference between an individual's birthdate and 2014–12-31. In this thesis, observations are limited to those who have worked at least 9 months in the organization. Age in 2014 years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before the end of the study period on 2018–09-31.

Figure 18. (2014 Cohort) Total Population Age in 2014: Differences in Race

c. Occupation

Figure 19 depicts that the white-collar subpopulation age distribution pattern is similar to the blue-collar subpopulation age distribution pattern, but it is more aligned toward an older age. This finding is likened to the results of the density plot entry age distribution in Figure 13. These findings are expected because of the inherent later career entry age related to increased higher-education requirements associated with white-collar professional levels of healthcare work.

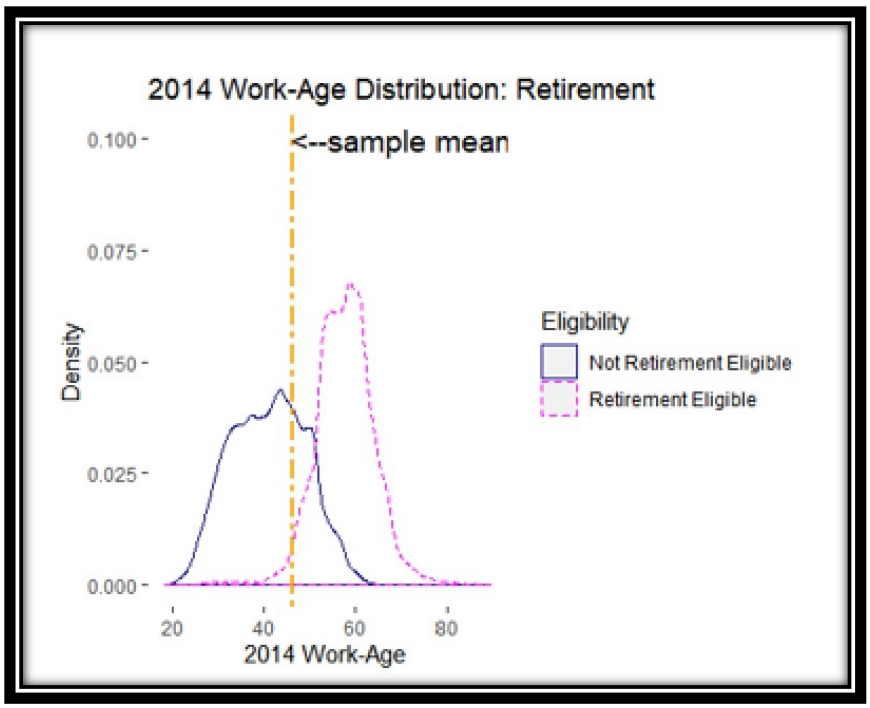


Note: White-Collar Population Mean: **47.82** *(N=23,170).* Blue-Collar Population Mean: **44.81** *(N=27,776).* Density plots depict age in 2014 in years distributions within a collar-specific 2014 Cohort subpopulation. The age in 2014 is calculated from the difference between an individual's birthdate and 2014–12-31. In this thesis, observations are limited to those who have worked at least 9 months in the organization. Age in 2014 years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before the end of the study period on 2018–09-31.

Figure 19. (2014 Cohort) Total Population Age in 2014: Differences in Work Collar

d. Retirement

The results depicted in Figure 20 are expected, due to the large impact an individual's current age has on their retirement eligibility status. These results provide little additional information about the 2014 Cohort.

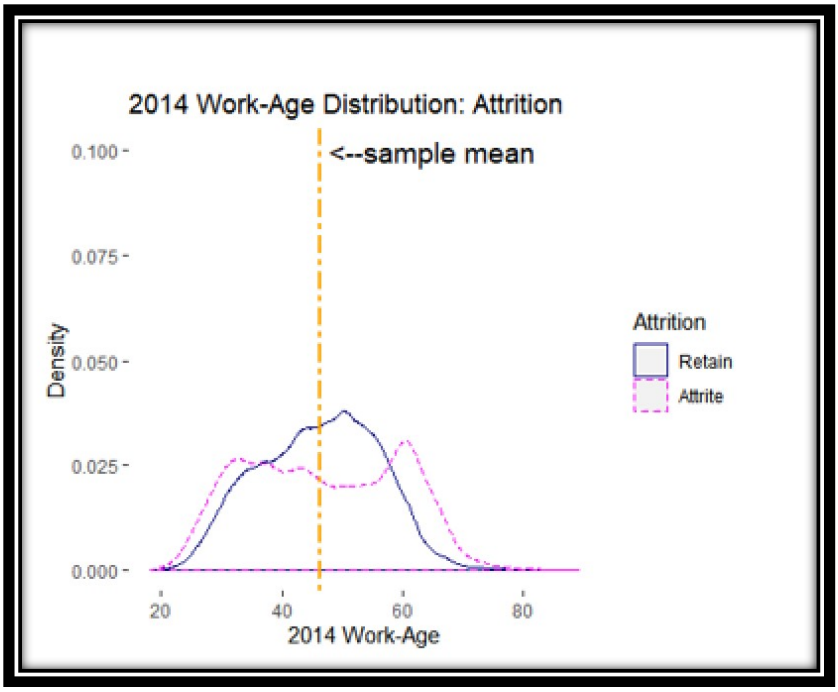


Note: Retirement Eligible Population Mean: **57.77** *(N=16,264).* Non-Retirement Eligible Population Mean: **41.02** (*N=34,682).* Density plots depict age in 2014 in years distributions within an eligible-specific 2014 Cohort subpopulation. The age in 2014 is calculated from the difference between an individual's birthdate and 2014–12-31. In this thesis, observations are limited to those who have worked at least 9 months in the organization. Age in 2014 years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before the end of the study period on 2018–09-31.

Figure 20. (2014 Cohort) Total Population Age in 2014: Differences in Retirement Eligibility

e. Attrition

The results depicted in Figure 21 are also expected but better confirm the non-linear nature of attrition behavior. The density plots in Figure 21 reflect an increased rate of attrition for younger persons in the early stages of their career, which is likely due to external life events and the job-sorting process. A narrower and prominent distribution peak is observed in the population that attrite during the study period at approximately 60 years of age, which signals a portion of the workforce departing for retirement. Unsurprisingly, the age distribution for the subpopulation of workers who remain employed appears to straddle the two attrition peaks. What is also notable in the retained employee subpopulation age distribution graph is a greater proportion of retained employees are found to be in their 50s, which likely signals this working age population intends to remain employed until they are retirement eligible.

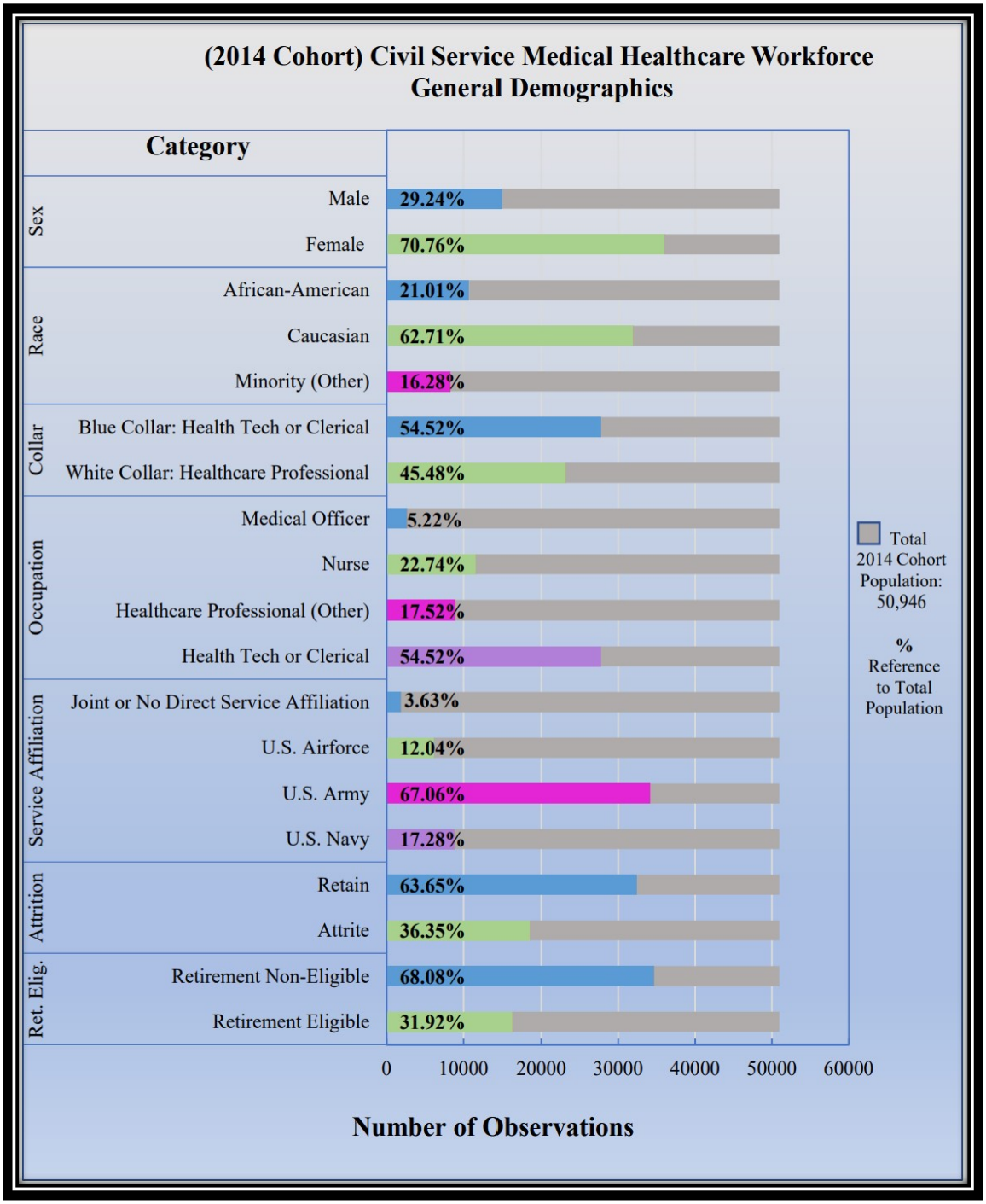


Note: Attrition-Positive Population Mean: **46.84** *(N=18,519).* Retained-Worker Population Mean: **46.09** (*N=32,427).* Density plots depict age in 2014 in years distributions within an attrition-specific 2014 Cohort subpopulation. The age in 2014 is calculated from the difference between an individual's birthdate and 2014–12-31. In this thesis, observations are limited to those who have worked at least 9 months in the organization. Age in 2014 years are accounted for each observation included within the 2014 Cohort until 2018–09-31 whether the individual departed or remained working before the end of the study period on 2018–09-31.

Figure 21. (2014 Cohort) Age in 2014 Total Population: Differences in Attrition and Retainment

4. 2014 Cohort Overall Population Demographics

Figure 22 displays the overall demographic makeup of the total 2014 Cohort population. The results show the healthcare industry in the civil service environment is predominantly female, Caucasian, in the blue-collar category, with employment mostly affiliated with the U.S. Army. It is imperative to the interpretation of the results and further analysis to restate that U.S. military medical facilities primarily utilize active duty personnel in their manpower planning and function execution. Therefore, the results depicted do not illustrate the proportion of demographics that comprise an entire military healthcare system but, instead, reflect the supplemental manpower of the civil service population working within the military healthcare system.



Notes: Categories reflect percentage of the 2014 Cohort occupation-specific population. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables based on individual reported self-identified race. Attrition is considered positive if an individual from the 2014 Cohort departs the workforce during the study period (2014-01-01 to 2018-09-31). Retirement eligibility status is considered positive if an individual in the 2014 Cohort either is or becomes retirement eligible before the end of the study period.

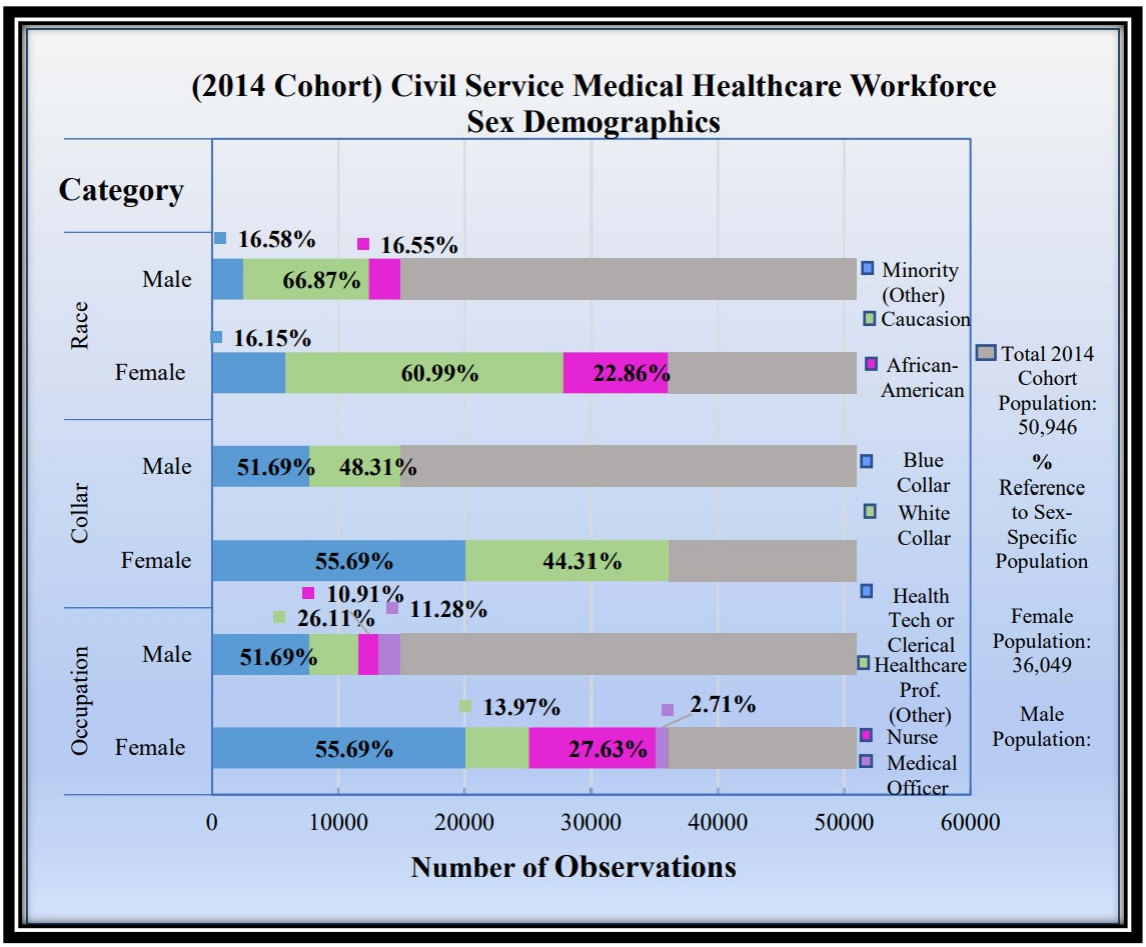
Figure 22. (2014 Cohort) General Demographics

Consequently, the results interestingly illustrate the U.S. Army to be the largest employer of the 2014 Cohort population. However, any conclusions from this finding or further service-affiliation analysis is likely more closely related to the size, approved funding, and active duty manpower billet structure of a service organization than to organizational cultural influences on workforce behavior. Similarly, medical officers comprise only approximately 5% of the total civil service healthcare workforce, but this does not indicate that only 5% of an MTF's manpower are physicians. Rather, it shows only the proportion of the civil service workforce employed in this role; in actuality, an MTF may contain a larger proportion of physicians employed through active duty manpower billets.

Another finding from these results is approximately one third of the 2014 Cohort workforce population is or will become retirement eligible within the study period. Similarly, approximately 36% of the overall population is expected to experience turnover during this time. However, this does not suggest all who attrite were also retirement eligible.

5. 2014 Cohort Sex-Specific Population Demographics

The findings of Figure 23 disclose that, while over 60% of the workforce population is Caucasian, a greater proportion of males are Caucasian and, more specifically, not African-American compared to the female subpopulation. Additionally, a larger proportion of men are working in white-collar professions than in the female population. More specifically, men are five times more likely to be a medical officer and twice as likely to be a healthcare professional (other) compared to women in this workforce. However, females are almost three times more likely to hold a nursing position compared to men.

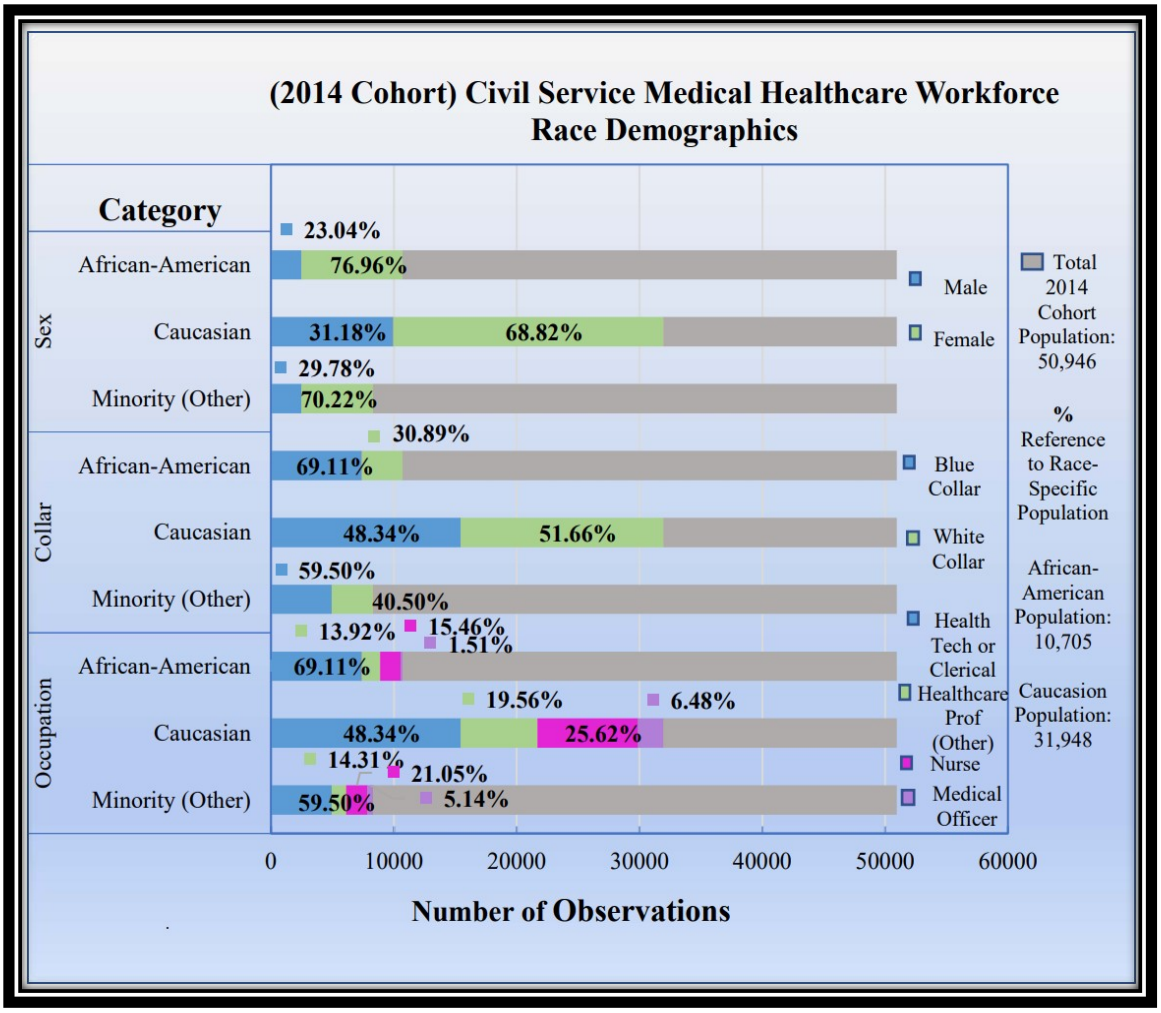


Notes: Categories reflect percentage of the 2014 Cohort sex-specific population. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables based on individual reported self-identified race.

Figure 23. (2014) Sex Demographics

6. 2014 Cohort Race-Specific Population Demographics

Findings from Figure 24 disclose African-Americans in the 2014 Cohort are proportionately more likely to be female than other races. The results of racial demographics reveal a more severe difference between races in relation to occupation type. Caucasian workers are disproportionately employed over other minority races in white-collar professions. The most striking difference occurs in the employment of the African-American population, whose workers are more than one third as likely to be employed as a medical officer than both Caucasian and minority (other) races. Additionally, almost 70% of the 2014 Cohort African-American subpopulation work in a blue-collar categorized job.



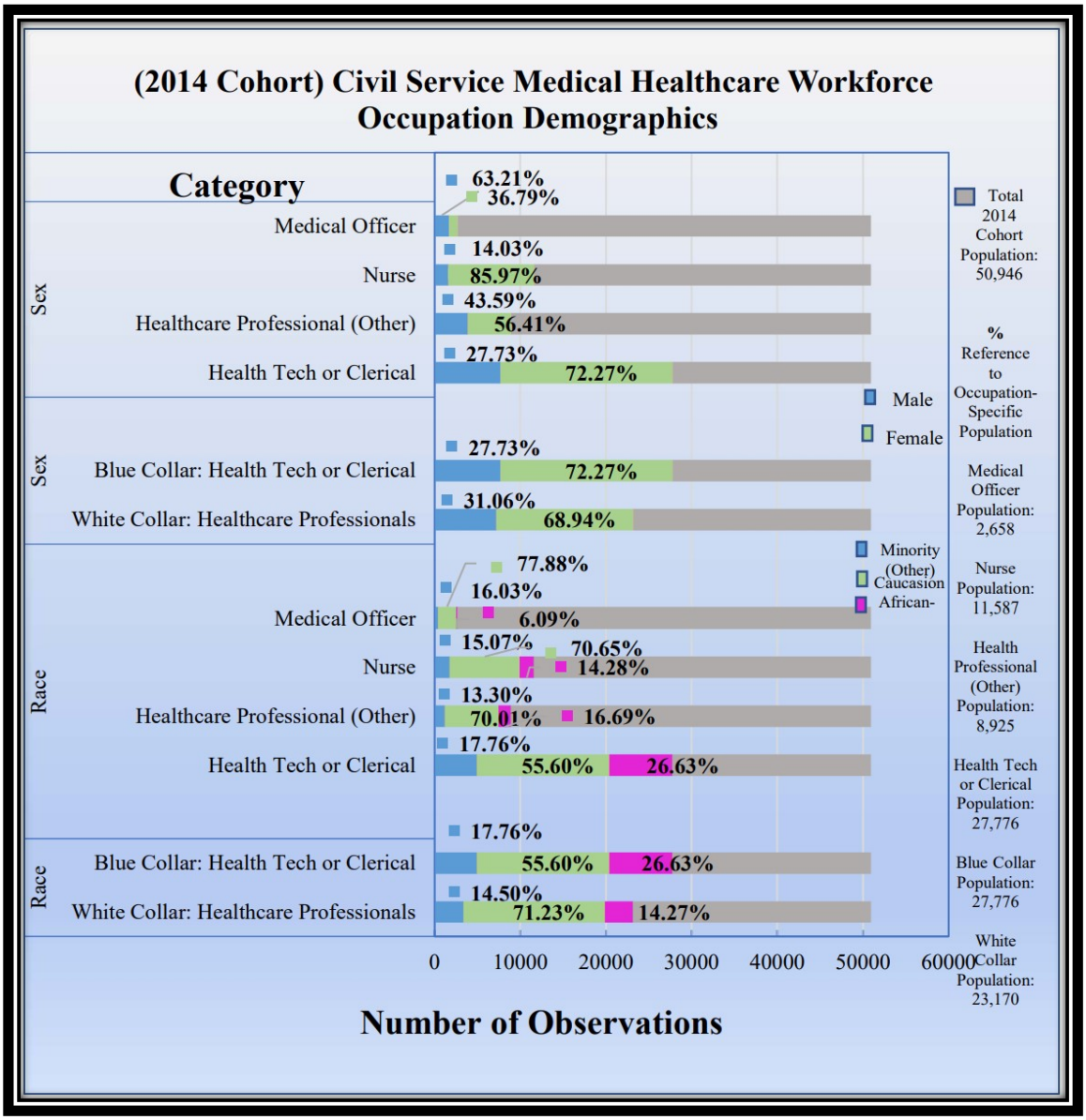
Notes: Categories reflect percentage of the 2014 Cohort race-specific population. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables based on individual reported self-identified race.

Figure 24. (2014 Cohort) Race Demographics

7. 2014 Cohort Occupation-Specific Population Demographics

The occupational demographic findings in Figure 25 are expected after reviewing Figures 22–24. Most occupation and collar types are found to be predominately female and predominately Caucasian. However, the medical officer occupation is the only occupation demographic proportionately more male than female, despite over 70% of the total workforce population being measured as female. Figure 25 continues to reflect a substantial

deficit in the makeup of African-Americans in white-collar type professions as compared to their overall population proportional makeup.



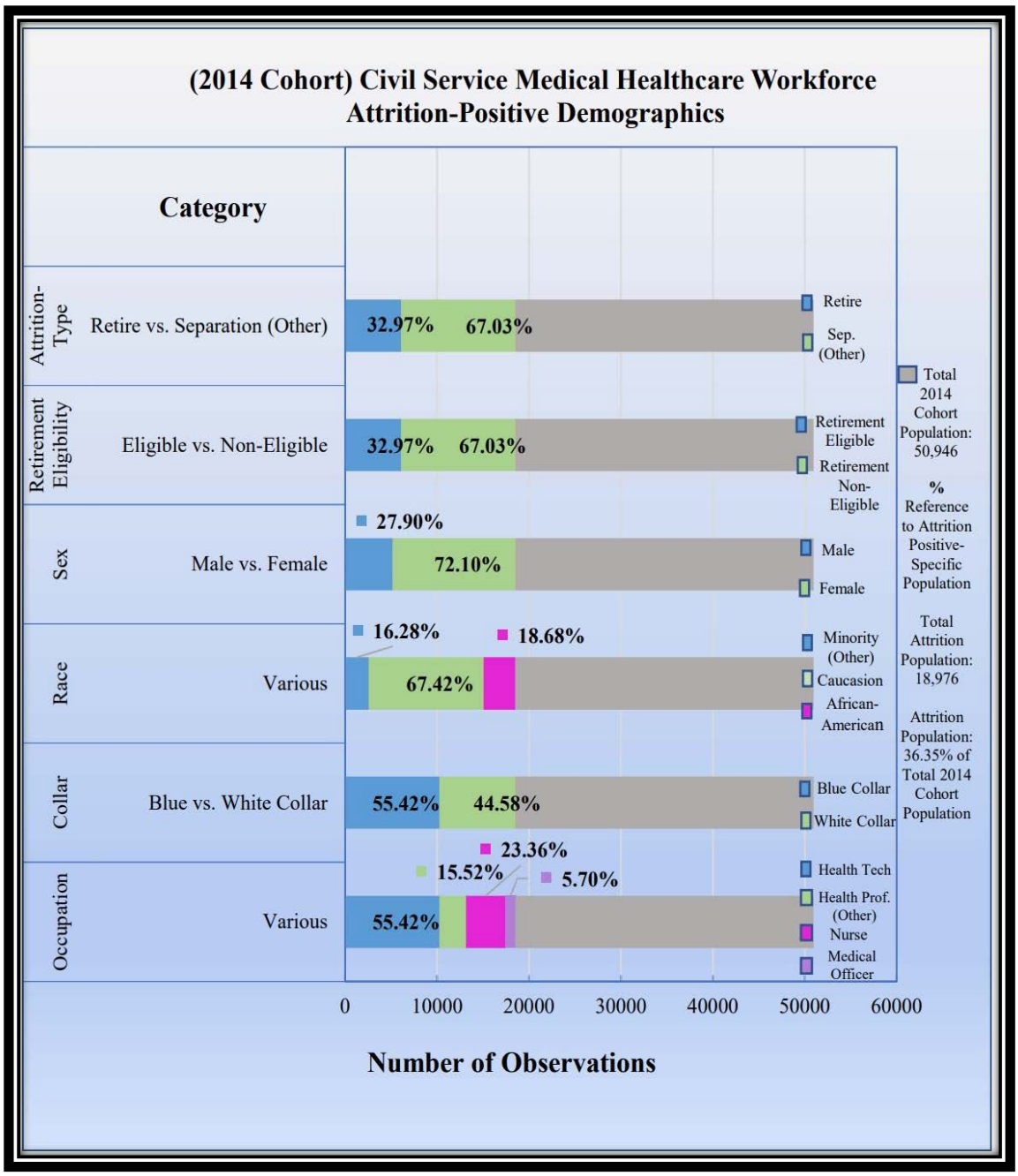
Notes: Categories reflect percentage of the 2014 Cohort occupation-specific population. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables based on individual reported self-identified race.

Figure 25. (2014 Cohort) Occupation Demographics

8. 2014 Cohort Attrition Type-Specific Population Demographics

Figure 26 reflects the demographic makeup of individuals within the 2014 Cohort who separated from the organization during the study period (2014-01-01 to 2018-09-31). Of the attrition-positive workforce population, only a third were considered to have been retirement eligible. This finding indicates most attrition occurs independent of retirement opportunity. While retirement eligibility may be closely linked to an attrition decision of an individual, retirement is not the greatest attrition rate contributor. All other demographic percentages in the attrition-positive population mostly mirror the overall 2014 Cohort total population demographic makeup. However, the results also suggest the nurse, female, and Caucasian subpopulations may attrite at marginally higher rates than their counterparts. More significantly, African-Americans and those in the healthcare profession (other) category may attrite at a lower rate proportionate to their population makeup. More broadly, the findings suggest attrition rates for demographic subpopulations may have remained stable during the study period if the end demographic percentages reflect the 2014 Cohort data demographic composition.

The descriptive civil service healthcare workforce demographic comparison in Appendix A displays the attrition rate proportions per demographic group category. The proportion of attrition within demographics in terms of total population proportions is proportionately consistent with the results in Figure 26. This finding indicates that no singular demographic group grossly stands out as experiencing a disproportionate amount of attrition.

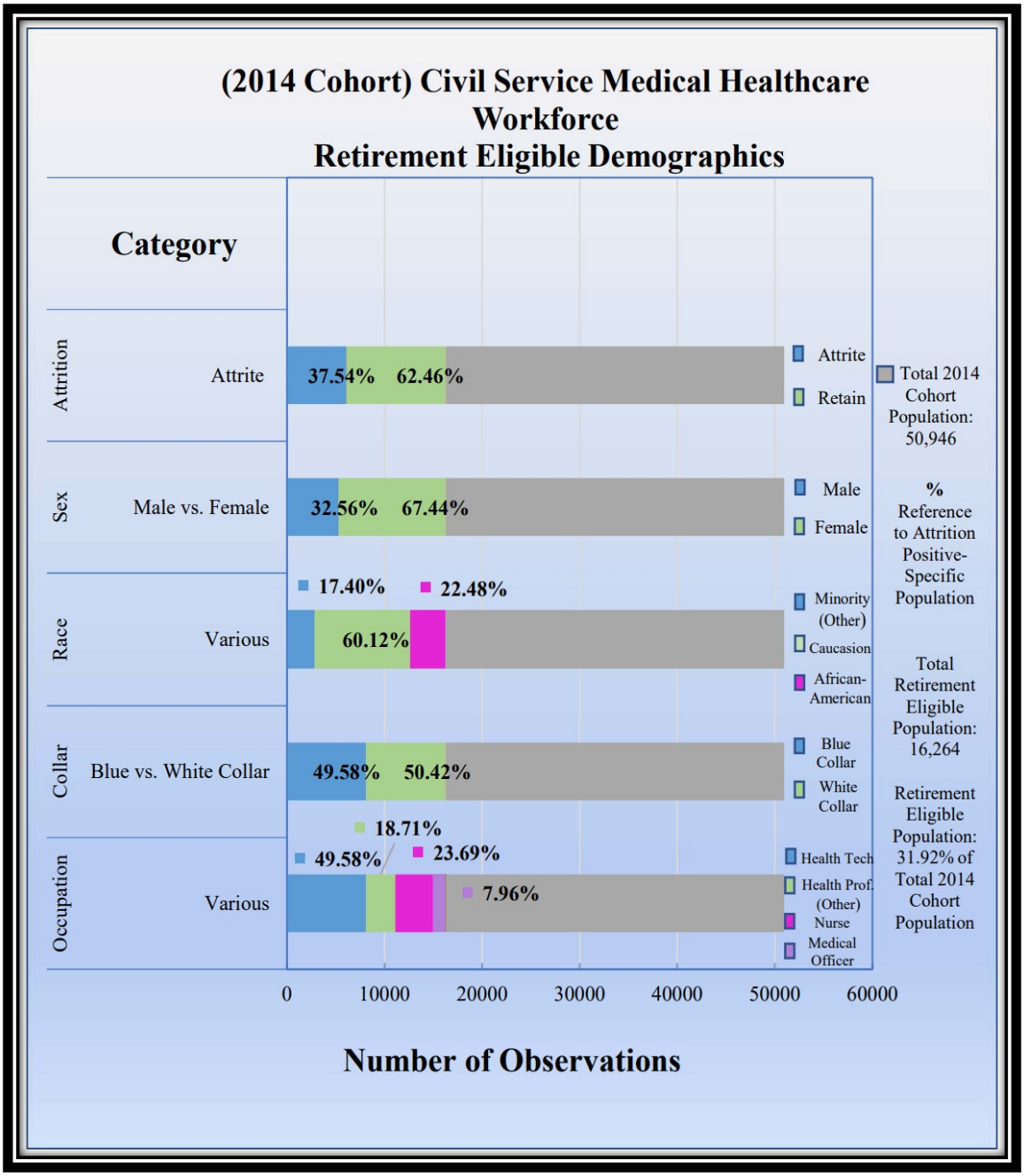


Notes Categories reflect percentage of the 2014 Cohort attrition-positive population. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables based on individual reported self-identified race.

Figure 26. (2014 Cohort) Attrition Demographics

9. 2014 Cohort Retirement Eligible Population Demographics

The results in Figure 27 reflect the demographics of the retirement-eligible subpopulation. Most of the demographic percentages are consistent with the 2014 Cohort total population demographic measurements. The two demographic populations that differ more significantly are the sex subpopulations and the occupation subpopulations. However, these findings are consistent with the average age of workforce entry findings in Figures 10–15. Figure 27 shows that a greater percentage of males are found to be retirement eligible than the overall demographic percentages found in Figure 23 would suggest. This further indicates a late workforce entry surge is likely a behavior more specific to males than females. Additionally, given the prior results of Figure 23, the results of Figure 27 reflect a smaller-than-anticipated retirement-eligible percentage. The lower proportion is likely related to the tendency of individuals in the blue-collar fields to enter the workforce at an earlier age, as reflected in Figure 13. The reason behind this finding can be linked to both the increased education requirements for white-collar workers and the large association with age and retirement eligibility.



Notes: Categories reflect percentage of the 2014 Cohort retirement eligible population. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables based on individual reported self-identified race.

Figure 27. (2014 Cohort) Retirement Eligible Demographics

The purpose of the results in Table 2 is to investigate whether any demographic category or group is more vulnerable to attrition when retirement eligibility status is

reached. According to Table 2, retirement-eligible Caucasians in the white-collar healthcare professions, particularly medical officers and nurses, experience a higher percentage of turnover than their blue-collar and minority counterparts.

Table 2. (2014 Cohort) Percent of Retirement Eligible Who Attrite

2014 Cohort Population Percent of Retirement Eligible Who Attrite		
Category	**Variable**	**2014 Cohort Percent in Group Who Attrite If Retirement Eligible**
ATTRITION	Total Retirement Eligible *N=16,264*	37.54%
OCCUPATION	Healthcare Tech or Clerical Assistant *N=8,063*	36.17%
	Healthcare Professional (Other) *N=3,053*	36.26%
	Nurse *N=3,853*	40.18%
	Medical Officer *N=12,295*	41.24%
COLLAR	White Collar *N=8,201*	38.89%
	Blue Collar *N=8,063*	36.17%
RACE	Caucasian *N=9,778*	40.68%
	African-American *N=3,656*	31.15%
	Minority (Other) *N=2,830*	34.91%
SEX	Male *N=5,295*	37.94%
	Female *N=10,969*	37.34%

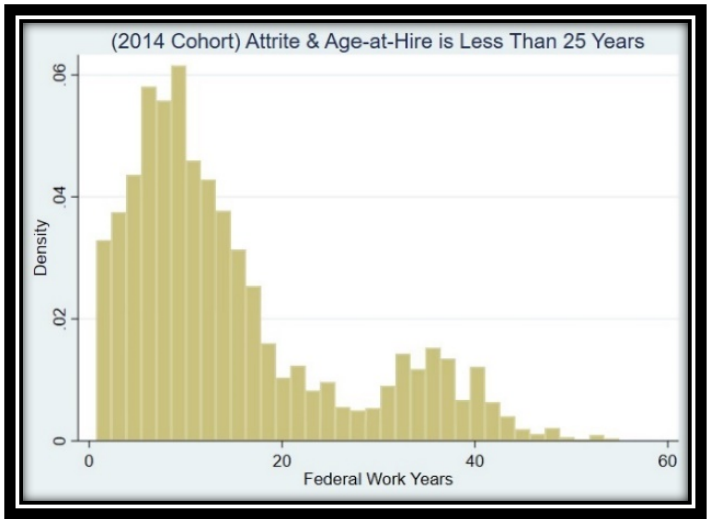
Notes: Categories reflect percentage of the 2014 Cohort population-type specified. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management. Professional Healthcare (Other) refers to professional health care occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables based on individual reported self-identified race.

10. 2014 Cohort Population and the Relationship Between Age-at-Hire and Total Federal Work Years

In theory, the decision to attrite is related to goodness of job fit as perceived by the individual or organization. Additionally, it is also closely tied to personal, professional, and monetary means and opportunity an individual might find at another organization or during retirement. Analysis of total federal work year and age-at-hire density plots in Figures 4–15 also support this theoretical relationship and further suggest two types of workforce entry age groups with coinciding attrition and retention behavior exist in the workforce. Figures 28–32 explore the relationship between entry age and total federal work years for individuals who attrite during the study period.

a. Age-at-Hire Is 25 Years or Less

For the subpopulations of early entry workers aged 18–25 years upon hire, the distribution of total federal work years illustrates a higher proportion of this population departs before even reaching five working years, as compared to than those who remain in federal service for 20 years or more. This finding supports the theory younger workers are more sensitive to the job-sorting process as they embark on their careers.

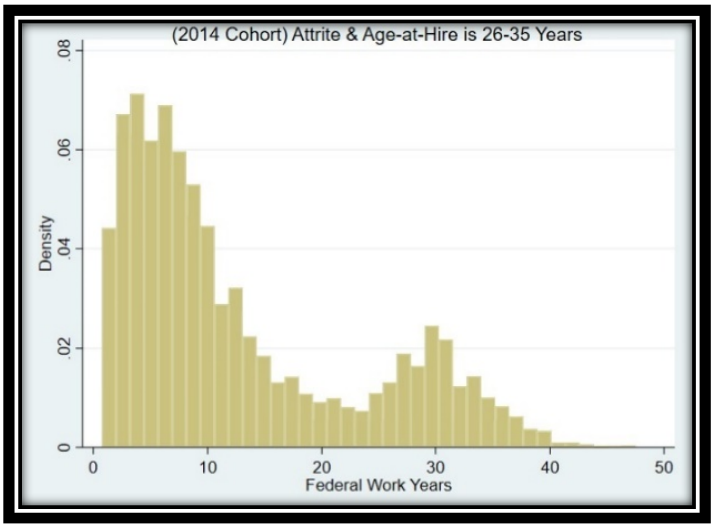


Note: Bar histogram represents distribution of total federal work years earned toward federal retirement for a subpopulation who entered the federal workforce at 25 years of age or less and departed the federal workforce before the end of the study period.

Figure 28. (2014 Cohort) Total Federal Work Years Attrite and Age-at-Hire Is 25 Years or Less

b. Age-at-Hire Is 26–35 Years

As the workforce entry age increases to a span of 26–35 years, a similar distribution pattern in Figure 29 persists as occurred in the younger entry-age population. This population is also categorized as being in the earlier stages of a career, and the initial distribution peak similarly reflects a majority departing before reaching 10 work years. However, what is different in this entry-age group population compared to their even younger counterparts is a more prominent second distribution peak centered at 30 work years. This finding indicates that, in contrast to the 25 and under entry age population, a larger portion remains in federal service throughout their career lifetime.



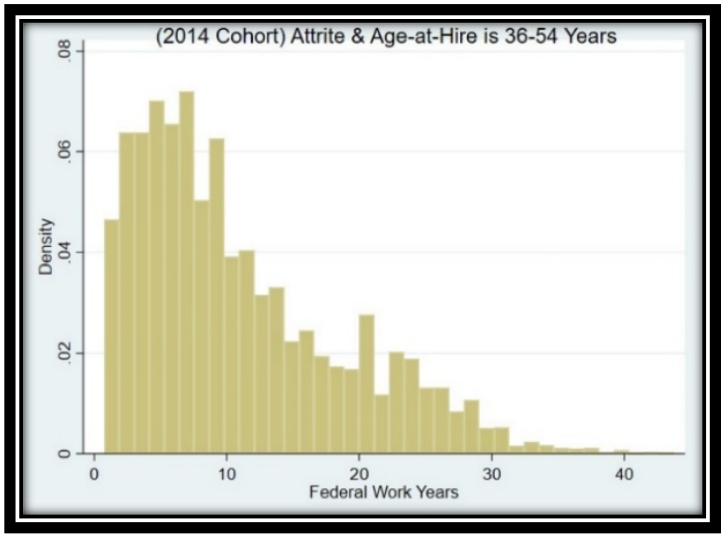
Note: Bar histogram represents distribution of total federal work years earned toward federal retirement subpopulation who entered the federal workforce at between 26–35 years of age and departed the federal workforce before the end of the study period.

Figure 29. (2014 Cohort) Total Federal Work Years Attrite and Age-at-Hire Is 26–35 Years

c. Age-at-Hire Is 36–54 Years

The assumption for individuals in the middle of their working lifetime is they are more likely to enter a work environment purposefully with a predisposed notion of job goodness of fit. Figure 30 illustrates that, for this age group, a fair amount of job sorting continues to exist, as evidenced by high-density measurements at less than 10 years.

However, the minimum FERS retirement-eligibility requirement is age 62 years with at least five federal work years. Some portion of those in this population departing before 10 work years could be due to meeting this requirement. Notably different in the distribution of federal work years in this population is the distribution curve does not plateau and rise again in this population, as compared to its younger work-entry counterparts. Instead, the distribution curve steadily declines, with a greater proportion of the population working more than 10 years or more overall. These finding suggest this entry-age group may enter federal service with the intent to remain until retirement is earned but still experiences some amount of the job sorting phenomenon.



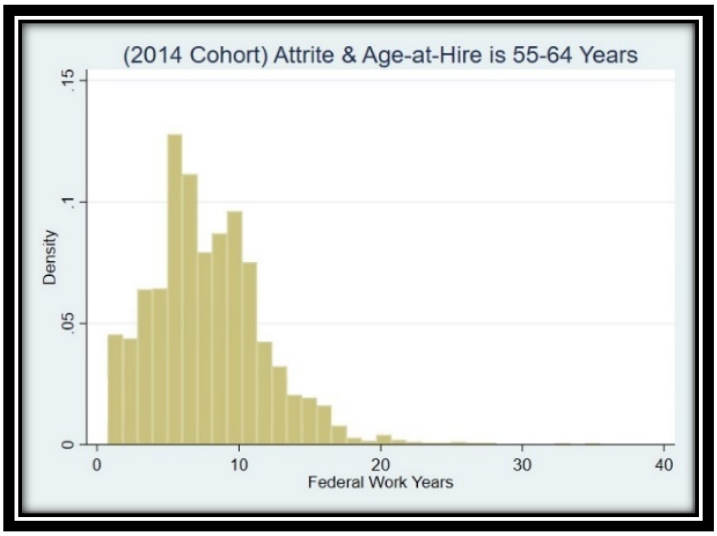
Note: Bar histogram represents distribution of total federal work years earned toward federal retirement for a subpopulation who entered the federal workforce at between 36–50 years of age and departed the federal workforce before the end of the study period.

Figure 30. (2014 Cohort) Total Federal Work Years if Attrite and Age-at-Hire Is 36–54 Years

d. Age-at-Hire Is 55–64 Years

As the workforce entry age increases to the later ages within a career lifecycle, Figure 31 reveals a more normally distributed histogram for the subpopulation of workers who enter federal service at an age between 55 and 64 years. This older entry-age group also exhibits a greater proportion of workers departing with less than 10 work years.

However, this result is probably more closely related to the minimum FERS retirement eligibility criteria than to the job-sorting process.

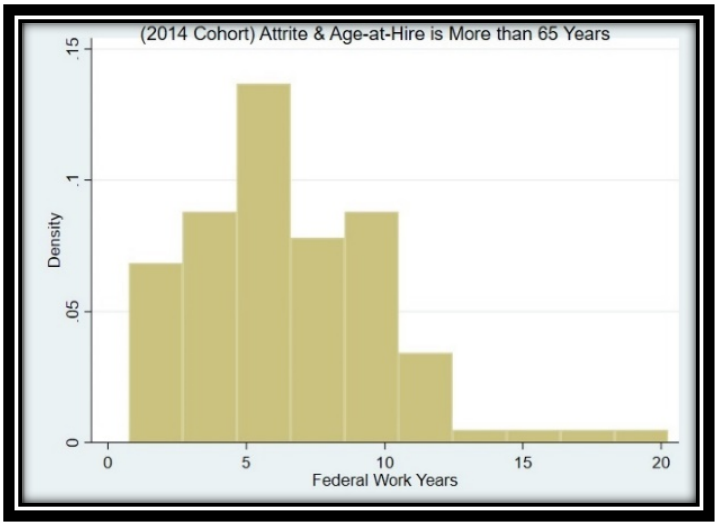


Note: Bar histogram represents distribution of total federal work years earned toward federal retirement for a subpopulation who entered the federal workforce at between 51–64 years of age and departed the federal workforce before the end of the study period.

Figure 31. (2014 Cohort) Total Federal Work Years if Attrite and Age-at Hire Is 55–64 Years

e. Age-at-Hire Is 65 Years or More

As expected, for individuals who enter federal service at an age of 65 years or older, the distribution of work years for those who attrite is relatively flat, because the individual is already of federal social security-eligibility age. A large peak is observed at the five work years, which is likely attributed to the five years of service and 62 years or older FERS retirement-eligibility criteria. A substantial drop off in the distribution occurs after 10 years, which can likely be attributed to meeting a second level of FERS retirement eligibility criteria as well as advanced working age.

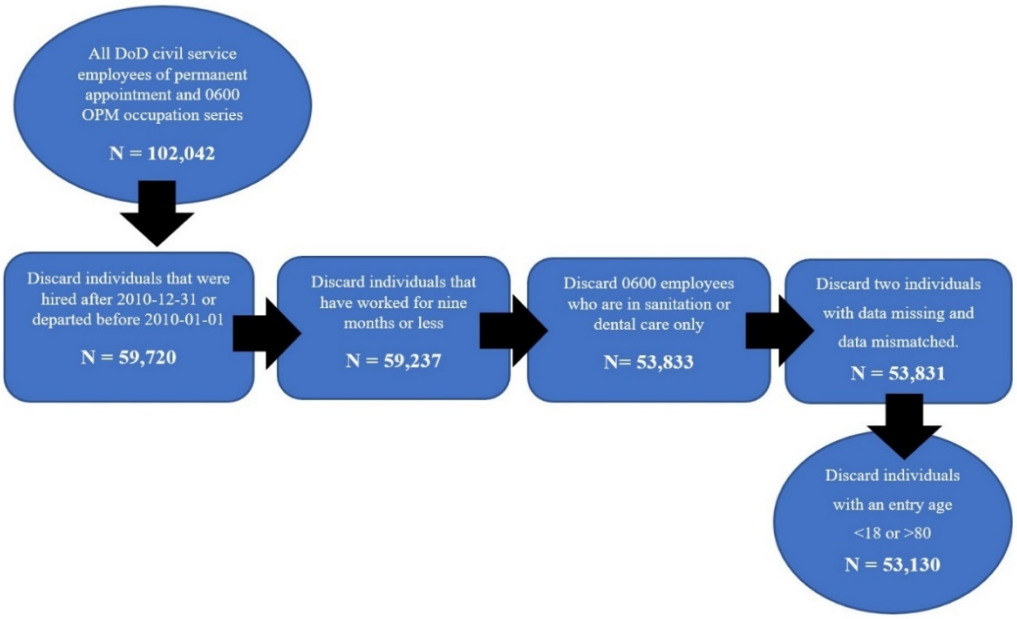


Note: Bar histogram represents distribution of total federal work years earned toward federal retirement for a subpopulation who entered the federal workforce at 65 years of age or more and departed the federal workforce before the end of the study period.

Figure 32. (2014 Cohort) Total Federal Work Years if Attrite and Age-at-Hire Is 65 Years or More

11. Demographic Sensitivity Analysis with 2010 and 2018 Cohort Population Comparison

To ensure the demographic structure of the 2014 Cohort is not comparatively unique to other cohort group years because of external economic or policy influences, this thesis compares 2010 Cohort and 2018 Cohort demographics to the 2014 Cohort study population. The process of structuring the 2010 and 2018 cohort groups follows the same methodology utilized to isolate the 2014 Cohort study group. Figures 33 and 34 illustrate the process for structuring each cohort year data. A small difference occurs in observation totals between each cohort group. One explanation for a larger federal healthcare workforce in 2010 could partly be due to the uncertainty workers felt during the 2009 economic recession. The 2018 Cohort observations total is significantly less than the 2014 Cohort observation count. However, the 2018 Cohort only includes nine months of study data due to limitations of DMDC data availability during this analysis. In contrast, the 2010 and 2014 cohorts contain 12 months of data.



Note: Data structuring for 2010 Cohort follows the same methodology as creating the 2014 Cohort. 2010 Cohort may contain some of the same observations as the 2014 Cohort if those individuals were also working in 2014.

Figure 33. 2010 Cohort Data Structure Methodology Flow Chart

Note: Data Structuring for 2018 Cohort follows the same methodology as creating the 2010 and 2014 Cohorts. The 2018 Cohort may contain some of the same observations as the 2010 and 2014 Cohorts. The 2018 Cohort was created from data that ends 2018–09-31 as oppose to the end of the calendar year.

Figure 34. 2018 Cohort Data Structure Methodology Flow Chart

The Appendix of this thesis contains cross-tabulated demographic comparisons between the cohort groups. The values reflect percentages of the total cohort-specific populations, and continuous variables are reflected as average number of years within the cohort-specific population. All demographic percent values depict a difference of <1% between cohort groups, except for the percent of individuals who self-identify and report to be of Hispanic ethnicity. The reported value in the 2014 Cohort is the lowest reported value at 1.7% compared to the highest reported value of 4.19% in the 2018 Cohort population. This difference does not affect the concluding analysis within this thesis, because ethnicity is not considered. However, why this difference exists is unknown at this time; it may signal a trend in increased hiring of individuals who report a Hispanic ethnicity, a policy change that results in more individuals reporting their ethnicity, or increased accuracy in data management and record keeping of this human resource file category.

The average workforce age-at-hire is within one-year value across the cohort groups and tabulated subpopulation groups. However, an approximate difference of 1.5 years or more of accrued tenure exists between the 2018 Cohort group compared to the 2010 and 2014 Cohort groups. This difference in tenure average could be due to the inconsistency of included months (9 months versus 12 months).

B. LOGISTIC REGRESSION ANALYSIS

The second type of analytical method in this thesis is logistic regression analysis. The binary outcome variable used throughout the model building and fitting process is an attrition event.

1. Base-Working Models

The base model in this thesis should include the demographic variables of interests not only available in the data but also previously explored and found to be meaningful or impactful to this study's purpose during univariate and bivariate analysis. The results of the descriptive analysis indicate differences in career longevity, workforce entry age, and attrition behavior among healthcare collar worker categories, race categories, and sex categories. The thesis literature review highlights the importance of organizational culture

on attrition rate outcomes. The differences between military service component working cultures and methods of operation vary. However, the descriptive analysis reveals the U.S. Army employs a disproportionate amount of the civil service healthcare workforce compared to the other services. Additionally, due to different service MTF manpower strategies, the frequency of occupation types employed within each service organization is not evenly distributed. For example, the U.S. Army might employ a large portion of civilians in medical officer and health technician positions, but the U.S. Air Force may choose only active duty personnel to fulfill these roles. Consequently, including a service-affiliation variable in a regression model will introduce bias within model. However, service affiliation is still considered during the model fitting process to dismiss any untoward impact of these different organizational cultures.

Descriptive results also reveal that continuous variables describing career longevity and lifecycles differ among demographic groups. These results further expose that both workforce entry age and an individual's retirement eligibility status have a dichotomous impact on both career longevity and attrition rates, especially when applied to different sex subpopulations. Given these findings, these variables should also be explored in the model fitting process.

a. Basic Demographic Testing

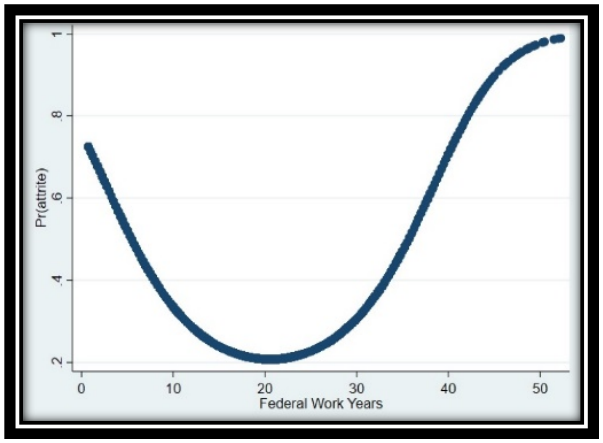
The first logistic regression model includes the broadest demographic elements of sex, race, collar, and military service affiliation. Model 1, Table 3 displays this initial model's results. All logistic regression models in this study are executed as odds ratios, and results should be interpreted as the average odds of attrition likelihood, ceteris paribus, during the study period (2014-01-01 to 2018-09-31), compared against the covariate's counterfactual average attrition likelihood in odds. The counterfactuals in all regression models in this thesis will be in interpreted against the baseline male, Caucasian, blue collar, and health technician or clerical assistant-type worker. Service-affiliation odds ratio results are interpreted against the average odds of attrition of a U.S. Army employee. Because these service elements are found to have both little marginal effect on the odds and to be

insignificant at the statistical standard of <10%, subsequent model building and testing in this study do not include the service-affiliation covariates.

b. Continuous Variables and Polynomial Variable Inclusion Testing

The second and third models aim to include the impact of continuous variables on attrition likelihood. Because of the finite nature of an individual's career lifespan, it is logical to consider that the relationship between time-related continuous variables and attrition may not be constant over time. In this situation, it is reasonable to explore if total federal work years and age-at-hire variables should be included in the logistic regression model as polynomial variables. Figures 5–15 further support this assessment in that these distribution graphs illustrate a relationship with attrition throughout the career lifecycle as experiencing multiple peak distributions, indicating the possibility of a non-linear relationship with attrition.

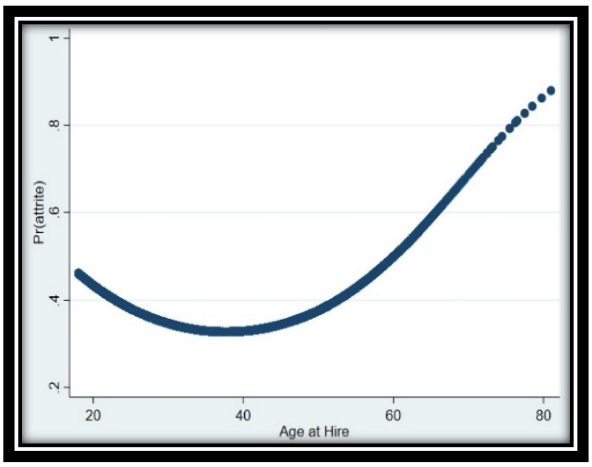
Figure 35 demonstrates through a scatterplot graph the relationship between total federal work years and the predicted probability of attrition. According to Figure 35, the predicted probability of attrition decreases on average throughout federal work years until approximately the 20-year mark, when the predicted probability of attrition increases on average over subsequent federal work years.



Note: An attrition event is categorized as a sample observation's departure from the civil service healthcare workforce without return during the study period (2014-01-01 to 2018–09-31).

Figure 35. 2014 Cohort Total Population Tenure Effect on Predicted Probability of Attrition Scatter Plot

Figure 36 demonstrates a similar relationship between workforce entry age and predicted probability of attrition. However, in contrast to Figure 35, the scatterplot graph in Figure 36 exhibits a much wider and shallower curve over time. Comparable to Figure 35, in the earlier stages of the graph in Figure 36, or, in this case, during the younger ages-at-hire, the predicted probability of attrition decreases as age-at-hire increases. However, at an average workforce entry age in the late 30s or early 40s, the probability of attrition increases steeply in a more linear mode.



Note: An attrition event is categorized as a sample observation's departure from the civil service healthcare workforce without return during the study period (2014-01-01 to 2018–09-31). Age-at-Hire refers to the age of an individual when they entered the civil service workforce.

Figure 36. 2014 Cohort Total Population Age-at-Hire Effect on Predicted Probability of Attrition Scatter Plot

The theoretical exploration, scatterplot graphing, and descriptive analysis of these time-related continuous variables provide enough evidence to reasonably assume the inclusion of these variables as polynomial variables within the logistic regression odds ratio model will create a better model fit. The results of Models 2 and 3 are displayed in Table 3 and include each polynomial variable set.

c. Base Working Model Results

Model 2, Table 3 considers the impact of total federal work years on odds of attrition during the study period. All covariates, including total federal work years and total federal work years squared, remain significant with this model. The collar, sex, and race covariates maintain the same direction of effect in this model, but their coefficient values shift in magnitude closer to the odds of one. The impact of increasing total federal work years appears to absorb some of the differentiation in workforce behavior among demographic groups. The overall impact of increasing federal work years is nonlinear in the model and consequently has an average effect of lower attrition odds until approximately 18 work years; at 18 federal work years, the overall average odds of attrition, ceteris paribus, increase the likelihood of attrition as work years increase.

Table 3. (2014 Cohort) Odds Ratio Logistic Analysis of Workforce Attrition: Base Model Results

VARIABLES	(1) (2014 Cohort) Base Model *with Service*	(2) (2014 Cohort) Base Model *with Tenure*	(3) (2014 Cohort) Base Model *with Age-at-Hire*	(4) (2014 Cohort) Base Model *with Occupation*	(5) (2014 Cohort) Base Model *with Retirement Eligibility*	(6) (2014 Cohort) Base Model *Remove Insig. Variables*
Female	1.125*** (0.023)	1.044** (0.022)	1.071*** (0.03)	1.054** (0.024)	1.026 (0.023)	
African-American	0.722*** (0.017)	0.816*** (0.022)	0.824*** (0.021)	0.828*** (0.021)	0.838*** (0.021)	0.835*** (0.021)
Minority (Other)	0.692*** (0.018)	0.767*** (0.021)	0.775*** (0.021)	0.773*** (0.021)	0.772*** (0.021)	0.775*** (0.021)
White Collar	0.900*** (0.017)	0.897*** (0.020)	0.906*** (0.018)			0.904*** (0.018)
U.S. Navy	1.007 (0.025)					
Joint/NA Service	1.05 (0.052)					
U.S. Air Force	1.024 (0.030)					
Total Federal Work Years		0.788*** (0.03)	0.792*** (0.003)	0.791*** (0.003)	0.760*** (0.003)	0.760*** (0.003)
Total Federal Work Years Squared		1.006*** (0.000)	1.006*** (0.000)	1.006*** (0.000)	1.006*** (0.000)	1.006*** (0.000)
Age-at-Hire			0.912*** (0.006)	0.914*** (0.006)	0.931*** (0.006)	0.931*** (0.006)
Age-at-Hire Squared			1.001*** (0.000)	1.001*** (0.000)	1.001*** (0.000)	1.001*** (0.000)
Medical Officer				1.045 (0.048)	1.053 (0.048)	
Nurse				0.965 (0.024)	0.963 (0.024)	
Healthcare Professional (Other)				0.804*** (0.022)	0.802*** (0.022)	
Retirement Eligible					2.738*** (0.094)	2.742*** (0.094)
Constant	0.621*** (0.014)	3.374*** (0.122)	17.448*** (2.083)	17.431** (2.09)	24.385*** (2.935)	24.385*** (2.935)
Observations	50,946	50,946	50,946	50,946	50,946	50,946
Pseudo R2	0.0052	0.0604	0.0638	0.0645	0.0767	0.0767

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: All results displayed in odds ratio of average attrition likelihood, ceteris paribus, during the study period (2014-01-01 to 2018-09-31) compared to a male, Caucasian, or blue-collar or health technician worker. Service-affiliation odds ratio results are compared to the average odds of attrition likelihood of U.S. Army employees. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management. Professional healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables based on individual reported self-identified race. Total Federal Work Years, Total Federal Work Years Squared, Age-at-Hire and Age-at-Hire Squared are continuous variables that account for years an individual has invested in civil service and the age of the individual upon workforce entry and with linear and non-linear effects. Each model displays relatively similar covariate magnitudes, and covariate values do not change direction in attrition likelihood effects between different models. Service-affiliation indicators, nurse occupation, and medical occupation are not significant model contributors. The female indicator variable is no longer considered significant when retirement eligibility is added to the model and held constant. Pseudo R2 remain relatively consistent throughout the models. Observed odds ratio is not the center of the confidence interval in this regression analysis because of the asymmetric nature of the odds ratio scale. Standard error is the square root of the sum of the reciprocal of the frequencies for the variable outcome ratio.

Model 3, Table 3 add the effect of workforce entry age. Despite the addition of this variable, all other covariates remain relatively consistent in their value and constant in their direction of impact on attrition likelihood. The impact of an individual's age-at-hire produces lower odds of attrition on average for an individual in the 2014 Cohort until the approximate workforce entry age of 44 years or more; at 44 years or more, the attrition odds change direction in favor of attrition likelihood with each unit of increased entry age.

Model 4, Table 3 segregates occupational groups within the white-collar subpopulation to evaluate their individual impact on the odds of attrition likelihood. Non-occupation variable coefficient values remain constant in magnitude and direction of attrition odds in Model 4. In previous models, the impact of being white collar versus blue collar decreased the average odds of attrition likelihood. However, Model 4 results show only healthcare professionals (other) and nurses have lower odds of attrition likelihood. In fact, the impact of being a medical officer is not only found to increase the odds of attrition compared to being in the role of a technician or assistant type, but this impact does not meet a statistical significance standard to <10% level. The impact of being a nurse, is also found to not be statistically significant.

Model 5, Table 3 considers the status of retirement eligibility. Retirement eligibility is met for an observation if the individual is or becomes retirement eligible through FERS or social security benefit eligibility before the end of the study period. The results of Model 5, Table 3 report that, ceteris paribus, the odds of attrition during the study period for a retirement-eligible individual is twice that of a retirement ineligible worker. While the addition of this significant variable to the model has little impact overall on the remaining covariates' value magnitudes and directions within the model, some notable changes occur. Accounting for the effect of retirement eligibility on attrition shifts the values of sex and race in magnitude closer to the odds of one. Most prominent in the model results is the change in the directional effect of being female versus male on the average odds of attrition during the study period. The impact of being female is marginally shifted in value but becomes insignificant to statistical standard of <10% when controlling for retirement eligibility. This change implies the effects of tenure and retirement eligibility almost eliminates the difference in attrition behavior between sex subpopulations.

Model 6 considers removing all variables found to be statistically insignificant in the prior models. Excluding these variables has almost no impact on the value, magnitude, or direction of the remaining covariates and does little to change the predictive power of the model. For this analysis to develop a more complete population picture, it is reasonable to continue to include sex and occupation-specific demographics in the model, despite the statistically insignificant impact of these variables.

Across the whole data sample set, the population proportion of medical officers is a little over 5%. Additionally, over 77% of medical officers are also Caucasian and tend to enter the workforce at a later entry age. It is possible most the attrition effects related to being a medical officer are captured by other variables in the model that share similar characteristics. Nurses represent over 20% of the population, but they are also predominantly female. Furthermore, variations in nurse type are not made distinctive in the data set. This occupation variable could be insignificant to the model, because the impact of being a nurse is captured in the sex variable, or because too much variation in behavior exists within the nurse population subset.

However, no occupation within the white-collar category contains more inherent job-type variation than within the healthcare professional (other) category. Nevertheless, this variable is found to be significant at the <1% level with a marginally larger impact on attrition probability. Professionals who fall under this category are considered less critical and therefore are in less demand in the private market than nurses or doctors, which may contribute to the increased consistency in this population's attrition behavior despite the variation in their individual job roles.

Overall, Model 5, Table 3 provides the most complete information relevant to this study and is the best model fit. The general conclusions from Model 5 are that ceteris paribus, healthcare professionals (other) and those in minority-classified races, are the least likely to attrite compared to their counterfactuals. According to Model 5, those who have accrued more work years or enter the workforce at increasing ages have initially lower odds of attrition on average until achieving approximately 18 total federal work years or if 44 years old at the time of workforce entry. Lastly, according to Model 5, retirement eligible individuals have, on average, odds of attrition twice as large as those ineligible.

d. Robustness and Sensitivity Check

To ensure this thesis's analysis is robust across models in this functional form and to ensure any bias in the results is not due to the chosen cohort year group, Table 4 compares the chosen final model (Model 5, Table 3) with robust standard error estimations and also includes the results of the same models applied to the 2010 Cohort sample data. Furthermore, the purpose of sensitivity analysis validates these results may provide general insights for this workforce population across similar time periods, as well as the impact of external influences such as economics, policy, or organizational change on workforce turnover behavior. The 2018 Cohort is not included for sensitivity comparison, because data for a five-year outcome study observation period to assess attrition behavior does not exist for this cohort.

Table 4. (2014 Cohort) Odds Ratio Logistic Analysis of Workforce Attrition: Final Model Robustness and Data Sensitivity Comparison

VARIABLES	(1) (2014 Cohort) Final Model: *Occupation*	(2) (2010 Cohort) Final Model: *Occupation*	(3) (2014 Cohort) Final Model: *Occupation* *Robust SE*	(4) (2010 Cohort) Final Model: *Occupation* *Robust SE*
Age-at-Hire	0.931***	0.959***	0.932***	0.959***
	(0.006)	(0.006)	(0.006)	(0.006)
Age-at-Hire Squared	1.001***	1.000*	1.001***	1.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Total Federal Work Years	0.760***	0.645***	0.760***	0.645***
	(0.003)	(0.003)	(0.004)	(0.000)
Total Federal Work Years Squared	1.006***	1.009***	1.006***	1.009***
	(0.000)	(0.000)	(0.000)	(0.000)
Female	1.026	0.958*	1.026*	0.958*
	(0.023)	(0.021)	(0.023)	(0.021)
African-American	0.838***	0.796***	0.838***	0.796***
	(0.021)	(0.019)	(0.021)	(0.020)
Minority (Other)	0.772***	0.750***	0.772***	0.750***
	(0.021)	(0.020)	(0.021)	(0.020)
Medical Officer	1.053	1.078*	1.053	1.078*
	(0.048)	(0.049)	(0.049)	(0.050)
Nurse	0.963	0.961	0.963**	0.961
	(0.024)	(0.024)	(0.024)	(0.024)
Healthcare Professional (Other)	0.802***	0.748***	0.802***	0.748***
	(0.022)	(0.020)	(0.022)	(0.020)
Retirement Eligible	2.738***	3.159***	2.738***	3.159***
	(0.094)	(0.108)	(0.094)	(0.107)
Constant	24.385***	127.67***	23.786***	127.671***
	(2.935)	(15.442)	(2.960)	(15.306)
Observations	50,946	53,130	50,946	53,130
Pseudo R2	0.0767	0.1486	0.0775	0.1486

Standard errors (SE) in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: All results displayed in odds ratio of average attrition likelihood, ceteris paribus, compared to a male, Caucasian, or health technician or a clerical assistant-type worker. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables based on individual reported self-identified race. Total Federal Work Years, Total Federal Work Years Squared, Age-at-Hire and Age-at-Hire Squared are continuous variables that account for years an individual has invested in civil service and the age of the individual upon workforce entry and with linear and non-linear effects. Each model displays relatively similar covariate magnitudes and covariate values do not change direction in attrition likelihood effects between different models. The female indicator variable is not significant and changes direction from the 2014 Cohort sample to the 2010 Cohort. However, its odds value remains close to a 1:1 ratio compared to the male population. The impact of being a medical officer remains the same in magnitude but also becomes significant to the model in the 2010 Cohort sample. Pseudo R2 is larger in the 2010 Cohort sample analysis; this could be due to the larger sample size. Observed odds ratio is not the center of the confidence interval in this regression analysis because of the asymmetric nature of the odds ratio scale. Standard error is the square root of the sum of the reciprocal of the frequencies for the variable outcome ratio.

For both the 2010 Cohort and 2014 Cohort, the logistic regression odds ratio analysis with the robust standard errors results prove to be almost identical in variable coefficient value, magnitude, direction, and predictive power. Overall, model result comparisons between the 2014 Cohort study sample and the 2010 Cohort study sample are mostly similar with a few conspicuous differences. Ceteris paribus, the effect of age-at-hire remains similar among the models, but the magnitude of total federal work years on the odds of attrition is decreased compared to the 2014 Cohort model outcomes. Additionally, while the impact of retirement eligibility status increases the odds of attrition in the 2010 Cohort sample.

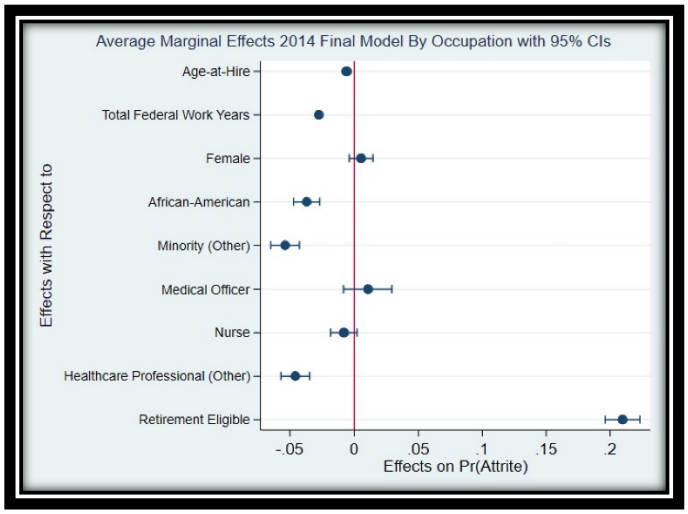
While increasing work years is usually associated with being or approaching retirement eligibility, these contradictory outcomes of magnitude may be related to the economic recession experienced during the 2010 Cohort study period. Consequences of related federal budget crises in the form of continuing resolutions, hiring freezes, and the reoccurrence of mandatory furlough for federal workers may have incentivized retirement-eligible workers to attrite due to organizational climate changes. In contrast, Models 2 and 4, Table 4 also indicate that compared to the 2014 Cohort, the 2010 Cohort remained less likely to attrite for two more additional tenure years before the effect of added work years begins to increase the odds of attrition. This finding may be attributed to a looser private labor market during the recession that may have incentivized some workers to remain in the workforce an extra year than they normally would.

Additionally, for the 2010 Cohort, the significance and direction of attrition odds for the female variable are changed, while the effect in magnitude remains close to the odds of one. For medical officers in the 2010 Cohort, the effect becomes significant at the <10% level, but the value and direction do not change. Also of note—but not largely varied—is the impact of being a healthcare professional (other) or a minority group on attrition behavior for the 2010 Cohort sample compared to the 2014 Cohort sample. The comparative results indicate that in these demographic groups, the average odds of attrition are even more decreased in the 2010 versus 2014 Cohort. This difference is relatively minimal but may also be largely due to the economic recession and private labor market

changes that occurred during the 2010 Cohort study period, which is then captured in the differences between these model results.

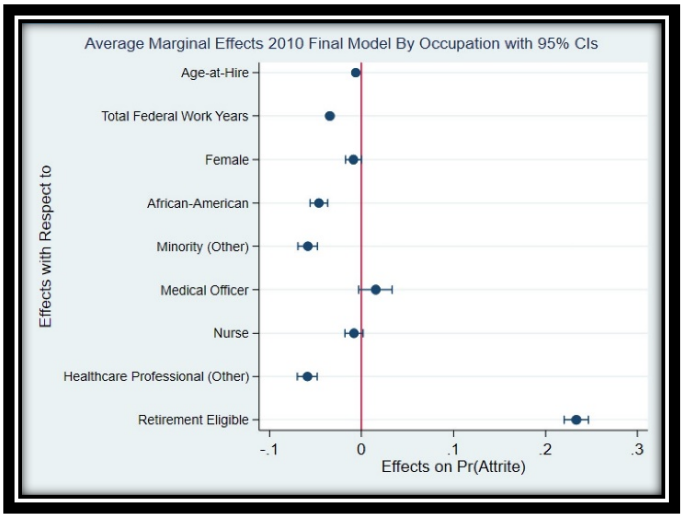
2. Marginal Effects

The difference in covariate impacts in terms of magnitude and direction of Models 3 and 4, Table 4 are more easily viewed and assessed through the graphs of average marginal effects in Figures 37 and 38. The marginal effects graphs facilitate simple model outcome comparisons between different cohort years. Figures 37 and 38 plot points are similar enough that it is reasonable to assume that Model 5, Table 3 is the best model fit for the data available for this study.



Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all odds ratio marginal effects comparisons. This graph is a visual marking of the direction and magnitude of impact on the probability an individual with that characteristic, ceteris paribus, during the study period.

Figure 37. (2014 Cohort) Final Model Average Marginal Effects



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation as the basis of all marginal effect comparisons. This graph is a visual marking of the direction and magnitude of impact on the probability of an individual with that characteristic, ceteris paribus, during the study period.

Figure 38. (2014 Cohort) Final Model Average Marginal Effects

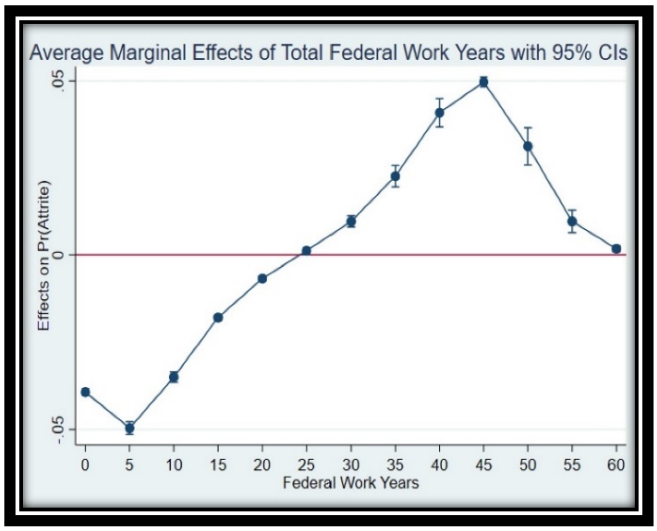
a. Marginal Effects of Each Federal Work Year

The results of the 2014 Cohort Final Model with robust standard error estimations are displayed in Tables 3 and 4. The results present the overall average, non-linear impact of increasing federal work years on attrition during the study period. However, Figure 39 depicts the marginal effect of each federal work year from one year to the next on the probability an individual will attrite. The Figure 39 graph illustrates that not only are individuals less likely to attrite in the first years of federal work compared to a baseline probability but also the probability of attrition initially decreases linearly but then adjusts to an increased probability toward zero from one work year to the next until an individual achieves approximately 25 federal work years. At approximately 25 work years, this linear relationship crosses zero toward an increased probability of attrition until approximately 45 federal work years.

This finding is consistent with logic and the descriptive analysis results in that, for every year worked at an organization, the attrition likelihood decreases for each following year. While attrition exists at peak rates during the early years of employment and again when retirement eligibility criteria is met, every year an individual invests in an

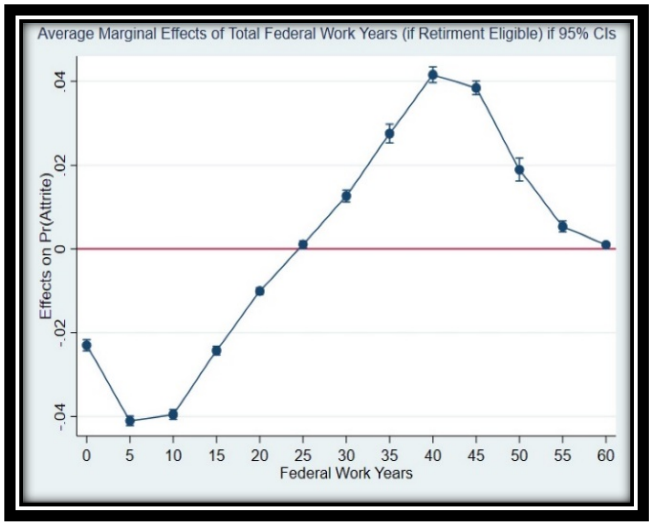
organization will increase the cost of leaving that organization and, therefore, leads to a smaller probability of attrition. If an outside opportunity cannot exceed the value of the time invested at the current organization, the incentive to attrite is diminished. When retirement eligibility is met, the cost of an attrition decision is less than it was prior to eligibility status.

When only the retirement eligible population is considered, the average marginal effect of each federal work year on attrition probability produces a similar pattern of as depicted in the Figure 39 graph but more tightly fitted around zero. This finding indicates the magnitude of the marginal effects of each work year are decreased if an individual is retirement eligible.



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 39. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also retirement eligible, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

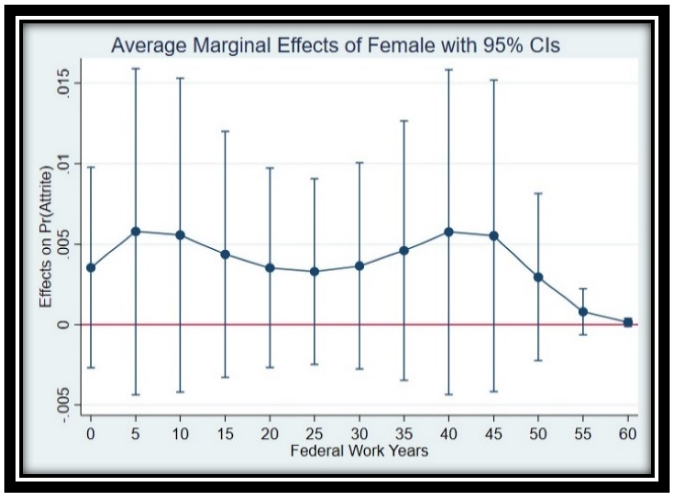
Figure 40. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if Retirement Eligible

b. Marginal Effects of Each Federal Work Year by Sex

According to Figure 41, the average marginal effect of being female on the likelihood an individual will attrite during the study period remains at a greater attrition likelihood over the course of an individual's career. Year to year, females are at greatest attrition risk compared to males, ceteris paribus, before they have achieved 15 work years and again after approximately 35 work years. This finding may indicate that during early work years or possibly during what is traditionally considered female childbearing years or family life-event years, females attrite at a comparatively higher rate than men. However, this effect plateaus over time until retirement eligibility; despite this difference between the sex populations, the magnitude of the increased likelihood is incredibly low at approximately a 0.005 variance in probability at its peak differential level.

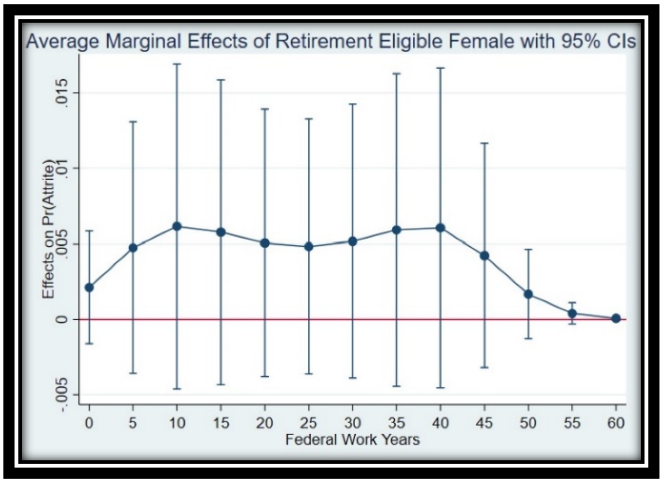
Figure 42 depicts the average marginal effects of being both female and retirement eligible throughout a career lifetime. The pattern and magnitude are similar to the average marginal effect graph of Figure 41, except for a shallower plateau among the attrition peaks. This finding is to be expected, because all individuals in this population are

retirement eligible and thus would not display a vastly different attrition behavior during the middle-career years.



Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also female, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 41. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if Female



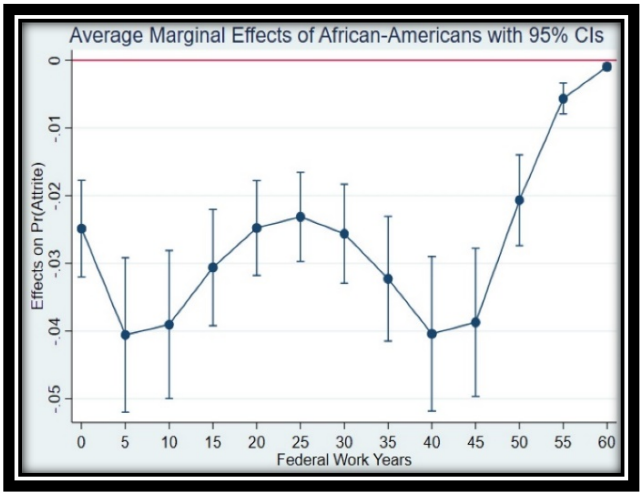
Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also female and retirement eligible, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 42. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if Female and Retirement Eligible

c. Marginal Effects of Each Federal Work Year by Race

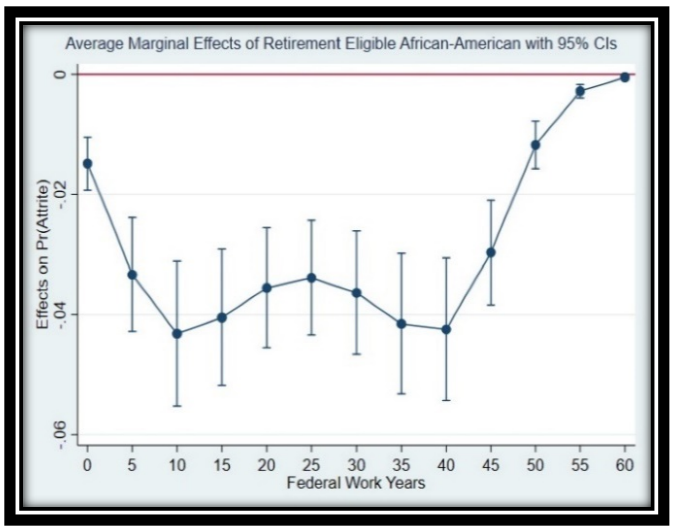
Figure 43 depicts the marginal effects of being African-American during federal work years, ceteris paribus, compared to the Caucasian subpopulation. Overall, the African-American population is at a lower risk for attrition compared to the Caucasian population. However, the likelihood of attrition is highest during the following federal work years: less than five work years, 15–35 work years, and then again at 45 work years. These values reflect the initial sorting process during early work years. The increase in attrition vulnerability during work years 15–35 may be a result of individuals meeting retirement-eligibility criteria retirement if the individual entered the civil service workforce at a higher-than-average age or for the purpose of pursuing a second retirement-earning career.

According to Figure 44, retirement eligible African-Americans follow the same work-year-to-work-year attrition pattern as the general African-American subpopulation but with a magnitude effect closer to zero and a shallower peak at approximately 15–35 work years compared to Figure 43.



Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also African-American, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 43. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if African-American



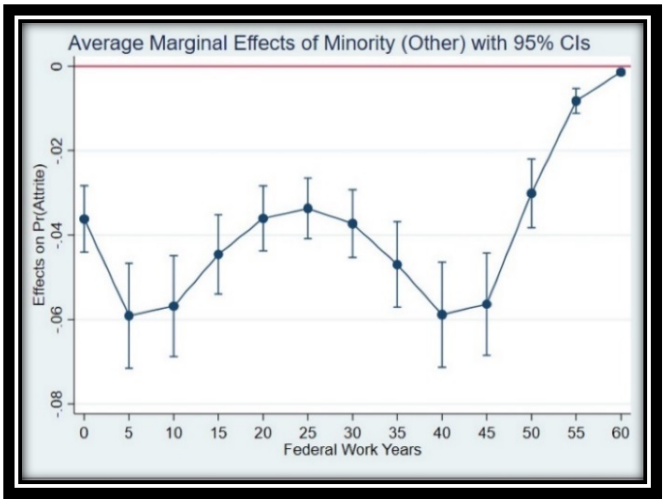
Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also African-American and retirement eligible, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 44. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if African-American and Retirement Eligible

The fact attrition likelihood continues to decrease in the early career stages (up to 10 work years) for the African-American subpopulation whether they are retirement eligible or ineligible may point to signs of propensity for civil service within this specific population or, alternatively, a deliberate choice to work and remain in federal service. This notion is evidenced by a decreased average attrition rate compared to the Caucasian population during what is traditionally a job-sorting period.

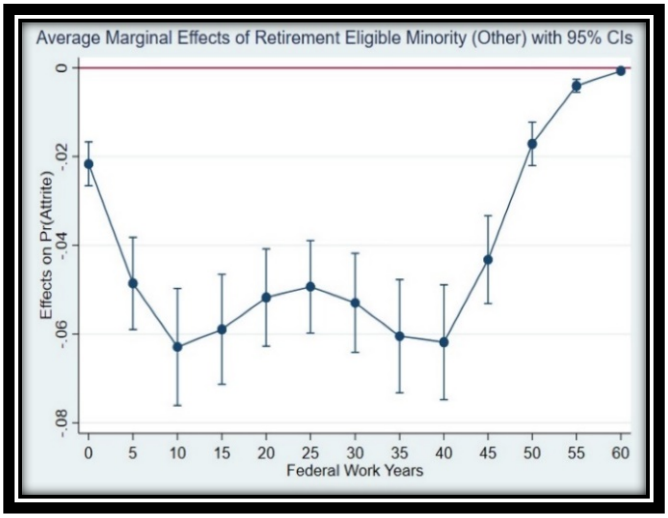
According to Figure 45, results of the average marginal effects on attrition during the career lifespan of the minority (other) population mirror the results of the African-American population in Figure 43 but with greater magnitude.

The results of the average marginal effects on attrition during the career lifespan of the retirement-eligible minority (other) population shown in Figure 46 mirror the results of the African-American retirement-eligible population in Figure 44 but with greater magnitude. It is reasonable to conclude both minority groups are less likely than individuals in the Caucasian population, ceteris paribus, to attrite federal work year to work year throughout their career.



Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also a minority (other), ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 45. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if Minority (Other)



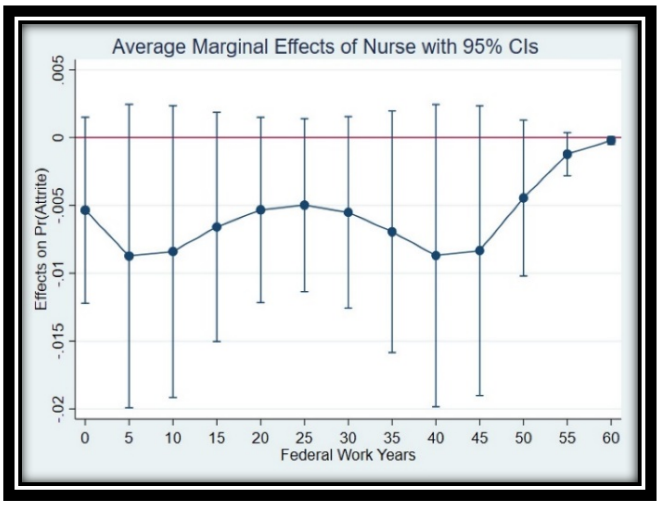
Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also a minority (other) and retirement eligible, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 46. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if Minority (Other) and Retirement Eligible

d. Marginal Effects of Each Federal Work Year by Occupation

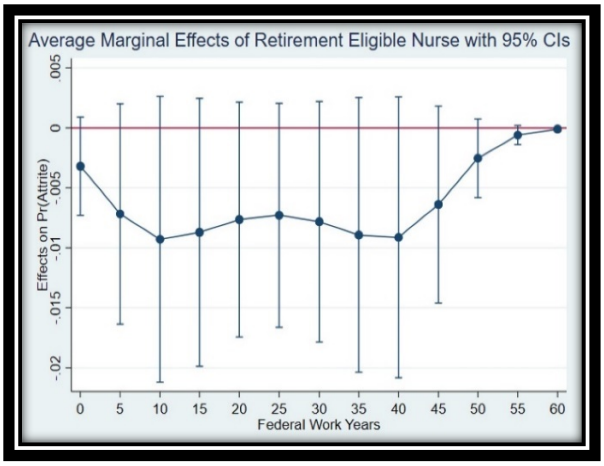
Figure 47 depicts the average marginal effect of being a nurse on the likelihood an individual will attrite work year to work year. During the career lifespan, being a nurse is associated with a decreased likelihood of attrition compared to a health technician or clerical assistive-type healthcare worker. The career work years when nurses are marginally most vulnerable to attrition are 15–35. The graph depicts the measured magnitude of the marginal effect as an extremely minor difference from the baseline average. This graph indicates a substantial difference in attrition rates does not likely exist overall in the nurse population work year to work year compared to those in blue-collar type positions.

For the 2014 Cohort retirement-eligible nurses, the pattern of attrition likelihood work year to work year in Figure 48 mirrors the results of the total nurse population in both pattern and magnitude as depicted in Figure 47.



Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also a nurse, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 47. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if Nurse



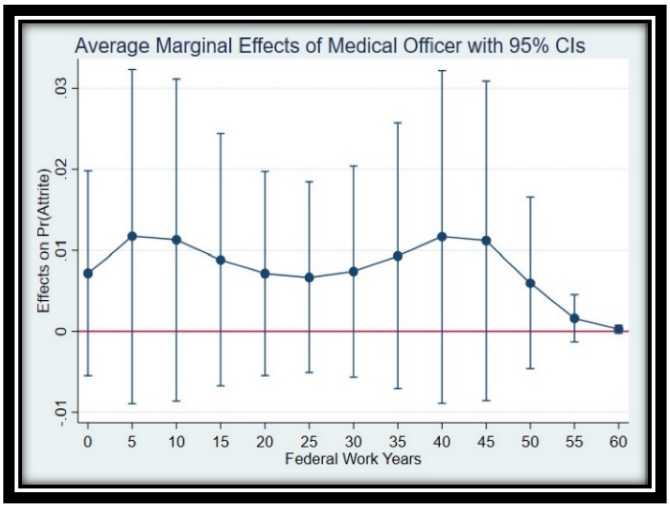
Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also a nurse and retirement eligible, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 48. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if Nurse and Retirement Eligible

Figure 49 depicts the average marginal effect of being a medical officer on the likelihood an individual will attrite work year to work year. During the career lifespan, being a medical officer is associated with an increased likelihood of attrition compared to a health technician or clerical assistant worker. The work years when medical officers are marginally the most vulnerable to attrition are 0–15 and 35–45. The Figure 49 graph depicts the small magnitude of the marginal effects. Despite minor marginal effects, the results imply that medical officers in the early stages of their career may be more sensitive to the job-sorting process or firm-poaching practices compared to other occupations. Another explanation could be medical officers enter the public sector as a second career and, in their later years of age, may only intend to remain in the workforce until minimal retirement criteria is met, as depicted in the Figure 49 graph.

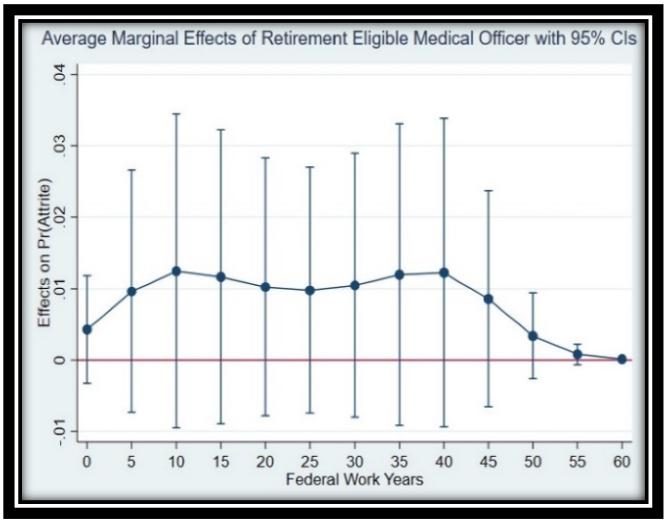
Figure 50 shows that for the 2014 Cohort retirement-eligible medical officers, the pattern of attrition likelihood work year to work mirrors the results of the total medical officer population in both pattern and magnitude. However, the increase in attrition likelihood yields a longer positive linear relationship between 0–10 work years. This finding is consistent with the explanation that medical officers may seek civil service

employment during a more advanced career and/or biological age and, subsequently, depart when they achieve minimum retirement-eligibility requirement.



Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also a medical officer, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

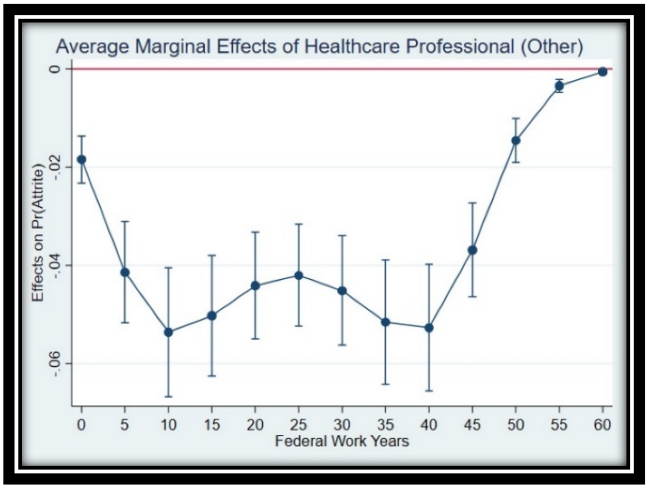
Figure 49. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if Medical Officer



Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also a medical officer and retirement eligible, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 50. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if Medical Officer and Retirement Eligible

Figure 51 displays a similar graphical pattern to the graphs in Figures 43 and 45. The average marginal effect on attrition during a career lifespan for healthcare professionals (other) for the 2014 Cohort mimic the attrition probability pattern during a career lifespan found in the minority groups. However, in the case of healthcare professionals (other), the magnitude of the marginal effects is one of the largest depicted in the marginal effects section. While those who are considered healthcare professionals (other) experience a decreased likelihood of attrition during their career, the 10- and 40-work-year periods mark the least attrition vulnerable career points for this community.



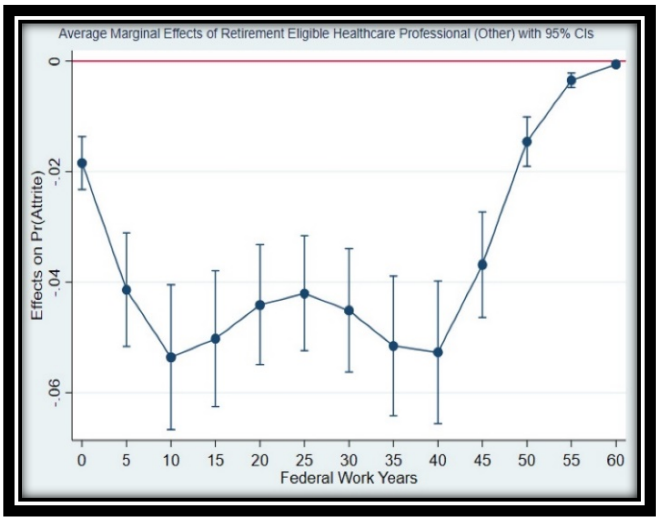
Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also a healthcare professional (other), ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 51. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if Healthcare Professional (Other)

The likelihood of attrition for this community needs to be interpreted against the attrition likelihood for the healthcare technician and clerical assistant populations. Both occupation groups tend to not be as susceptible to worker poaching or private sector demand when compared to the medical officer and nurse occupations. Also, while technicians may be involved in some shift rotation work, this occupation, like healthcare professionals (other), are primarily employed during more traditional work hours. However, despite the similarities between these two occupation groups, healthcare

professions (other) maintain a decreased likelihood of attrition year to year throughout their career lifespan. The most reasonable explanation is the healthcare professional (other) population may be more sensitive to the intrinsic rewards offered in the public sector or has an increased propensity to join and remain in the civil service work environment.

For the 2014 Cohort, Figure 52 depicts the average marginal effects on attrition for retirement-eligible healthcare professionals (other) work year to work year. The graph pattern in Figure 52 is almost indistinguishable in both pattern and magnitude to the results of Figure 51.



Note: Red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal working year to the next if an individual is also a healthcare professional (other) and retirement eligible, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 3, Table 4.

Figure 52. (2014 Cohort) Final Model Average Marginal Effect of Each Federal Work Year if Healthcare Professional (Other) and Retirement Eligible

The 2014 Cohort Final Model with robust standard error estimations as depicted in Model 2, Table 4 and the individual marginal effects of each work year is graphed in Figures 39–52 indicate that work-year effects on an individual's likelihood to attrite is nonlinear and changes throughout time. The marginal effects of each demographic group compared to its counterfactual throughout the career lifespan show a change in magnitude of attrition likelihood but not in direction. Therefore, the impact of an individual's sex,

race, or occupation on attrition behavior remains relatively constant during a career lifetime and in contrast, the impact of total federal work years and an individual's age is more specific to its changing quantity year to year over a career lifespan.

C. LOGISITIC REGRESSION ANALYSIS WITH IPC

The second logistic regression odds ratio analysis aims to control for regional or external economic factors that may impact an individual's attrition decision. This study utilized duty location zip codes for 33 of the largest Military Treatment Facility (MTF) community hospitals and medical centers that were identifiable in the data and merged the associated county average IPC data information with the 2014 Cohort sample data. The U.S. Census official website reports county IPC values in 2018 dollars with their value quantity represented by the average IPC value between 2014 and 2018. Due to the limitations in matching MTF's with county IPC for every observation, the result is a 2014 Cohort sample population that is approximately half of the observations used for prior analyses. To ensure no gross bias exists within the remaining 2014 Cohort with IPC effects sample, Table 5 displays general descriptive demographic percentages for both the complete and IPC-limited 2014 Cohort study sample populations.

1. 2014 Cohort IPC Data Population Comparison

According to Table 5, the demographic proportions within the limited sample for analysis with IPC effects is within one to three percentage points of the complete 2014 Cohort. While this eliminates some sample selection bias, the observations are included in the IPC study sample because of their associated employment at larger healthcare facilities. Therefore, sample selection bias exists and inhibits the generalization of results interpretation across the entire 2014 Cohort population.

Table 5. (2014 Cohort) Percent Demographics Comparison with IPC

2014 Cohort Population Percent Demographics Versus 2014 Cohort Income Per Capital Limited Data Subpopulation Percent Demographics			
Category	**Variable**	**2014 Cohort Income Per Capita Limited Data Population: N=27,514**	**2014 Cohort Population: N= 50,946**
ATTRITION & RETIREMENT ELIGIBILITY	Total Attrition	35.39%	36.35%
	Retirement Eligible	33.71%	31.92%
OCCUPATION	Healthcare Tech or Clerical Assistant	53.55%	54.52%
	Healthcare Professional (Other)	16.43%	17.52%
	Nurse	24.99%	22.74%
	Medical Officer	5.03%	5.22%
COLLAR	White Collar	46.45%	45.48%
	Blue Collar	53.55%	54.52%
RACE	Caucasian	60.67%	62.71%
	African-American	23.43%	21.01%
	Minority (Other)	15.90%	16.28%
SEX	Male	29.01%	29.24%
	Female	70.99%	70.76%

Notes: Limited population is due to limited association of individual observation's most recent duty zip code with a large hospital or medical centers. Income per capita (IPC) is associated with the hospital or medical center's county-reported average IPC from 2014–2018 in 2018-dollar value. Categories reflect percentage of the 2014 Cohort population type specified. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race.

2. IPC Working Models

The logistic regression odds ratio models will explore the impact of region and IPC effects. To include region effects, this study generates region indicator variables. This thesis generalizes regions broadly, assigning MTFs to three available regions: U.S. east, U.S. west, and U.S. middle region. This middle region is used as the base comparison population for the IPC models. The IPC variable is a continuous variable to be interpreted

in $1,000 units. All other elements of the model with IPC effects are based off the inputs of the 2014 Cohort Final Model.

a. IPC and Region Variables

The results of the first logistic regression odds ratio model are displayed as Model 1, Table 6. Compared to the original 2014 Cohort Final Model, the independent variable results of the first IPC effects model remained relatively similar in statistical significance, direction, and magnitude, except for the sex covariate. The impact of being female is significant in this model at the <1% level. Furthermore, in Table 6, females in this model have greater average attrition odds compared to men when controlling for IPC effects. This finding suggests the female workforce subpopulation may be more sensitive to IPC effects than the male population. The Model 1 results also indicate the insignificance of region factors to the model; it is likely these regional groupings are too generalized and contain too much outcome variation within their categories. Also, the components that are significant about the regions may be more accurately captured in controlling for IPC effects, which are based on MTF location-specific data. The IPC variable in Model 1 is found to be significant at the <1% level and suggests that MTFs located in a high value IPC region may be more vulnerable to increased staff turnover, ceteris paribus.

Table 6. (2014 Cohort) Odds Ratio Logistic Analysis Base Model Comparisons with Income per Capita

VARIABLES	(1) (2014 Cohort) Base Model *with IPC & Region*	(2) (2014 Cohort) Base Model *with IPC Only*
Age-at-Hire	0.927***	0.927***
	(0.008)	(0.008)
Age-at-Hire	1.001***	1.001***
	(0.000)	(0.000)
Total Federal Work Years	0.760***	0.760***
	(0.005)	(0.005)
Total Federal Work Years Squared	1.006***	1.006***
	(0.000)	(0.000)
Female	1.107***	1.106***
	(0.034)	(0.034)
African-American	0.876***	0.868***
	(0.030)	(0.029)
Minority (Other)	0.773***	0.772***
	(0.030)	(0.030)
Medical Officer	1.098	1.096
	(0.070)	(0.069)
Nurse	0.925**	0.926**
	(0.031)	(0.031)
Healthcare Professional (Other)	0.779***	0.777***
	(0.030)	(0.030)
Retirement Eligible	2.726***	2.727***
	(0.128)	(0.128)
IPC in $1000's	1.021***	1.021***
	(0.002)	(0.002)
East	0.991	
	(0.028)	
West	1.070	
	(0.042)	
Constant	12.722***	12.877***
	(2.238)	(2.264)
Observations	27,514	27,514
Pseudo R2	0.0760	0.0761

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Income per capita (IPC) is associated with the hospital or medical center's county-reported average IPC from 2014–2018 in 2018-dollar value. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race. All results displayed in odds ratio of average attrition likelihood, ceteris paribus, during the study period (2014-01-01 to 2018-09-31) compared to a male, Caucasian, or blue-collar or health technician worker. Region-related covariate odds ratio results are compared to the average odds of attrition likelihood of an employee located in the middle region of the U.S. Total Federal Work Years, Total Federal Work Years Squared, Age-at-Hire and Age-at-Hire Squared are continuous variables that account for years an individual has invested in civil service and the age of the individual upon workforce entry and with linear and non-linear effects. Each model displays relatively similar covariate magnitudes, and covariate values do not change direction in attrition likelihood effects between different models. Region variables are not significant model contributors. Pseudo R2 remains consistent between the models. Observed odds ratio is not the center of the confidence interval in this regression analysis because of the asymmetric nature of the odds ratio scale. Standard error is the square root of the sum of the reciprocal of the frequencies for the variable outcome ratio.

Model 2, Table 6 eliminates the insignificant region variables. With the removal of the insignificant region variables, the remaining model coefficient values are almost identical in magnitude, significance, and the direction of each's effect on attrition odds. Model 2 is the best fit model for the 2014 Cohort logistic regression analysis with IPC effects.

b. Final IPC Model Robustness Check and Sensitivity Analysis

To ensure this thesis's analysis is robust across this functional form and further bias in results is not due to the chosen cohort year group, Table 7 compares the chosen final model with IPC effects (Model 2, Table 6) with robust standard error estimations and then compares the results of the same models applied to the 2010 Cohort sample. A limitation of utilizing the 2010 Cohort logistic regression outcome results for model sensitivity comparison is the IPC values in the data are derived from the 2014–2018 county-average IPC values. The difference between these time periods is only five years, but this difference could impact the model results if the IPC values did not remain consistent throughout time.

Model 1, Table 7 displays the best IPC model fit, Model 3 displays the model results with robust standard error estimations, and Models 2 and 4 display the results of the same model using 2010 Cohort sample data with and without robust standard error estimations. Across all four models, work years, age-at-hire, race factors, retirement eligibility status, IPC effects, and being a healthcare professional (other) or a nurse are found to be significant at <5% level. Being a medical officer is found to be significant at <10% level in the 2010 Cohort models only. Being female compared to male is found to be significant at the <1% level in 2014 Cohort models but contradictorily fails to meet the level of the significance standards at the <10% level in the 2010 Cohort models.

Table 7. (2014 Cohort) and (2010 Cohort) Odds Ratio Logistic Analysis Final Models with Income per Capita Robustness and Data Sensitivity Comparison

VARIABLES	(1) (2014 Cohort) Final Model: *with Income per Capita (IPC)*	(2) (2010 Cohort) Final Model: *with Income per Capita (IPC)*	(3) (2014 Cohort) Final Model: *with Income per Capita (IPC) Robust SE*	(4) (2010 Cohort) Final Model: *with Income per Capita (IPC) Robust SE*
Age-at-Hire	0.927***	0.960***	0.927***	0.960***
	(0.008)	(0.008)	(0.008)	(0.008)
Age-at-Hire Squared	1.001***	1.000	1.001***	1.000
	(0.000)	(0.000)	(0.000)	(0.000)
Total Federal Work Years	0.760***	0.648***	0.760***	0.648***
	(0.005)	(0.005)	(0.005)	(0.005)
Total Federal Work Years Squared	1.006***	1.009***	1.006***	1.009***
	(0.000)	(0.000)	(0.000)	(0.000)
Female	1.106***	1.032	1.106***	1.032
	(0.034)	(0.031)	(0.034)	(0.031)
African-American	0.868***	0.810***	0.868***	0.810***
	(0.029)	(0.026)	(0.029)	(0.026)
Minority (Other)	0.772***	0.769***	0.772***	0.769***
	(0.030)	(0.028)	(0.030)	(0.029)
Medical Officer	1.096	1.117*	1.096	1.117*
	(0.069)	(0.071)	(0.070)	(0.072)
Nurse	0.926**	0.927**	0.926**	0.927**
	(0.031)	(0.031)	(0.030)	(0.030)
Healthcare Professional (Other)	0.777***	0.713***	0.777***	0.713***
	(0.030)	(0.027)	(0.030)	(0.027)
Retirement Eligible	2.727***	3.317***	2.727***	3.317***
	(0.128)	(0.154)	(0.125)	(0.152)
IPC in $1000's	1.021***	1.022***	1.021***	1.022***
	(0.002)	(0.002)	(0.002)	(0.002)
Constant	12.877***	60.215***	12.877***	60.215***
	(2.264)	(10.358)	(2.308)	(10.233)
Observations	27,514	28,639	27,514	28,639
Pseudo R2	0.0761	0.1441	0.0760	0.1441

Standard errors (SE) in parentheses
*** p<0.01, ** p<0.05, * p<0.1

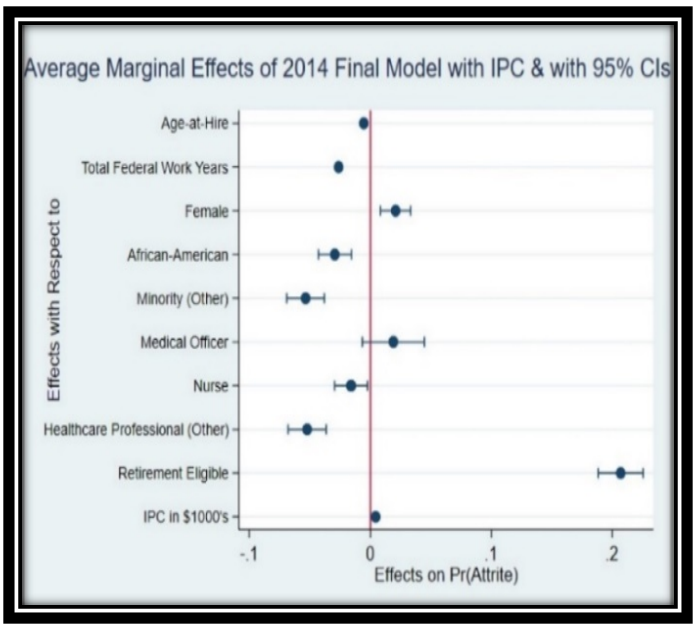
Note: Income per capita (IPC) is associated with the hospital or medical center's county-reported average IPC from 2014–2018 in 2018-dollar value. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race. All results displayed in odds ratio of average attrition likelihood, ceteris paribus, during the study period compared to a male, Caucasian, or blue-collar or health technician worker. Total Federal Work Years, Total Federal Work Years Squared, Age-at-Hire and Age-at-Hire Squared are continuous variables that account for years an individual has invested in civil service and the age of the individual upon workforce entry and with linear and non-linear effects. Each model displays relatively similar covariate magnitudes and covariate values do not change direction in attrition likelihood effect between different models. However, the female indicator variable is not significant in the 2010 Cohort models, but its odds value remains close to a 1:1 ratio compared to the male population. The impact of being a medical officer remains the same in magnitude but becomes significant to the 2010 Cohort model but is not significant in the 2014 Cohort model. Pseudo R2 is larger in the 2010 Cohort sample analysis; this could be due to the larger sample size. Observed odds ratio is not the center of the confidence interval in this regression analysis because of the asymmetric nature of the odds ratio scale. Standard error is the square root of the sum of the reciprocal of the frequencies for the variable outcome ratio.

The results of Table 7 display consistent independent variable values in magnitude and direction across all models. Some larger changes of interest are the effect of being female on attrition odds, which decrease in magnitude in the 2010 Cohort models, while the effect of being a medical officer on attrition odds is increased in the 2010 Cohort models. These magnitude changes are not large, and one explanation for these changes could be medical officers during the economic recession were more likely to attrite in response to higher salaries offered in the private market. In contrast, females during the end of economic recession in the 2014 Cohort study years may have felt freer to switch jobs, occupations, or depart the workforce due to family life events.

Lastly, in the 2014 Cohort models, the effect of retirement eligibility results in an individual being over twice as likely to attrite. In the 2010 models, the effect of retirement eligibility on attrition increases to over three time more likely to attrite. While this difference is not large, it may be explained by the idea that retirement-eligible individuals may have been more vulnerable to attrition during the economic recession because of federal workforce organizational climate and system changes that occurred simultaneously.

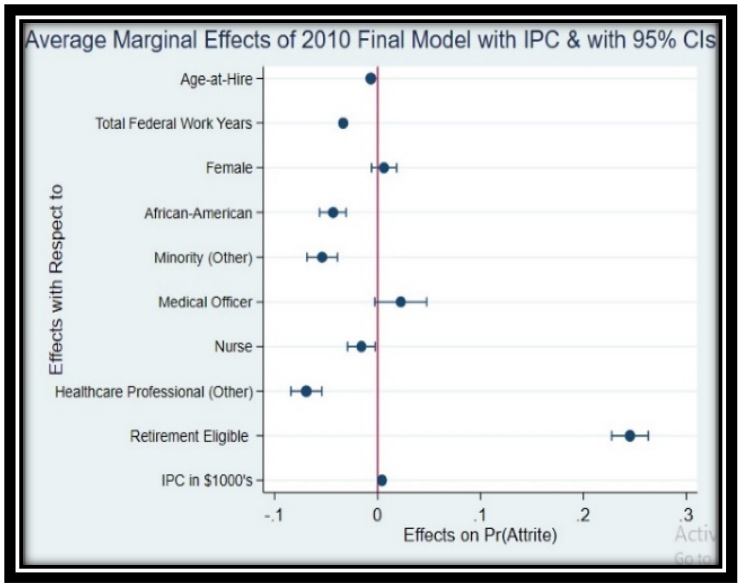
c. Marginal Effects

The differences in covariate impacts in terms of magnitude and direction in the Table 7 models are more easily viewed and assessed through the graphs of average marginal effects in Figures 53 and 54. The visual markings of each variable's coefficient illustrates the model results and facilitates simple model outcome comparisons between different cohort years. It is reasonable to assume Model 3, Table 7 is the best model fit for the data. Furthermore, the sensitivity analysis validates that these results may provide general insights for this workforce population across similar time periods. Additionally, the results also illustrate the impact of external influences, such as economics, policy, or organizational changes on workforce behavior in a short period of time.



Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the probability an individual with that characteristic, ceteris paribus, during the study period.

Figure 53. (2014 Cohort) Final Model with IPC Effects Average Marginal Effects

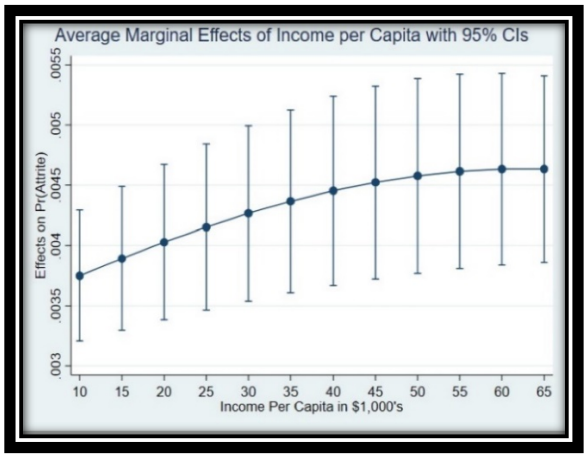


Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the probability an individual with that characteristic, ceteris paribus, during the study period.

Figure 54. (2010 Cohort) Final Model with IPC Effects Average Marginal Effects

d. Marginal Effect of Each $1,000 Increase in IPC

The results of the 2014 Cohort Final Model with IPC and robust standard error estimations displayed in Table 7 present the overall average impact of IPC per $1,000 value on the odds of an individual attrition outcome during the study period, ceteris paribus. Figure 55 depicts the effect of each $1,000 increase from the last $1,000 IPC value amount on the likelihood an attrition event will occur during the study period. The graph shows that local county IPC values contribute to worker attrition risk at all value sets. However, the largest effects on attrition occurs during the incremental increases between the IPC amounts of $10,000 and $40,000. After the $40,000 threshold, the magnitude of the marginal effect of each IPC value increase is minimized.



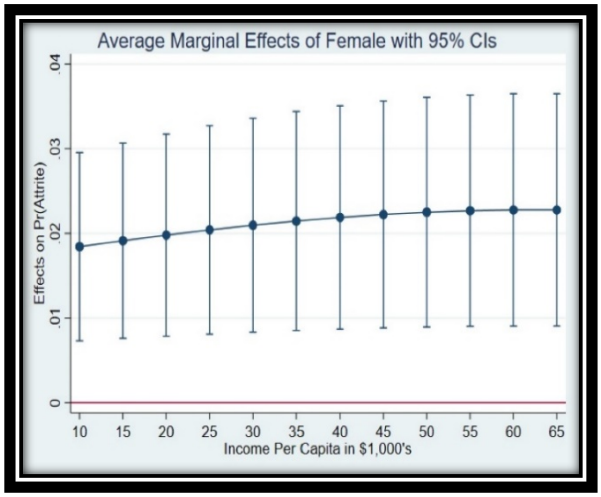
Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood an individual in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

Figure 55. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 increase

e. Marginal Effect of Each $1,000 Increase in IPC if Female

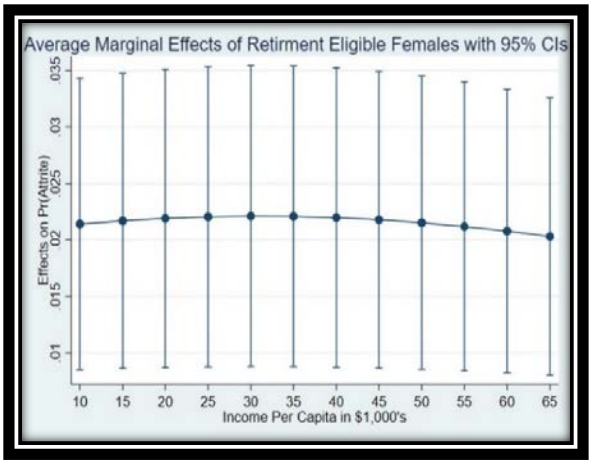
Figure 56 illustrates the marginal effects on attrition of each IPC $1,000 increase for the female population compared to the male population, while Figure 57 illustrates the effect for retirement-eligible females only. The graph in Figure 56 shows the female population is vulnerable to IPC effects as each $1,000 amount increases; however, the

positive linear curve is relatively shallow, which indicates the sensitivity to IPC changes is not substantial. In the retirement eligible population, the female population is less sensitive in their attrition response to IPC changes. Figure 57 also shows the female retirement-eligible community is slightly less likely to attrite with IPC increases greater than $35,000. This inverse response to increased IPC is likely due to cost-of-living standards that may be associated with higher IPC counties. An individual approaching retirement may be more sensitive to cost-of-living factors associated with a high IPC value. In contrast, a working individual may be more sensitive to competitive pay choices in the private labor market that are also associated with high IPC values.



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood a female in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

Figure 56. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if Female



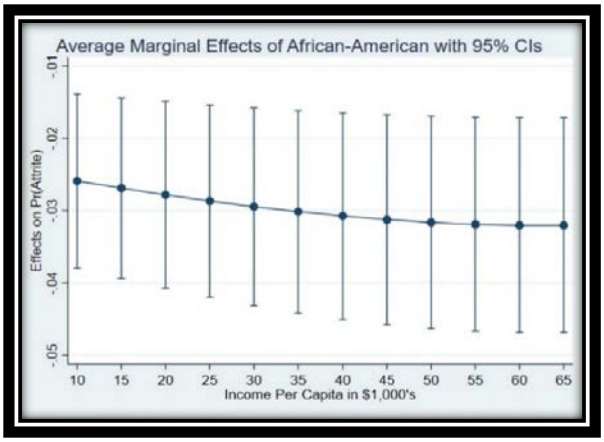
Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood a retirement eligible female in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

Figure 57. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if Female and Retirement Eligible

f. Marginal Effect of Each $1000 Increase in IPC If Race Population

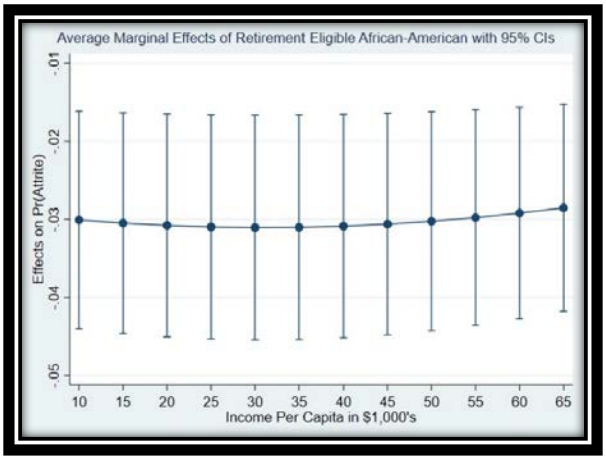
Figures 58 and 59 illustrate the effect of each $1,000 IPC increase on the attrition likelihood behavior of the African-American population during the study period. The graph in Figure 58 is consistent with descriptive and logistic model results that indicate the African-American population is less likely to attrite, but even more interesting is that with each incremental IPC increase this group is even more unlikely to attrite.

This finding suggests the African-American population, in the face of a high-cost living environment, are either not offered competitive pay jobs in the private labor market or avoid the risk of seeking outside competitive pay in lieu of the stability of civil service work when compared to the Caucasian population. For retirement-eligible individuals, Figure 59 depicts a less sensitive response to IPC value increases for all IPC values in the retirement eligible African-American population. Although, at an IPC value of $40,000 or more, a slight increase in attrition risk exists. For retirement-eligible individuals still able to work, the safety net of a federal pension may persuade these individuals to seek competitive pay elsewhere when having met FERS criteria.



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood an African-American in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

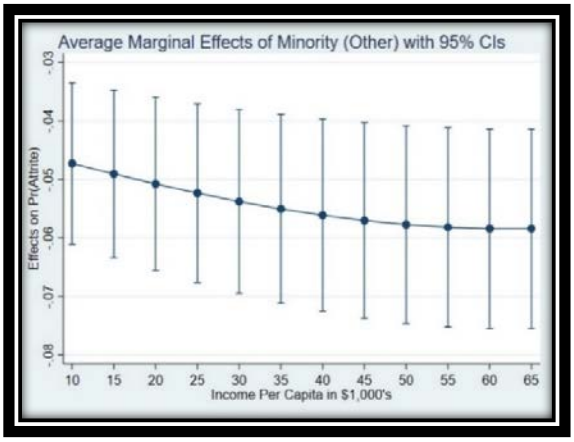
Figure 58. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if African-American



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood a retirement eligible African-American in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

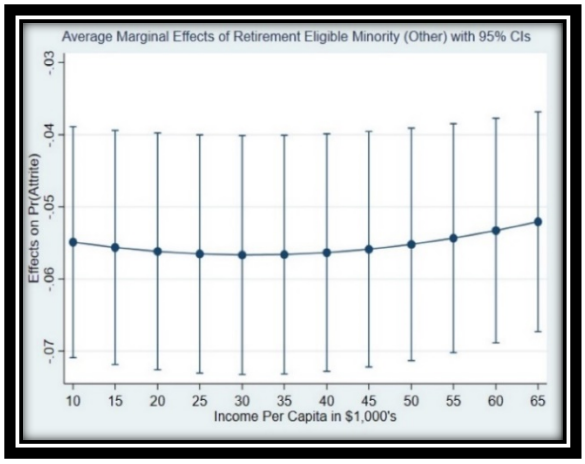
Figure 59. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if African-American and Retirement Eligible

Figures 60 and 61 illustrate the effect of each $1,000 IPC increase on the attrition likelihood behavior of the minority (other) population during the study period. The graphs in these figures are almost identical to the graph patterns found in the African-American population results in Figures 58 and 59. The difference in the minority (other) population results is that the marginal effect of attrition likelihood is of greater magnitude. It is reasonable to conclude both minority group populations are less likely than individuals in the Caucasian population, ceteris paribus, to attrite on average and have an inverse sensitivity response to increasing IPC values.



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood an individual in the minority (other) race category in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

Figure 60. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if Minority (Other)

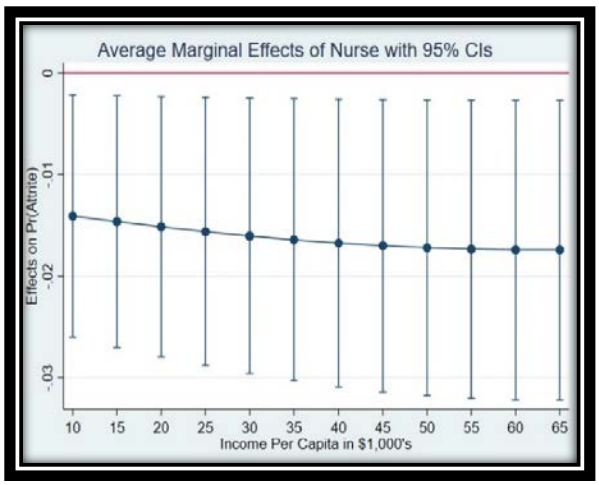


Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood a retirement eligible individual in the minority (other) race category in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

Figure 61. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if Minority (Other) and Retirement Eligible

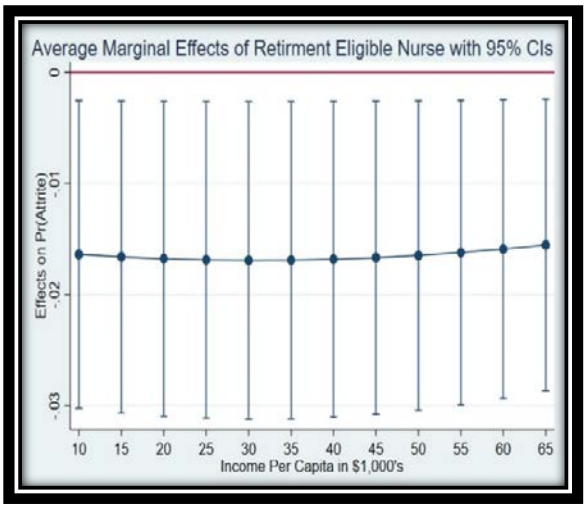
g. Marginal Effect of Each $1000 Increase in IPC by Occupation

Figures 62 and 63 illustrate the effect of each $1,000 IPC increase on the attrition likelihood behavior of the nurse population during the study period. The graph in Figure 62 also shows a slightly inverse response to the IPC value increase on attrition likelihood. However, overall, the linear relationship is shallow and non-existent at IPC values over $40,000. Retirement-eligible nurses are even less responsive to IPC value increases. Individuals in the nurse occupation may respond to IPC changes but not significantly more than the healthcare technician and clerical assistive baseline population, despite difference in pay, education, professional reception, and private labor market job demand.



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood a nurse in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

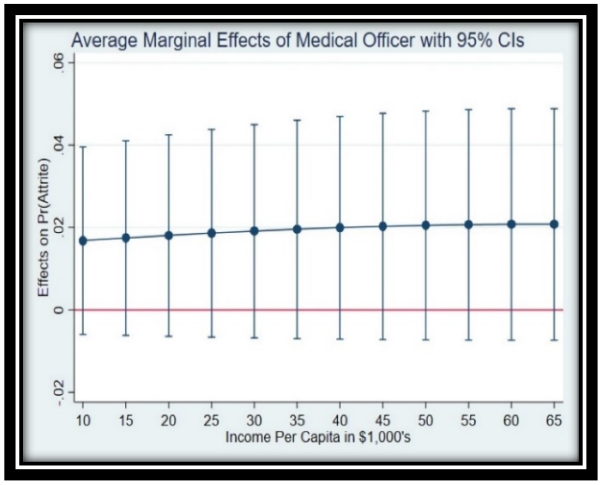
Figure 62. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if Nurse



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood a retirement eligible nurse in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

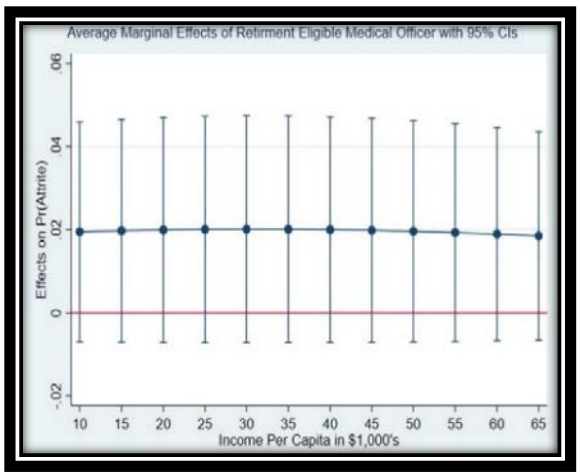
Figure 63. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if Nurse and Retirement Eligible

Figures 64 and 65 illustrate the effect of each $1,000 IPC increase on the attrition likelihood behavior of the medical officer population during the study period; both graph lines exhibit almost no slope. Even more so than nurses, medical officers from the 2014 Cohort do not appear to respond to IPC value increases. While individuals in medical officer occupations may have some response to IPC value changes, they do not respond more significantly than the healthcare technician and clerical assistive baseline population, despite difference in pay, education, professional reception, and private labor market job demand.



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood a medical officer in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

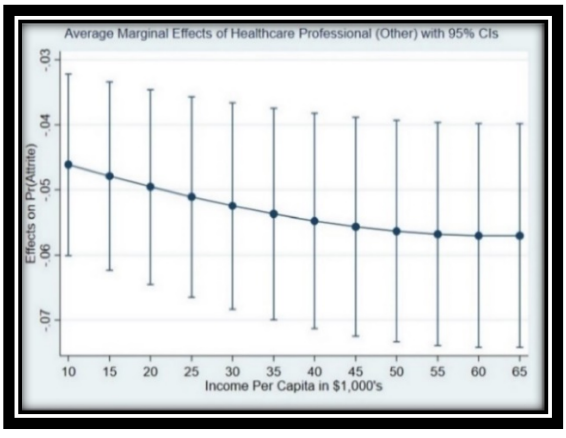
Figure 64. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if Medical Officer



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood a retirement eligible medical officer in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

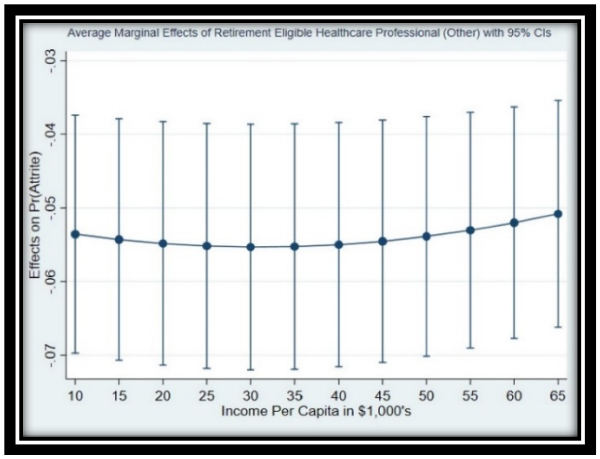
Figure 65. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if Medical Officer and Retirement Eligible

Figures 66 and 67 illustrate the effect of each $1,000 IPC increase on the attrition likelihood behavior of those in the healthcare professional (other) population during the study period. The graph in Figure 66 is consistent with descriptive and logistic model results findings that the healthcare professional (other) population is less likely to attrite despite IPC value increases and as IPC values increase, are even more unlikely to attrite.



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood a healthcare professional (other) in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

Figure 66. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if Healthcare Professional (Other)



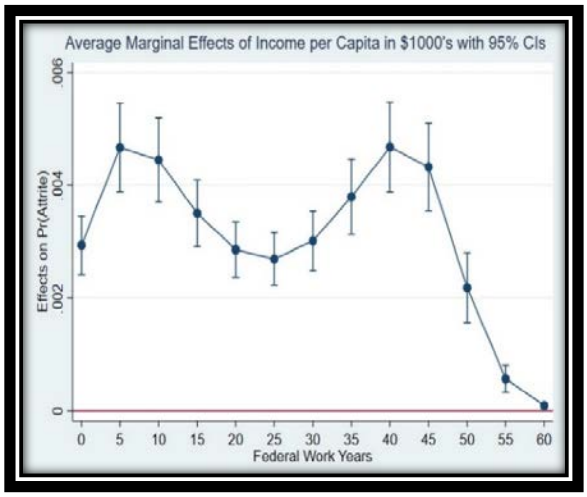
Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each $1,000 increase in county IPC, ceteris paribus, on the likelihood a retirement eligible healthcare professional (other) in the 2014 Cohort sample population will attrite under the logistic regression Model 2, Table 7.

Figure 67. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each IPC $1,000 Increase if Healthcare Professional (Other) and Retirement Eligible

This result suggests individuals in the healthcare professional (other) occupation are likely satisfied working in the government-related healthcare industry. As IPC values increase, cost of living increases, and often competitive pay for in-demand jobs increase as well. It is likely the healthcare professional (other) population is not as in high demand compared to other healthcare occupations in the private market. For the healthcare professional (other) population, remaining in federal service in a high cost-of-living environment is more beneficial than seeking a higher salary. The response for retirement-eligible individuals is also consistent with the minority-type populations. According to Figure 67, at an IPC value of $35,000 or more, a slight increase occurs in attrition risk. This finding, again, signals that the safety net of a federal pension allows an individual who attrition risk averse to be more sensitive to IPC value increases. Lastly, almost all retirement-eligible subpopulations, except for females, are more sensitive to IPC value increases compared to their counterfactuals.

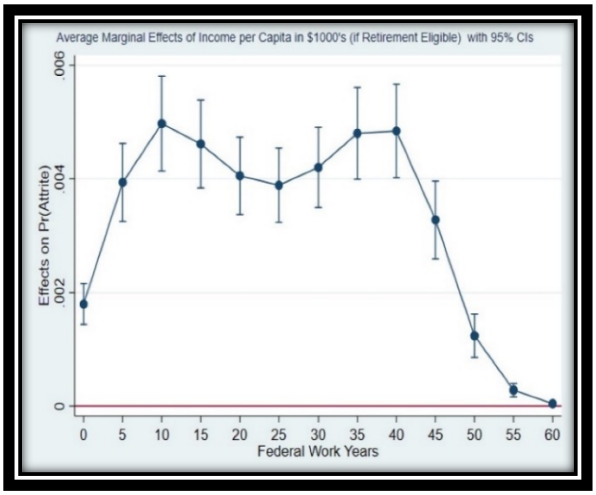
h. Marginal Effect of Each Federal Work Year if Controlling for IPC

Figures 68 and 69 illustrate the changes in average IPC effects on attrition likelihood work year to work year during a career lifetime. The results graphed in Figure 68 indicate that, while increasing IPC values also increase the likelihood that an individual will attrite during the entire career lifespan, the early stages of an individual's career in civil service are associated with the most sensitivity to incremental increases in IPC values. This sensitivity peaks again, predictably, during the later work years (35 work years or more). Retirement-eligible individuals experience a similar response in IPC sensitivity changes work year to work year but overall remain more likely in magnitude to attrite than retirement-ineligible individuals.



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each Federal Work Year, ceteris paribus, on the IPC in $1,000's attrition likelihood effect in the 2014 Cohort Model 2, Table 7.

Figure 68. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each Federal Work Year on IPC Effect



Note: The red line represents the probability of attrition for a Caucasian male in a health technician or clerical assistant occupation. This graph depicts the marginal effect of each federal work year, ceteris paribus, on the IPC in $1,000's attrition likelihood effect in the retirement-eligible-only population in the 2014 Cohort sample using Model 2, Table 7.

Figure 69. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects of Each Federal Work Year on IPC Effect if Retirement Eligible

Overall, increases in local IPC are associated with greater attrition risk for the workforce, but the rationale behind an individual's sensitivity to IPC changes may be related to cost-of-living factors, private market competitive pay effects, or both. Therefore, meaningful interpretation of the IPC effect in the logistic regression model is more difficult. However, the results of marginal effects of incremental IPC value increases within subpopulations provides more clarity. It is likely females are more sensitive to IPC effects than their male counterparts, while nurses and medical officers are surprisingly less sensitive compared to the healthcare technician population. Minority groups and those working in the healthcare professional (other) populations are even less likely to attrite in high-value IPC environments compared to their counterfactuals. This finding suggests the federal work environment is a more stable option in high IPC locations for these populations that appear to be attrition-risk averse.

D. LOGISITIC REGRESSION ANALYSIS WITH LIMITED ATTRITE OUTCOMES

1. Thesis Study 2014 Cohort Best-Fit Models with Robust Standard Error Estimations

The best-fit models for this thesis's study are identified with robust standard error results in Table 8. Model 1 contains occupation collar type effects only, Model 2 separates occupation types in the white-collar professions, and Model 3 includes IPC effects.

This thesis's descriptive analysis and logistic analysis with individual marginal effects suggests a subpopulation of workers attrite in the early civil service career years due to either the job-sorting process or their having met FERS criteria at age 62 years or older. This critical workforce subpopulation also enters the workforce at an older age and attrite as soon as retirement eligibility criteria is met. The decision to depart the workforce once the individual has met their eligibility criteria is probably tied to both perceived labor intensity of the occupation and biological age, in addition to retirement-eligibility status. The analysis results also suggest that, when controlling for total federal work years, the female population does not necessarily attrite at an overall higher rate compared to the male workforce. However, some evidence exists that females may be comparatively at an increased risk for attrition during the early stages of their career. Analysis results with IPC effects vary in impact magnitude during the career lifespan. These findings suggest there are complicated dynamics among competing values between an individual's demographics and time effects on attrition events.

Table 8. (2014 Cohort) Best-Fit Odds Ratio Logistic Regression Models with Robust Standard Error Estimations

VARIABLES	(1) (2014 Cohort) Final Model: *Collar Effects* *Robust*	(2) (2014 Cohort) Final Model: *Occupation Effects* *Robust*	(3) (2014 Cohort) Final Model: *with IPC Effects* *Robust*
Age-at-Hire	0.930***	0.932***	0.927***
	(0.006)	(0.006)	(0.008)
Age-at-Hire Squared	1.001***	1.001***	1.001***
	(0.000)	(0.000)	(0.0001)
Total Federal Work Years	0.760***	0.760***	0.760***
	(0.004)	(0.004)	(0.005)
Total Federal Work Years Squared	1.006***	1.006***	1.006***
	(0.000)	(0.000)	(0.000)
Female	1.041*	1.026*	1.106***
	(0.023)	(0.023)	(0.034)
African-American	0.833***	0.838***	0.868***
	(0.021)	(0.021)	(0.029)
Minority Other	0.744***	0.772***	0.772***
	(0.021)	(0.021)	(0.030)
Medical Officer		1.053	1.096
		(0.049)	(0.070)
Nurse		0.963**	0.926**
		(0.024)	(0.030)
Healthcare Professional (Other)		0.802***	0.777**
		(0.022)	(0.030)
Retirement Eligible	2.735***	2.738***	2.727***
	(0.018)	(0.092)	(0.125)
White Collar	-0.100***		
	(0.092)		
IPC in $1000's			1.021***
			(0.002)
Constant	23.854***	23.786***	12.877***
	(2.953)	(2.960)	(2.308)
Observations	50,946	50,946	27,514
Pseudo R2	0.0768	0.775	0.0760

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Income per capita (IPC) is associated with the hospital or medical center's county-reported average IPC from 2014–2018 in 2018-dollar value. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race. All results displayed in odds ratio of average attrition likelihood, ceteris paribus, during the study period compared to a male, Caucasian, or blue-collar or health technician worker. Total Federal Work Years, Total Federal Work Years Squared, Age-at-Hire and Age-at-Hire Squared are continuous variables that account for years an individual has invested in civil service and the age of the individual upon workforce entry and with linear and non-linear effects. Each model displays relatively similar covariate magnitudes and covariate values do not change direction in attrition likelihood effects between different models. Pseudo R2 remains consistent between models. Observed odds ratio is not the center of the confidence interval in this regression analysis because of the asymmetric nature of the odds ratio scale. Standard error is the square root of the sum of the reciprocal of the frequencies for the variable outcome ratio.

2. Odds Ratio Logistic Analysis Models with Varied Attrition Outcomes Based on Tenure

The last portion of this thesis's analysis aims to dissect further the effect of different population characteristics on attrition that occurs at specific tenure milestones. This thesis will use the structures of Models 1–3, Table 8. However, this analysis will replace the outcome attrition event variable with a more specific attrition event outcome. The outcome variables will occur in three different event categories and are applied to each of the three models. Tenure milestones place time limits on the outcome event and are as follows: attrition after less than six work years, attrition after 6–10 work years, attrition after 11–20 work years, and attrition after 21 work years or more. Table 9 displays these model's results with robust standard error estimations.

a. Age-at-Hire Effects

The results of the models in Table 9 provide interesting insight about workforce turnover contributors at different career points. For example, ceteris paribus, a worker's entry age has a very strong effect on attrition across all three model types during the first five work years. At this career point, the impact of an individual's age-at-hire produces lower odds of attrition on average until the worker entry age is approximately 60. At the age of 60, attrition risk increases with each unit increased in workforce entry age. The entry-age factor remains significant throughout the other tenure career milestone attrition models, while the nonlinear effects do not. The effect of an individual's age-at-hire on attrition after 6–10 work years and attrition after 11–20 work years produces lower attrition odds until the worker age-at-hire approaches mid-to-late 30s. At this entry age point, the worker becomes more likely to attrite with each age unit increase. Lastly, for workers with at least 21 total federal work years, each age-unit increase always results in increased attrition likelihood.

These findings suggest that more age-mature individuals who enter civil service are at less risk for attrition than younger workers during this period, except for individuals approaching retirement-eligibility criteria age. This behavior is likely related to an individual's familiarity or prudence in the job application process, wherein he or she is

aware of the likelihood of success and satisfaction with a civil service job match. In the later stages of the career, it is also logical that the older an individual is at the time of hire, in addition to two decades of accrued tenure, the greater the attrition risk.

Table 9. (2014 Cohort) Odds Ratio Logistic Regression Models with Limited Attrite Parameter Event

VARIABLES	(1) Attrite in <6 Work Years (2014 Cohort) Final Model: Collar Effects *Robust SE*	(2) Attrite in <6 Work Years (2014 Cohort) Final Model: Occupation Effects *Robust SE*	(3) Attrite in <6 Work Years (2014 Cohort) Final Model: With Income per Capita (IPC) Effects *Robust SE*	(4) Attrite in 6-10 Work Years (2014 Cohort) Final Model: Collar Effects *Robust SE*	(5) Attrite in 6-10 Work Years (2014 Cohort) Final Model: Occupation Effects *Robust SE*	(6) Attrite in 6-10 Work Years (2014 Cohort) Final Model: Income per Capita (IPC) Effects *Robust SE*	(7) Attrite in 11-20 Work Years (2014 Cohort) Final Model: Collar Effects *Robust SE*	(8) Attrite in 11-20 Work Years (2014 Cohort) Final Model: Occupation Effects *Robust SE*	(9) Attrite in 11-20 Work Years (2014 Cohort) Final Model: Income per Capita (IPC) Effects *Robust SE*	(10) Attrite in 21+ Work Years (2014 Cohort) Final Model: Collar Effects *Robust SE*	(11) Attrite in 21+ Work Years (2014 Cohort) Final Model: Occupation Effects *Robust SE*	(12) Attrite in 21+ Work Years (2014 Cohort) Final Model: Income per Capita (IPC) Effects *Robust SE*
Age-at-Hire	0.873***	0.874***	0.847***	0.857***	0.858***	0.851***	0.849***	0.850***	0.842***	1.167***	1.163***	1.167***
	(0.016)	(0.016)	(0.022)	(0.011)	(0.011)	(0.015)	(0.009)	(0.010)	(0.013)	(0.024)	(0.024)	(0.033)
Age-at-Hire Squared	1.001***	1.001***	1.001***	1.002***	1.002***	1.002***	1.002***	1.002***	1.002***	0.999***	0.999***	0.999**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Total Work Years	0.536***	0.537***	0.604***	525.428***	536.566***	526.732***	10.290***	10.297***	9.681***	2.561***	2.572***	2.538***
	(0.028)	(0.028)	(0.045)	(46.366)	(47.617)	(64.791)	(0.354)	(0.354)	(0.437)	(0.080)	(0.081)	(0.107)
Total Work Years Squared	0.920***	0.920***	0.907***	0.669***	0.668***	0.669***	0.928***	0.928***	0.930***	0.987***	0.987***	0.988***
	(0.005)	(0.005)	(0.007)	(0.004)	(0.004)	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Female	1.270***	1.270***	1.491***	0.990	0.943	0.938	0.889***	0.885***	0.966	1.065	1.017	1.101
	(0.076)	(0.079)	(0.130)	(0.040)	(0.040)	(0.057)	(0.034)	(0.035)	(0.053)	(0.058)	(0.057)	(0.083)
African-American	1.092	1.093	1.255**	0.973	0.978	1.001	0.841***	0.846***	0.807***	0.697***	0.696***	0.726***
	(0.083)	(0.083)	(0.129)	(0.046)	(0.046)	(0.068)	(0.039)	(0.039)	(0.050)	(0.041)	(0.041)	(0.055)
Minority (Other)	0.948	0.947	1.047	0.727***	0.722***	0.670***	0.757***	0.757***	0.749***	0.785***	0.780***	0.801***
	(0.075)	(0.0750)	(0.120)	(0.038)	(0.038)	(0.051)	(0.039)	(0.039)	(0.053)	(0.050)	(0.050)	(0.068)
Medical Officer		1.016	1.153		0.917	1.049		1.073	1.075		0.684***	0.785
		(0.121)	(0.185)		(0.078)	(0.122)		(0.090)	(0.126)		(0.088)	(0.139)
Nurse		0.929	0.906		0.986	0.950		0.967	0.922		1.037	1.046
		(0.60)	(0.080)		(0.044)	(0.057)		(0.047)	(0.058)		(0.064)	(0.084)
Healthcare Professional (Other)		0.877*	0.846		0.710***	0.707***		0.881**	0.843**		0.905	0.860*
		(0.065)	(0.091)		(0.037)	(0.052)		(0.045)	(0.061)		(0.058)	(0.075)
Retirement Eligible	2.739***	2.724***	2.209***	2.545***	2.536***	2.832***	1.990***	2.006***	2.138***	0.868	0.856	0.829
	(0.342)	(0.341)	(0.389)	(0.195)	(0.195)	(0.299)	(0.120)	(0.121)	(0.176)	(0.095)	(0.095)	(0.123)
White Collar	0.919			0.868***			0.942			0.938		
	(0.049)			(0.032)			(0.036)			0.046		
IPC in $1000's			1.032***			1.031***			1.008**			1.009**
			(0.005)			(0.004)			(0.003)			(0.004)
Constant	1896.808***	1846.187***	6847.160***	6.16e-10***	5.80e-10***	3.03e-10***	1.44e-07***	1.41e-07***	2.07e-07***	1.46e-09***	1.49e-09***	1.16e-09***
	(720.485)	(704.217)	(480.460)	(2.42e-10)	(0.195)	(1.72e-10)	(4.23e-08)	(4.15e-08)	(8.28e-08)	(7.00e-10)	(7.13e-10)	(7.46e-10)
Observations	50,946	50,946	27,514	50,946	50,946	27,514	50,946	50,946	27,514	50,946	50,946	27,514
Pseudo R2	0.7004	0.700	0.6974	0.3997	0.4007	0.4054	0.3052	0.3054	0.3002	0.4990	0.4995	0.5001

Robust standard errors (SE) in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Income per capita (IPC) is associated with the hospital or medical center's county-reported average IPC from 2014–2018 in 2018-dollar value. Models with IPC effect contains only a portion of the original 2014 Cohort study sample. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race. All results displayed in odds ratio of average attrition likelihood, ceteris paribus, during the study period compared to a male, Caucasian, or blue-collar or health technician worker. Total Federal Work Years, Total Federal Work Years Squared, Age-at-Hire and Age-at-Hire Squared are continuous variables that account for years an individual has invested in civil service and the age of the individual upon workforce entry and with linear and non-linear effects. Pseudo R2 varies between models. Observed odds ratio is not the center of the confidence interval in this regression analysis because of the asymmetric nature of the odds ratio scale. Standard error is the square root of the sum of the reciprocal of the frequencies for the variable outcome ratio.

b. Race Effects

Another interesting difference in Table 9's results are the effects of being African-American or minority (other) on attrition in less than five work years are not found to be significant. When IPC effects are in the model, as seen in Model 3, Table 9, the effect of being African-American is statistically significant at the 5% level. However, the effect of being African-American again becomes insignificant in Models 4–6 in Table 9, which reflects the likelihood of attrition in 6–10 work years. Even more surprising is the direction of attrition odds for the African-American population compared to the Caucasian population changes during the first five work years. During the early stages of a civil service career, being African-American results in increased odds of attrition likelihood. Although both the minority (other) and African-American populations experience decreased odds of attrition in the other attrition milestone models.

c. Sex Effects

The effect of being female as opposed to male on attrition during various tenure milestones, ceteris paribus, is significant during the first five work years and during work years 11–20. During the early career years, females are more likely to attrite than men. The magnitude of this effect increases when IPC effects are included in the model. This finding may indicate females are more vulnerable to the job-sorting process, like the minority groups populations, or may be departing the workforce because it aligns with childbearing and family life-event years. During work years 6–10, females are almost just as likely as males to attrite, but these results are not found to be significant. During work years 11–20, females are less likely to attrite than men, unless IPC effects are controlled in the model. When IPC effects are controlled, females are almost as likely as men to attrite, and the finding no longer meets level of significance standard of <10%. Females in the later stages of their career are only slightly more likely to attrite than men. However, the results of the female effect are not found to be statistically significant in these models, (Models 10–12, Table 9). This finding suggests that females have stronger organizational attachment if they retain past the early stages of their career.

d. Retirement Eligibility Effects

The impact of retirement eligibility is significant across all models and attrition tenure milestones. A retirement-eligible individual is approximately twice as likely to attrite throughout their career until they achieve over 21 work years, at which point they are less likely to attrite. A reasonable explanation for this finding is that, if an individual was a younger hire in terms of their age and earned two decades of service, they may be more likely to remain in civil service, because they are still of working age and desire a pension percentage payment during retirement. In contrast, those who enter civil service in later years with the goal to achieve a second pension from civil service likely have another form of retirement from an earlier career or are approaching SSN payment-eligible age. For these individuals, the minimum level of federal retirement compensation may be an adequate compensation when considering an attrition decision. These late workforce entry individuals who attrite at retirement eligibility likely do not incur 21 work years before attrition occurs. Therefore, their increased attrition likelihood is not counted as appositive event in the attrition in 21 work years or more models (Models 10-12, Table 9).

e. IPC Effects

The impact of IPC values, ceteris paribus, increases the odds of attrition across all tenure milestone models. However, its effect is greatest when a worker has 10 work years or less. The IPC effect is significant across all models at the <1% level.

f. Collar and Occupation-Type Effects

Medical officers remain just as likely or slightly more likely to attrite than healthcare technician and clerical assistant workers throughout career tenure milestones until they have achieved 21 work years or more, at which point the effect of being a medical officer decreases the odds of attrition significantly. All medical officer effects are insignificant across the model except in Model 11, which refers to attrition odds after 21 work years or more. While most of these results are not statistically significant, it does suggest medical officers may have more career stamina or longevity compared to workers in blue-collar-type occupations.

While the results indicate that the impact of being a nurse on average attrition likelihood compared to blue-collar workers is significant at the <5% level in the original 2014 Cohort Final model and in the IPC effects model, this variable does not meet the statistical standards of significance at the <10% level in any of the career tenure milestone models in Table 9. The odds of attrition, ceteris paribus, through most career stages for nurses are marginally decreased compared to health technician and clerical assistant-type workers. If a nurse has achieved more than 21 work years, the odds of attrition are greater than that of a healthcare technician or clerical assistant-type worker. The nursing profession is a labor-intensive occupation, which may contribute to a higher attrition risk after 21 years or more in the industry. However, most of the job types in the blue-collar category are also labor intensive. The difference in attrition odds between these groups at the later career stages might be attributed to the differences in salary and compensation that exists between these two groups over their careers, which therefore contributes to financial security in retirement.

Individuals in the healthcare professional (other) occupation category are less likely to attrite, compared to blue-collar-type occupations for each career milestone. The effect is most significant at <1% level and of the greatest magnitude in the attrition at 6–10 work years model (Models 5 and 6, Table 9). During the early work years, the impact of being a healthcare professional (other) does not meet statistical significance standards when the model controls for IPC effects. This may be due to the variation of occupation types within the healthcare professional (other) category. Certain occupations within the category may be more sensitive to IPC effects during the early job-sorting stages of a career compared to other occupations types within the healthcare professional (other) category.

Models 1, 4, 7, and 10, Table 9 control for collar-type effects only. The results of these models indicate that individuals in white-collar healthcare professions, overall, compared to blue-collar healthcare professions, are less likely to attrite at all career stages. However, this finding is only significant at the <10% level in the 6–10 work years model (Model 4, Table 9).

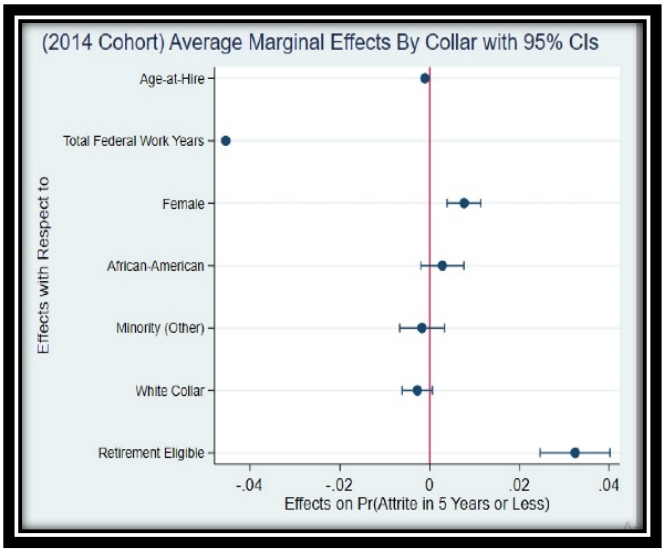
The general effect of occupations on attrition outcomes at different career stages does not differ substantially between occupation groups except for those in the healthcare

professional (other) category. The effect of being in this profession on attrition odds has consistently remained the most significant occupation, exhibiting the greatest magnitudes throughout all models in this thesis when compared to both blue-collar-type occupations as well as other white-collar-type professions. This occupation category may stand out as different from both blue-collar healthcare workers and the other white-collar healthcare workers because of the administrative nature and traditional work hours associated with many of the jobs within this occupation category.

3. Marginal Effects of Odds Ratio Logistic Analysis Models with Varied Attrition Outcomes Based on Tenure

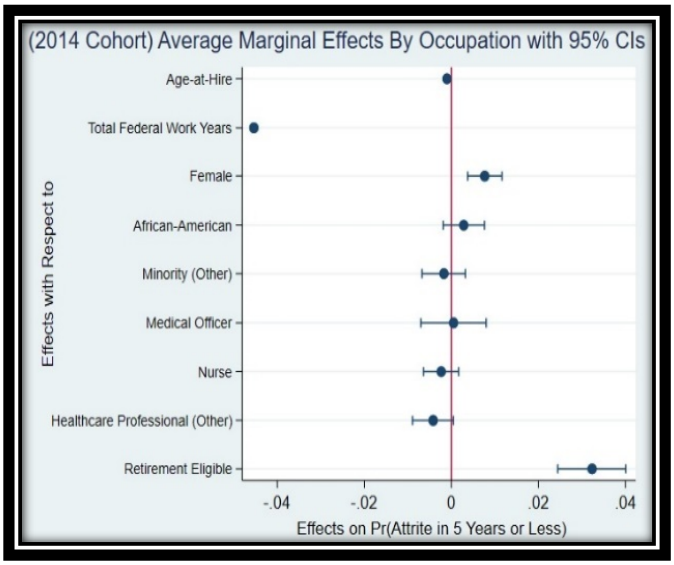
Figures 70–81 illustrate the difference in covariate impacts in terms of magnitude and direction of Models 1–12, Table 9 as graphs of average marginal effects. The visual markings of each variable's coefficient effects facilitate simple model outcome comparisons.

Figures 70–72 show the likelihood of attrition in the first five work years, ceteris paribus, is greatest for individuals who are retirement eligible, female, in a minority group, or a medical officer if IPC is held constant compared to the Caucasian, blue-collar, male, and retirement-ineligible population. Increases in IPC values also increase attrition odds during the first five work years.



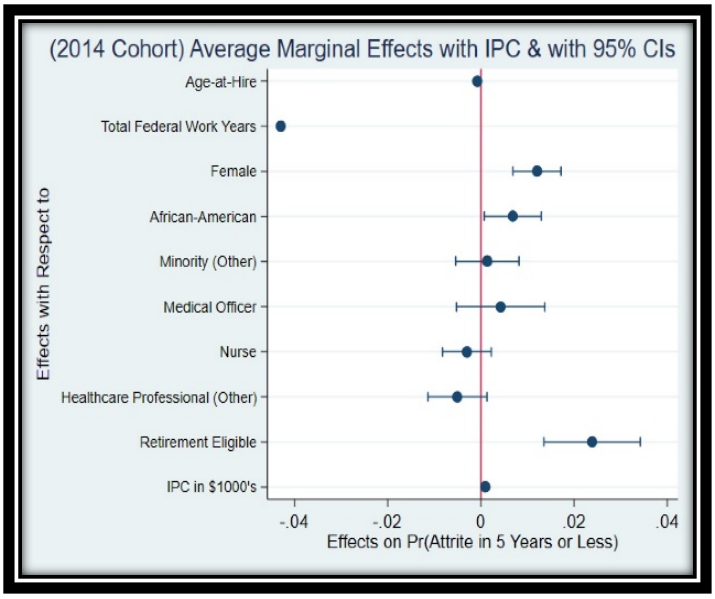
Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after less than six work years of an individual with that characteristic, ceteris paribus, during the study period. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management.

Figure 70. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects on Attrition in Less than Six Work Years



Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after less than six work years of an individual with that characteristic, ceteris paribus, during the study period. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race.

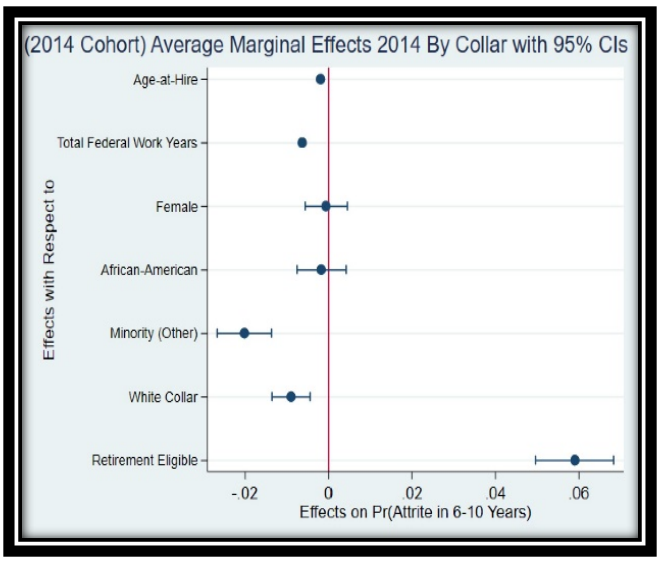
Figure 71. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects on Attrition in Less than Six Work Years



Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after less than six work years of an individual with that characteristic, ceteris paribus, during the study period. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race. Income per capita (IPC) is associated with the hospital or medical center's county-reported average IPC from 2014–2018 in 2018-dollar value. Models with IPC effect contains only a portion of the original 2014 Cohort study sample.

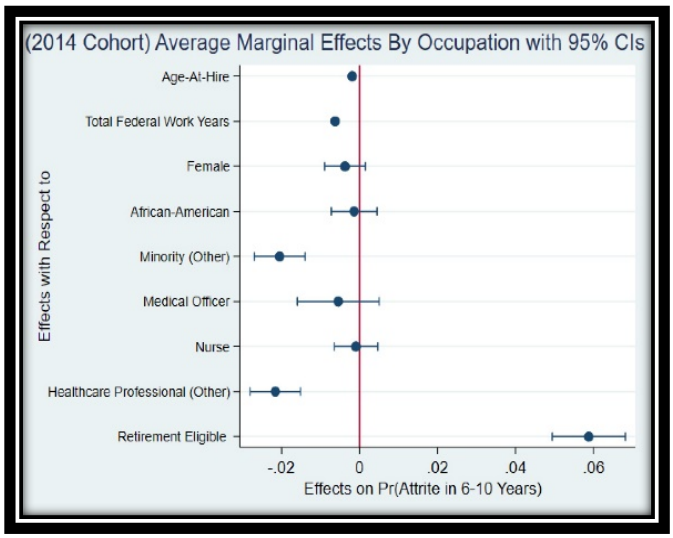
Figure 72. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects on Attrition in Less than Six Work Years

Figures 73–75 show the likelihood of attrition in work years 6–10, ceteris paribus, is greatest for individuals who are retirement eligible, African-American, or a medical officer if IPC is held constant compared to the Caucasian, blue-collar, male, and retirement-ineligible population. In general, all other demographic impacts are less likely to attrite in work years 6–10 compared to their attrition risk during the first five work years. Increases in IPC values also increase attrition odds during work years 6–10.



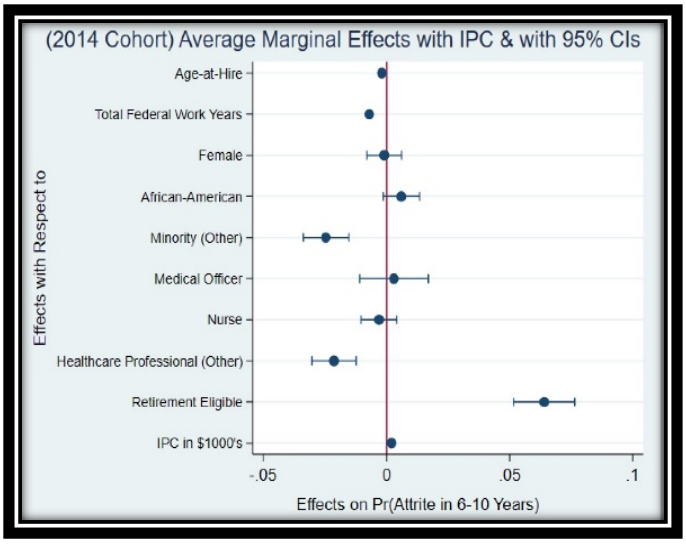
Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after 6–10 work years of an individual with that characteristic, ceteris paribus, during the study period. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management.

Figure 73. (2014 Cohort Final Model with Collar Effects) Average Marginal Effects on Attrition in 6–10 Work Years



Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after 6–10 work years of an individual with that characteristic, ceteris paribus, during the study period. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race.

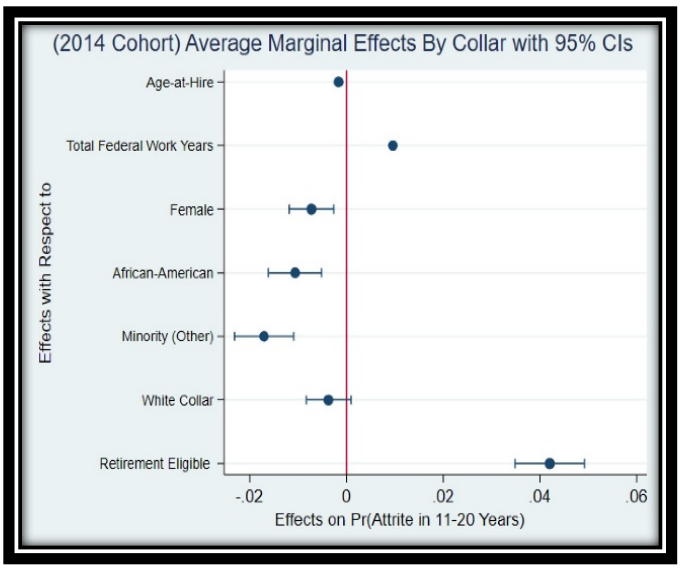
Figure 74. (2014 Cohort Final Model with Occupation Effects) Average Marginal Effects on Attrition in 6–10 Work Years



Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after 6–10 work years of an individual with that characteristic, ceteris paribus, during the study period. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race. Income per capita (IPC) is associated with the hospital or medical center's county-reported average IPC from 2014–2018 in 2018-dollar value. Models with IPC effect contains only a portion of the original 2014 Cohort study sample.

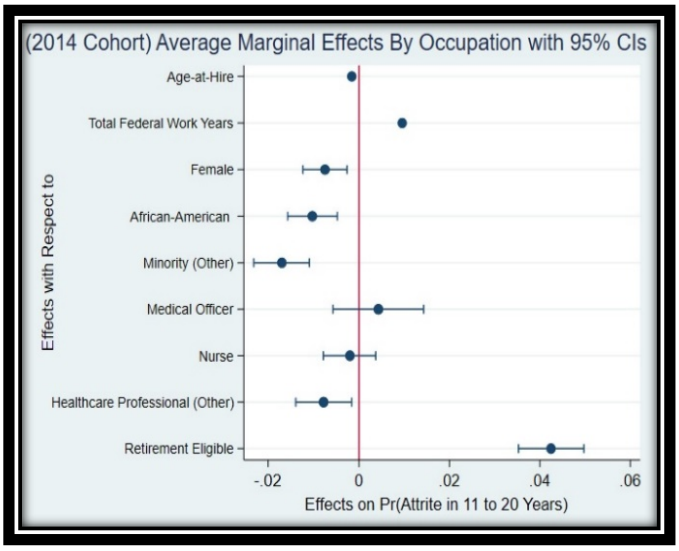
Figure 75. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects on Attrition in 6–10 Work Years

Figures 76–78 show the likelihood of attrition in work years 11–20, ceteris paribus, is greatest for retirement-eligible individuals or a medical officer, compared to the blue-collar and retirement-ineligible population. In general, all other demographic impacts are less likely to attrite in work years 11–20 compared to their attrition risk during the previous work years. IPC effects no longer increase attrition odds at the 11–20 work year career milestone.



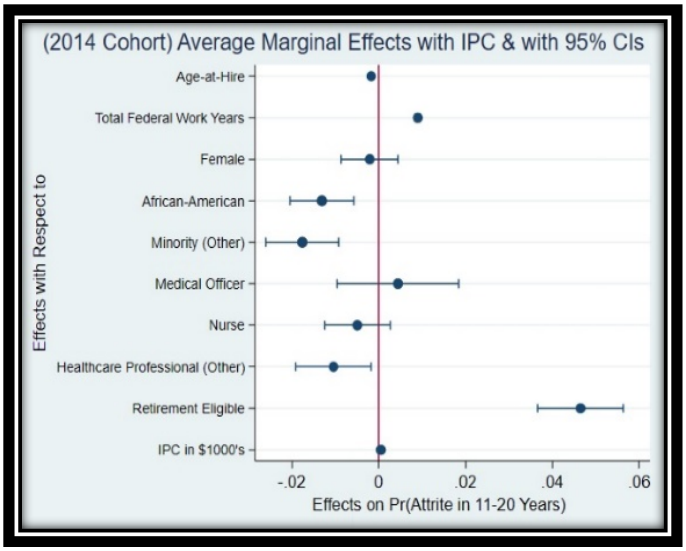
Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after 11–20 work years of an individual with that characteristic, ceteris paribus, during the study period. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management.

Figure 76. (2014 Cohort Final Model with Collar Effects) Average Marginal Effects on Attrition in 11–20 Work Years



Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after 11–20 work years of an individual with that characteristic, ceteris paribus, during the study period. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race.

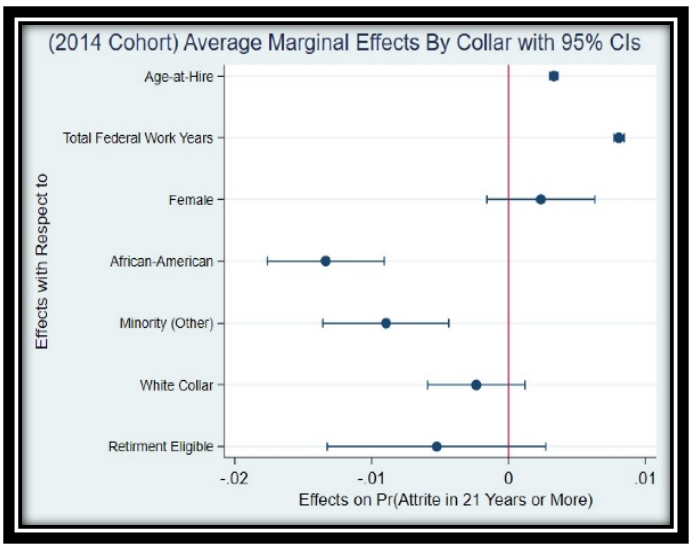
Figure 77. (2014 Cohort Final Model with Occupation Effects) Average Marginal Effects on Attrition in 11–20 Work Years



Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after 11–20 work years of an individual with that characteristic, ceteris paribus, during the study period. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race. Income per capita (IPC) is associated with the hospital or medical center's county-reported average IPC from 2014–2018 in 2018-dollar value. Models with IPC effect contains only a portion of the original 2014 Cohort study sample

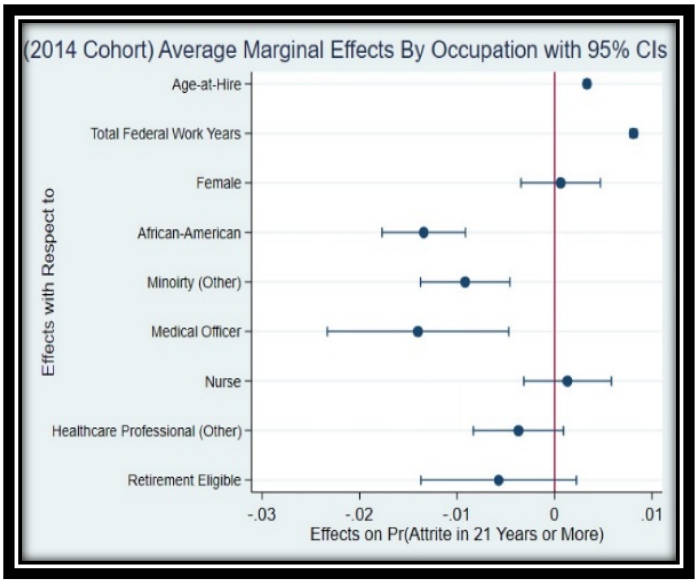
Figure 78. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects on Attrition in 11–20 Work Years

Figures 79–81 show the likelihood of attrition after 21 work years or more, ceteris paribus, is greatest for individuals who are female, nurses, or have an older workforce entry age compared to the blue-collar and male population. IPC values increase attrition odds at 21 work years or more.



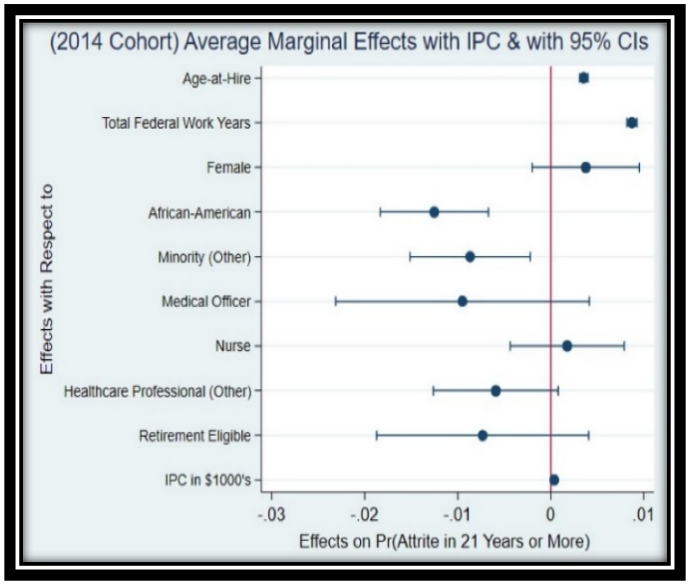
Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after 21+ work years of an individual with that characteristic, ceteris paribus, during the study period. Blue Collar refers to healthcare roles that are assistive, technical, or clerical and administrative in nature and do not require state board licensure for practice. White Collar refers to roles considered professional occupations associated with direct clinical healthcare, research, or management.

Figure 79. (2014 Cohort Final Model with Collar Effects) Average Marginal Effects on Attrition in 21 Work Years or More



Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after 21+ work years of an individual with that characteristic, ceteris paribus, during the study period. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race.

Figure 80. (2014 Cohort Final Model with Occupation Effects) Average Marginal Effects on Attrition in 21 Work Years or More



Note: The red line represents a Caucasian male in a health technician or clerical assistant occupation as the basis of all comparisons of marginal effects. This graph is a visual marking of the direction and magnitude of impact on the odds of attrition likelihood after 21+ work years of an individual with that characteristic, ceteris paribus, during the study period. Professional Healthcare (Other) refers to professional healthcare occupations: therapists (various types), pharmacists, physician assistants, and healthcare administrators. Race variables are based on individual reported self-identified race. Income per capita (IPC) is associated with the hospital or medical center's county-reported average IPC from 2014–2018 in 2018-dollar value. Models with IPC effect contains only a portion of the original 2014 Cohort study sample.

Figure 81. (2014 Cohort Final Model with IPC Effects) Average Marginal Effects on Attrition in 21 Work Years or More

V. DISCUSSION

A. THESIS RESEARCH QUESTIONS ANSWERS

1. Primary Research Questions

a. What are the baseline demographic and professional characteristics of the DoD civil service military healthcare workforce?

The DoD civil service military healthcare workforce demographic and professional characteristics results are best interpreted against the private market healthcare workforce demographics in a similar sample year. The National Center for Health Workforce Analysis (NCHWA), which operates under the direction of the U.S. Department of Health Human Services, utilizes data from the American Community Survey's (ACS) Public Use Microdata Sample (PUMS) to provide the public with healthcare workforce reports (NCHWA, 2018). The U.S. Census Bureau conducts the ACS, collecting individual self-reported data from approximately 1% of all U.S. households in the census year. The PUMS data set contains combined 1% data samples from years 2011–2015. The result is a sample set of approximately 5% of the total population (NCHWA, 2018). The U.S. Healthcare Workforce Chartbook (HWC) Brief contains the summarized results, which will serve as a private sector workforce comparison group for the civil service military healthcare workforce demographic and professional characteristics results.

The civil service military healthcare system employs individuals from the age of 18 to over 80 years old. The average workforce entry age is approximately 37 years and over 70% female. The HWC also reports female representation in the healthcare workforce at over 70% (NCHWA, 2018). More specifically, the HWC reports over 90% of nurses to be female compared to 85% of nurses in civil service. Additionally, the HWC reports approximately 35% of physicians are female compared to 37% of medical officers in civil service. The HWC reports female representation in healthcare professional (other) occupations ranges from approximately 30–90% depending on occupation type versus an approximate 56% female representation in the civil service workforce in this occupation category. Lastly, the HWC reports female representation in healthcare technician and clerical assistant-type position ranges from approximately 70–83% versus approximately

72% in the civil service workforce population (NCHWA, 2018). The baseline sex demographics in the private workforce and civil service workforce are strikingly similar. However, both data sets reveal females are underrepresented in the medical officer, or physician category, for both workforces.

In terms of race, approximately 67% of physicians in the HWC are reported to be Caucasian, while over 77% of civil service medical officers are Caucasian (NCHWA, 2018). In the occupation of nurses, the HWC reports approximately 73% of U.S. nurses are Caucasian compared to approximately 70% in the civil service workforce (NCHWA, 2018). In the healthcare professional (other) category, the HWC reports a Caucasian representation at a range of approximately 62–86% versus approximately 70% in the civil service workforce. Lastly, the HWC reports healthcare technicians are Caucasian at a prevalence of 46–78% versus approximately 55% in the civil service workforce (NCHWA, 2018). While the results of race demographics are similar among the populations, it appears minorities are not only underrepresented in the physician profession but also are underrepresented at a greater rate in the civil service workforce compared the national healthcare labor force.

The HWC does not report on retirement eligibility but does report on the proportion of the population aged 55 or older. According to the HWC, over 31% of physicians and over 25% of nurses are age 55 years or older (NCHWA, 2018). Additionally, healthcare professionals (other) are age 55 years or older at a range of approximately 14–30%, and healthcare technicians are age 55 years or older at a range of approximately 10–26%. In the civil service population, over 48% of medical officers, 33% of nurses, 34% of healthcare professionals (other), and over 29% of healthcare technicians and clerical assistants are retirement eligible. In the civil service workforce, retirement eligibility is typically associated with the age of 62 years or more. While this is not an equal comparison to aged 55 years or older, it does suggest the civil service workforce has a greater proportion of more mature workers compared to the private sector.

The results of this thesis's analysis suggest that across all occupations, the civil service workforce is likely more aged on average than individuals working in the private labor market, but this does not necessarily imply that the overall workforce population is

aging and approaching an aggregate or mass group turnover. Rather, in this situation, it more likely relates to an individual's purposeful intent to enter the public workforce at a later age, wherein entry will occur at asynchronous time periods. Although greater turnover in the civil service workforce related to retirement may occur in the future, it is also likely a mature workforce population will continue to replace them if the workforce patterns continue, as exhibited in this study. However, no matter how this difference is interpreted, being over the age of 55 years or being retirement eligible will increase a worker's attrition risk as the worker approaches the end of their career lifecycle or maximum working age.

b. Which characteristics of this workforce have the greatest impact on the civil service military healthcare worker's career lifecycle?

The results of both bivariate and logistic regression analysis suggest that age, tenure, and retirement eligibility have the largest average effects on a worker's career lifecycle. The effect of retirement eligibility increases the risk for worker attrition and is strongest for individuals who have been employed for fewer than 20 total federal work year.

The effect of an individual's age on attrition is largely related to younger workforce entry ages but only during the early stages of a career. This age characteristic is likely correlated with attrition because of the job-sorting process, family life events, employee poaching, and lack of organization commitment. Older individuals who enter an organization have a better sense of job fit and goals before the application process. Additionally, age is highly correlated with retirement-eligibility criteria. Due to the FERS criteria, workers who enter the civil service workforce at an advanced age can earn a partial pension within five federal work years. Therefore, an older individual in the early stages of earned tenure are more likely to attrite at the five- and 10-year marks. Individuals who were middle age or younger hires are currently older with accumulated tenure are less likely to attrite in the later career stages (21 work years or more). This finding could be due to better job fit, higher organizational commitment, or an effort to maximize pension payments in retirement.

The effect of total work years—or tenure—on an individual's career lifecycle changes throughout time. On average, a worker is less likely to attrite work year to work year during the career lifespan. However, the overall average effect of work years on attrition risk is non-linear. In general, an individual is less likely to attrite with increasing tenure until approximately 18 work years. After 18 work years, an individual is more likely to attrite, ceteris paribus, with each additional work year earned.

The results in this thesis also reveal increases in IPC values also raise worker attrition risk on average throughout the career lifecycle. The greatest impact IPC values have on attrition occur before an individual has reached approximately 10 work years and then again after 35 work years or more. However, minority group populations and healthcare professionals (other) have an inverse relationship with increasing IPC values until they also meet retirement eligibility criteria.

The average tenure across the 2014 Cohort subpopulations demonstrate females and males have approximately the same average tenure, but minority groups average almost two additional work years compared to the Caucasian population. Additionally, workers in blue-collar professions average an additional work year compared to the white-collar population. More specifically, nurses and medical officers average almost two fewer work years when compared with the blue-collar population, while healthcare professionals (other) average approximately same number of work years.

2. Secondary Research Questions

a. Within this workforce, do correlations exist among employee characteristics that reveal subpopulations within the healthcare workforce?

The results of bivariate analysis indicate that men and medical officers on average are more likely to enter the workforce at an older age. Additionally, men enter the workforce in two distinct population groups: a younger-than-the-average female entry age and an older-than-the-average female entry age. The second group that enters civil service at a more mature age is also likely associated with prior active duty service. However, information to confirm this assumption does not exist in the data. While males and medical

providers are the most prominent demographics in the late workforce entry group, African-American and white-collar professions workers are also more likely to be in this group compared to their counterfactuals.

The Caucasian population is most associated with the white-collar professions of medical officers and nurses. Therefore, turnover behavior associated with this race population is also reflected in the associated occupation to some degree. Because the Caucasian population is the base comparison race population for all models used in logistic analysis, possible collinearity exists between race and these occupations. This occurrence may have contributed to the failed significance of these occupations' effects in some of the models. Similarly, this study associates a large portion of the blue-collar professions and the healthcare professional (other) occupations with minority races. The results of these relationships are subgroups exhibiting different turnover behaviors. Although minority races on average are less likely to attrite, ceteris paribus, than the Caucasian population, individuals who identify with a minority group are even less likely to attrite than those in blue-collar healthcare occupations.

The last subgroup identified in the study are the vulnerable populations, which include the female, African-American, or minority (other) populations. Individuals within these groups display an increased sensitivity to IPC effects and retirement-eligibility status, as well as external contributor effects to attrition that occur at the early stages of the career lifecycle, such as job sorting, childbearing, and family life events, or advanced education opportunities. IPC effects are the most impactful to vulnerable groups during the early stages of a career and during retirement-eligible years. All vulnerable populations are more likely to attrite during the first five work years than at any other point in the career lifecycle. When controlling for IPC effects, the effect of these vulnerable populations on attrition risk increases further in magnitude.

These differences suggest these populations face external barriers or considerations in their attrition decisions that are not included in the model and do not exist for their counterfactuals. The minority populations exhibit a propensity to remain in stable civil service employment, even if more competitive pay is likely available in their local area. Similarly, the healthcare professional (other) population exhibits similar behavior.

However, this finding is likely correlated with a decreased demand for these occupations in the private market, while there should not be an increased or decreased demand in the private market for a specific race population. Female population differences are likely tied to personal biological barriers in limited childbearing years that aggregate attrition decisions. These outside influencers are usually dependent on spousal income and local cost of living, which are often correlated with local IPC values and likely contribute to the increased sensitivity to IPC effects found in the female population.

b. What characteristics most likely increase attrition behavior within this workforce, and how does this workforce behave in terms of attrition at retirement eligibility?

The characteristics of an individual most associated with attrition behavior are as follows:

1. Recently Employed (Less than Five Work Years)
2. Young Age-at-Hire and Recently Employed (Less than Five Work Years)
3. Retirement Eligible Nurse
4. Medical Officer
5. Retirement Eligible Medical Officer with an Older Workforce Entry Age
6. Medical Officer in a High-Value IPC Environment
7. Blue Collar or Healthcare Technician or Clerical Assistant
8. Retirement-Eligible White Collar
9. Recently Employed Female and Young Age-at-Hire
10. Recently Employed Female in a High-Value IPC Environment
11. Females with Over 21 Work Years
12. Females with Over 21 Work Years in a High-Value IPC Environment
13. Caucasian
14. Retirement Eligible if a More Mature Age-at-Hire

In addition to these demographic characteristics, in general, being hired at an older age and being retirement ineligible is associated with increased work years and lower attrition risk. In contrast, being at an older age at the time of workforce entry and being retirement eligible is associated with attrition. Overall, a younger age-at-hire is associated with increased attrition during the first 10 years of work. However, if these individuals remain employed beyond 10 work years, they are less likely to attrite for the duration of their working career. On average, retirement-eligible individuals are more likely to attrite than retirement-ineligible individuals. This attrition risk also increases as work years increase, particularly for the older workforce entry population. For retirement-eligible individuals who entered civil service at a younger age, attrition risk is increased after 30 work years. Lastly, individuals currently in their 20s to early 30s or older than 60 are more likely to attrite within the next five work years than workers of other ages.

B. RESEARCH LIMITATIONS

1. Data Sample

The data sample used for this thesis is specific to the civil service healthcare workforce in the cohort year 2014. Additionally, this data reflects only civil-service employees and not government contract workers. Therefore, a proportion of the civilian healthcare workforce in the MTF environment is not included in the analysis. Comparison of this data sample to 2010 and 2018 Cohort population samples shows the 2014 Cohort is not significantly different from these sample years in demographic composition. Further comparison of the 2010 and 2014 Cohort samples' workforce behavior indicated similar attrition outcomes and variable effects with a limited number of anomalies that could be attributed to external factors, such as the economic recession effects on the 2010 Cohort sample. This sample sensitivity testing provides this thesis with reasonable assurance that outcomes of the 2014 Cohort analysis are consistent with current population trends. However, with less than five years between these sample groups, it does provide reasonable assurance of historical behavior of this public workforce population.

The 2014 Cohort sample is proportionately the same in demographic characteristics to the private healthcare workforce 2011–2015 PUMS. However, fundamental differences

between the private and public workforce limit universal interpretations, conclusions, and applications of this thesis's findings. Research in this thesis's literature review finds workers in the public sector exhibit a propensity to serve in this workforce, and intrinsic rewards over extrinsic monetary rewards motivate them (Sampuran, 2018; Boekeloo, 2015; and Blau, 2003).

The results of this study's exploratory analysis methods on the 2014 Cohort are consistent with these findings. This study finds workers are most sensitive to IPC effects at a tenure of less than five years, indicating individuals who survive the job-sorting process and have a propensity for federal work are not as motivated by monetary awards. Additionally, vulnerable race populations and healthcare professional (other) population are even more likely to remain in public service as IPC values increase. This behavior may indicate these populations value the intrinsic benefits and stability of public work compared to competitive pay opportunities. Lastly, the results indicate a subgroup in the population that is purposeful in its entry into the workforce at an older age.

Propensity for the public sector environment by those who attempt to apply for federal service is further exemplified by the barriers that must be overcome to be hired into federal service employment. A hearing before the Subcommittee on Health of the Committee of Veterans' Affairs at the U.S. House of Representative in 2008 on the *Human Resource Challenges with The Veterans Health Administration* documents these hiring challenges that face civil service applicants.

> there is a perennial and widely acknowledged complaint by applicants for Federal employment about cumbersome Federal hiring procedures and practices which require too much time and excessive paperwork. Of those who do submit applications, many say they never received feedback from agencies of interest.
>
> The most recent Merit Systems Protection Board's surveys of entry-level hires and upper-level hires showed that substantial numbers had to wait 5 months or longer before being hired. This is much, much too long to expect a high-quality applicant to wait, particularly in the healthcare arena, which is extremely competitive.
>
> —Statement of Adrian M. Atizado on May 22, 2008

Even after an applicant is hired, they are subjected to a lengthy and substantial background check that can take from weeks to months if they have not already achieved the appropriate security level clearance in the previous 10 years. All these findings imply different influences motivate the average individual who both applies and then remains in civil service healthcare workforce than the average individual in the private sector healthcare labor market. Therefore, in this study, an invisible influence exists in all model outcomes related to the sample's self-selection into the civil service workforce. The result is, albeit inadvertent, study sample self-selection bias.

2. Research Method

This thesis utilizes descriptive analysis methods to explore the study population's demographic and professional characteristics and utilizes logistic analysis methods to study behavior. However, logistic analysis only predicts if an event occurs, not the time-to-an-event. Given the non-linear effect of total federal work years on attrition and its complex relationship with workforce age-at-hire and retirement eligibility, survival analysis, or non-parametric analysis methods could provide more accurate or clearer insights on workforce behavior relative to a worker's career lifecycle.

C. FURTHER INDICATIONS

a. Organizational Climate Change Effects on Attrition

The purpose of comparing the 2014 Cohort study sample group to the 2010 Cohort sample was for model and study sample sensitivity testing. However, when controlling for IPC value effects, this thesis may have inadvertently captured a partial effect related to the workforce's response to extreme organizational change related to the 2010 economic recession. The results indicate the 2010 Cohort sample yielded some differences in attrition behavior responses from the 2014 Cohort year. On average, ceteris paribus, while also controlling for IPC effects, retirement-eligible individuals and medical officers are more likely to attrite than retirement-eligible individuals and medical officers in the 2014 Cohort. Because IPC effects are controlled in this model, this behavior difference may be more closely related to external effects that are secondary to the economic recession, such as organizational behavior and culture changes.

While overall, workers in the 2010 Cohort remained employed for two additional work years on average than the 2014 Cohort sample, an increase in attrition rate in the retirement-eligible population occurs. As mentioned previously in this thesis, the recession was also correlated with federal hiring freezes, furloughs, policy changes, and a tighter budget. For the retirement-eligible population, the potentially dissatisfactory changes in the organization may have outweighed the benefit of another work year on retirement pension percentage payments. A medical officer is a critical, traditionally well-paid, and high-in-demand occupation with several continuing education requirements needed to maintain licensure. In the face of potentially dissatisfactory organization climate change and the removal of continuing education funding under fiscal budget constraints, the benefits of an increase in salary in the private market may have outweighed the value of diminishing non-monetary benefits in the civil service workforce.

b. Population is Likely Well Distributed but Likely a Limited Resource due to Propensity to Serve Factors

The 2014 Cohort demographic comparison to the private healthcare workforce indicates the civil service workforce may be proportionately more aged. The analysis results of the 2014 Cohort also indicate individuals in the subgroup who enter the civil service workforce at an older age are at an increased risk for attrition when a minimum retirement criterion is met. These findings could lead to the conclusion that this workforce is at risk for a future manpower gap because of an impending aggregate turnover related to aging out of the workforce. However, this thesis proposes a different assessment of this finding. A more mature population in terms of age and past work experience is not only aware of which organizations might provide a better job match but can also withstand the odious civil service hiring process. Therefore, this population subgroup is more likely to retain until retirement-eligibility criteria is met, because that is likely the individual's goal before even being hired.

The same propensity for civil service work applies to individuals of a younger age. While younger individuals are less likely to withstand the lengthy hiring process and are also still at a higher risk for attrition during their early years of employment compared to subsequent tenure milestones, they also exhibit a propensity for civil service before, during,

and after the job application process. If these individuals remain in the workforce past the first five years, they are at a decreased risk for attrition when a minimum retirement eligibility criterion is met.

The result of the distinct behavior of these subgroups throughout their career is a workforce that behaves more predictably within its subgroups and a system of various workforce entry and exit points. Individuals who have a propensity to serve in the civil service workforce who are also within these subgroups do not turn over quickly but rather make calculated attrition decisions in career span lengths of 5, 10, 20, and 30 years, depending on their retirement pension percentage desires. Therefore, a larger proportion of workers of an advanced age does not necessarily indicate a simultaneous workforce exit as individuals age out the workforce, because the next wave of mature hires who transfer from outside organizations for similar reasons will likely replace them.

Although the civil service healthcare workforce may not suffer a mass workforce exit soon, other implications for the future of this workforce structure related to its mature-in-age population. Several healthcare occupations are labor intensive and require physical body strength, conditioning, and stamina to fulfill all job requirements. In the MTF environment, the civil service workforce has been supplemental to the active duty military healthcare workforce. Because of enlistment and commission age restrictions and physical and health requirements required of military members during military employment, active duty individuals are, on average, in good health, in good physical condition, and young adult to middle-aged.

If leaders eliminate or reduce 17,000 active duty billets from the MTF environment, it will be difficult to replace them through private labor market recruiting. Firstly, the civil service hiring process and the compensation of civil service benefits in lieu of competitive pay does a respectable job of naturally eliminating individuals without a propensity to work in the public workforce. However, this unique workforce population with a propensity to service is not an unlimited resource that can easily be found in the private healthcare labor market, especially when many healthcare positions are in high demand. Secondly, even if enough of the public sector propensity workers exist to fill this potential future manpower gap, they would likely exhibit a similar proportion of worker-age distribution as the current

civil service healthcare workforce. The problem in this scenario is not a question of turnover but whether workers could physically perform all duties to the extent they are required without a mix of younger manpower available for assistance. Additionally, would these workers choose to remain in the workforce as their job becomes more labor intensive and if retirement eligibility requirements have already been met? If the active duty military manpower departs the MTF environment, it is probable the turnover rate will increase for retirement-eligible staff and likely surpass the increases that occurred in this subgroup during the economic recession.

VI. CONCLUSION

This purpose of this thesis is to explore the civil service healthcare workforce population and its attrition behavior during the career lifecycle. The benefit of this analysis is that it provides a population baseline for decision-making and policy-effects comparisons as the DHA executes a landmark organizational transition. Past workforce studies results indicate attrition rates increase during organization changes. The civil service workforce is not immune to this phenomenon as evidenced by this thesis's results of increase in attrition probability for the 2010 Cohort compared to the 2014 Cohort model results. The current proposal to realign or reduce over 17,000 active duty medical billets also puts the future DHA healthcare workforce at risk of a substantial manpower gap.

It is unlikely the private healthcare industry is capable or willing to absorb large amounts of deferred care to the network if the MTF cannot provide services due to reduced manpower. A recent RAND Corporation study reports that increases in Medicaid and Medicare compensation and coverage expansions will potentially change whether primary care providers continue to interact with the TRICARE program (Mulcahy et al., 2017). Another RAND Corporation study also reports a large proportion of private healthcare providers do not understand the unique health concerns or needs of the active duty, veteran, or beneficiary populations and may be unable to provide the same quality of care or services that are unique to this patient community and found in the MTF environment (Tanienlian et al., 2018).

Despite the workforce gap outlook, evidence exists the DHA is implementing some changes to address this issue. The 2017 DHA strategy map acknowledges the risk to manpower and places the workforce priority at the forefront as one of the four pillars of its integrated system of readiness and health (DHA, 2017). The DHA further specifies a workforce strategy goal is for the worker to feel empowered and valued at the command (DHA, 2017). This workforce strategy is in alignment with the findings from this thesis's literature review that the public workforce is better motivated through intrinsic incentives, such as empowerment (Sell & Cleal, 2011; Leider et al., 2016; Sampurna, 2018; Boekeloo et al., 2015; Blau, 2003). Lastly, the Military Health System official website's employment

information section reports entry-level positions are available and approved for expedited hiring authority for critical healthcare positions (DHA, 2019b). Historically, only experienced healthcare workers with at least two years of work experience were eligible to apply for healthcare positions. The reduction in both the experience requirement and the length of the hiring process is a step in the right direction to recruit a wider network of potential workers.

While all these changes indicate the DHA is strategizing appropriately, this thesis further reports implications and recommendations based specifically on this study's findings and findings from the literature review that go beyond the changes in policy that have already occurred.

A. RECOMMENDATIONS

1. Implications of Findings

a. Equality

(1) Reevaluate underrepresentation of minorities in white-collar positions and overrepresentation in blue-collar positions.

The healthcare industry in both the private and public labor market indicate minority populations are underrepresented in white-collar healthcare professions and conversely overrepresented in blue-collar healthcare positions. Additionally, while the healthcare industry in general is overwhelmingly female, men hold the most technical and highest-paid positions at a much greater proportion. To address this inequality requires societal cultural changes and education reforms on a larger scale. However, what is concerning is that the 2014 Cohort analysis shows, in the civil service workforce, African-Americans are even more underrepresented in the medical officer occupation than in the private healthcare industry. This thesis recommends immediate evaluation of equal opportunity practices related to this position and a refocusing of efforts in recruitment strategies to increase diversity in this profession.

b. Retain the At-Risk Populations

(1) Implementation of various forms of retention-related bonus pay

According to Sell and Cleal (2011), Leider et al. (2016), Sampurna (2018), Boekeloo et al. (2015), and Blau (2003), intrinsic motivators retain public sector workers, but extrinsic draws them to other organizations. To combat the temptation of outside organizations' extrinsic rewards, decision makers might consider an additional or increased specialty-related pay for critical and in-demand specialties, such as medical officers. McGrail (2017) and Cho and Lewis (2012) both found the persons of higher education were more likely to suffer attrition in early career and when approaching retirement age, especially when monetary rewards were included. Findings in this thesis are consistent with these studies and apply to the conditions unique to civil service medical officers. The incentive specialty-related pay should include yearly installments for a fixed number of years which will require the worker to remain in employment for a group of years, lest having to reimburse the prior bonus installments if they attrite before the end of their contract. In addition to specialty-related pay, this thesis study also recommends a contracted retention bonus if an individual has earned over 20 federal work years or if a retirement-eligibility criterion is met. The aim of this incentive is to motivate a worker to contractually remain in the workforce for a fixed number of years at the career junctures when they are at most risk for attrition and have already proved their organizational commitment.

(2) Implementation of increased education benefits

Providing continuing education opportunities at no cost is a huge retention tool for healthcare workers who require education units to maintain their certifications or licensures. Another potential retention incentive related to education is supporting individuals who pursue advanced education and certification in their field. Attrition motivated by the pursuit of advanced education likely occurs most often in the early career stages. This career stage is also a period where attrition risk is increased. Advancing employees' knowledge and skills are also a form of job-skill advancement and employee empowerment that adds intrinsic value to working at the organization.

(3) Widen the availability of part-time positions and increase the availability of child-care resources

The findings of this study are consistent with other research cited in the literature review that suggests females are not as great of an attrition risk compared to males as they were once considered to be. As early as 1989, Lewis and Park cited in their analysis that in the federal workforce, white-collar professions females did not exhibit higher turnover when considering age, promotion rates, salary differences, and tenure. This study echoes these findings. However, the results also suggest any attrition behavior differences for the female population compared to males was more pronounced during childbearing or family life event years. Yet, conversely, in subsequent career years, females were less likely to attrite than males. As family responsibilities merge between genders in modern society, the need for career interruption, flexible work hours, or extended affordable childcare is no longer a work barrier unique to female.

Additionally, healthcare shift workers in the private labor market are often provided the opportunity to work part time in addition to the availability of three 12-hour shifts being considered full-time work that meets benefits requirements. To remain competitive with the private labor market, especially for women and men with young children, this change is the most critical recommendation. Removal of this barrier is a strategy to both attract and retain young civil service workers who do not want to choose between professional and personal priorities. Additionally, the increased availability of part-time work or non-traditional work hours will likely have a positive impact on retention for the more mature-aged population who is considering the benefits of retirement against the benefits of working full time at a labor-intensive job.

c. Widen the Recruitment Pool

The results of this thesis suggest a certain population type chooses to enter the public sector and, more specifically, the civil service workforce. Reason suggests this population does not exist as an unlimited resource. Therefore, if a potential future manpower gap exists, the DHA and federal human resource policies need to consider how they can remove employment barriers and widen the workforce selection pool.

(1) Offer a sign-on bonus or tuition reimbursement

To widen the selection pool of civil service applicants, the DHA will have to compete with recruitment tactics in the private healthcare industry. Some of the hiring incentives that have become standard practice are a form of a sign-on bonus for critical positions even in marginal amounts. Additionally, a form of tuition reimbursement for direct clinical or patient-care occupations is a relatively standard recruitment tactic but can also be simultaneously utilized as a retention tool if the individual does not become eligible for the benefit until a fixed amount of tenure is achieved.

(2) Be prepared for increases in turnover rate and additional training requirements for new employees

When widening the selection and hiring pool, the proportion of the workforce that will be a good job fit is likely to be smaller in scale than historical workforce hiring proportions. Additionally, individuals are sometimes drawn to government work because of an affiliation through family, environment, or prior active duty service. A widened recruitment and selection pool will likely result in an increased proportion of the workforce that does not understand the unique needs of military and veteran patients. They may also not be familiar with the organizational culture and bureaucracy of the military and government environments. The result of this unfamiliarity should be an expected increase in turnover rates overall and a process to provide increased education and support to deal with these challenges throughout not only the hiring and orientation process but also the career lifespan.

(3) Implement official training programs for new graduates

Implementing training programs for certifications or training new nurses or medical officer graduates would be a tremendous public relations strategy for the DHA. Being responsible for a training program is time consuming and costly but also provides the facility with its own personal recruitment pool full of vetted individuals who are trained in the manner and quality the facility most desires in a new-hire candidate. A new hire could potentially develop a commitment to the organization during the time spent in the training

program. Hiring from a training pool can fast track workers through the risky job-sorting process that often leads to attrition during the early employment years.

(4) Assess the effects of newly implemented policy and strategies using the results of this thesis as a baseline comparison group

The results of this study provide information about a previously unknown population and provides the baseline demographic and professional characteristics of this workforce population and information on its associated turnover behavior. As the DHA plans, implements, and then evaluates new policy and strategies, baseline comparison measurements of this workforce will be essential to any meaningful evaluation of a current problem or a new program or policy's effectiveness.

2. Future Workforce Research

The baseline data of the civil service military healthcare workforce presented in this thesis serves a significant role in providing a reference point for future analysis of this specific workforce and potentially other healthcare and federal workforce studies. This thesis recommends the utilization of survival analysis or other non-parametric methods to assess the 2014 Cohort or future civil service healthcare populations. This thesis further recommends that job satisfaction survey analysis is conducted in the civil service healthcare population in conjunction with data analytics to better understand the personal, cultural, or external environmental factors associated with actual attrition behavior observed in the data.

Organizational transitions at the scale of the DHA integration are rare but provide a monumental opportunity to assess the effects of a large-scale leadership and system change on turnover behavior. This thesis adamantly recommends a follow-on study to this research to be conducted after the DHA transition is complete.

As a research community, an increased effort to utilize data that reflects true attrition behavior within a workforce when conducting workforce turnover research or workforce modeling needs to occur. As Bristol (2006), Cho and Lewis (2019), Cohen et

al. (2015), Gesesew et al. (2016), Lane (1998), Leider et al. (2016), Rambur et al. (2008), Rittenhouse et al. (2004), and Sell and Cleal (2011), both debate and show in their research results, turnover intention is not a reliable proxy or predictor of attrition. However, universal access to reliable data for researchers is limited. Studies from Cho and Lewis (2012), Cohen et al (2015), Copeland (2011), Kellough and Osuna (1995), Morgan (2018), and Moynihan and Landuyt (2008) and reports by Brien, (2019) and Buttrey, Klingensmith, and Whitaker, (2018) reveal the benefits of using federal personnel file data in performing research studies. There is a critical need to remove access barriers to this kind of data in the future while also protecting the integrity of a study subject's privacy exists. Hopefully this study's results contribute to the general knowledge on workforce turnover behavior for the research community and can serve to further justify the need for accurate workforce attrition data in research and workforce planning.

B. CONCLUSION

As DHA leaders continue to map out strategies for the MTFs regarding future capabilities and services, they will not only have to consider patient population healthcare needs, efficiency costs, and outside network capabilities but also what service capabilities these facilities can execute with the manpower who will remain and the workforce who can be recruited after this transition is complete. This thesis shows the civil service military healthcare workforce is similar in demographic and professional composition but unique in behavior compared to private sector healthcare workers. Therefore, retaining the current workforce will require intrinsic reward methods that are unique motivators for the current workforce. In contrast, not only are competitive extrinsic rewards also required to retain current workers at the margin of attrition but also to recruit a widened pool of applicants for the civil service workforce in the event of its likely workforce expansion. Without the essential baseline knowledge this thesis provides, there is simply no way forward in strategic planning and evaluation for an effective and functional healthcare system at the MTF level.

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APPENDIX

Descriptive Civilian Healthcare Workforce Demographic Comparisons (Cohort Years: 2010, 2014, 2018)																		
Demographic Category	**Sex**		**Race**			**Occupation**				**Collar**		**Cohort Year**			**Average Years**		
	Female	Male	Caucasian	African-American	Minority (Other)	Medical Officer	Nurse	Healthcare Professional (Other)	Health Tech or Clerical	Blue Collar	White Collar	2010	2014	2018	Average Age-at-Hire	Total Federal Working Years	Age in 2014
2010 Cohort (53,130 Total Population)	70.61%	29.39%	61.68%	21.86%	16.46%	5.32%	22.57%	16.88%	55.23%	55.23%	44.77%				35.92	14.26	
2014 Cohort (50,946 Total Population)	70.76%	29.24%	62.71%	21.01%	16.28%	5.22%	22.74%	17.52%	54.52%	54.52%	45.48%				36.51	13.19	46.37
2018 Cohort (43,044 Total Population)	71.24%	28.76%	61.45%	21.32%	17.24%	4.94%	22.99%	18.17%	53.90%	53.90%	46.10%				37.03	11.55	
Female (2010) Cohort	70.61%		42.19%	16.98%	11.58%	1.96%	19.50%	9.53%	39.63%	39.63%	30.98%	70.61%			35.25	14.2	
Female (2014) Cohort	70.76%		43.16%	16.17%	11.43%	1.92%	19.55%	9.88%	39.40%	39.40%	31.35%		70.76%		35.78	13.12	45.59
Female (2018) Cohort	71.24%		42.48%	16.42%	12.34%	1.82%	19.72%	10.27%	39.43%	39.43%	30.98%			71.24%	36.31	11.42	
Male (2010) Cohort		29.39%	19.49%	5.02%	4.88%	3.36%	3.07%	7.35%	15.61%	15.61%	13.78%	29.39%			37.53	14.41	
Male (2014) Cohort		29.24%	19.55%	4.84%	4.85%	3.30%	3.19%	7.64%	15.12%	15.12%	14.12%		29.24%		38.29	13.37	48.25
Male (2018) Cohort		28.76%	18.97%	4.89%	4.90%	3.11%	3.27%	7.90%	14.47%	14.47%	13.78%			28.76%	38.82	11.89	
Caucasian (2010) Cohort	42.19%	19.49%	61.68%			4.10%	15.89%	11.79%	29.90%	29.90%	31.78%	61.68%			36.62	13.57	
Caucasian (2014) Cohort	43.16%	19.55%	62.71%			4.06%	16.07%	12.27%	30.31%	30.31%	32.40%		62.71%		37.2	12.36	46.30
Caucasian (2018) Cohort	42.48%	18.97%	61.45%			3.80%	15.89%	12.42%	29.34%	29.34%	32.11%			61.45%	37.62	10.78	
African-American (2010) Cohort	16.98%	5.02%		21.86%		0.34%	3.25%	2.85%	15.42%	15.56%	6.44%	21.86%			34.27	15.71	
African-American (2014) Cohort	16.17%	4.84%		21.01%		0.32%	3.25%	2.92%	14.52%	14.52%	6.49%		21.01%		34.89	14.97	46.39
African-American (2018) Cohort	16.42%	4.89%		21.32%		0.31%	3.35%	3.16%	14.49%	14.49%	6.83%			21.32%	35.79	13.35	
Minority (Other) (2010) Cohort	11.58%	4.88%			16.46%	0.88%	3.42%	2.24%	9.96%	9.96%	6.55%	16.46%			35.49	14.95	
Minority (Other) (2014) Cohort	11.43%	4.85%			16.28%	0.84%	3.43%	2.33%	9.68%	9.68%	6.59%		16.28%		35.96	14.12	46.58
Minority (Other) (2018) Cohort	12.34%	4.90%			17.24%	0.82%	3.75%	2.59%	10.08%	10.08%	7.16%			17.24%	36.46	12.09	
Hispanic Ethnicity												2.89%	1.70%	4.19%			

% References Entire Cohort-Specific Population

Descriptive Civilian Healthcare Workforce Demographic Comparisons (Cohort Years: 2010, 2014, 2018) (Continued)

Demographic Category	Sex		Race			Occupation				Collar		Cohort Year			Average Years		
	Female	Male	Caucasian	African-American	Minority (Other)	Medical Officer	Nurse	Healthcare Professional (Other)	Health Tech or Clerical	Blue Collar	White Collar	2010	2014	2018	Average Age-at-Hire	Total Federal Working Years	Age in 2014
Medical Officer (2010) Cohort	1.96%	3.36%	4.10%	0.34%	0.88%	5.32%						5.32%			43.59	13.07	
Medical Officer (2014) Cohort	1.92%	3.30%	4.06%	0.32%	0.84%	5.22%							5.22%		44.56	12.37	53.63
Medical Officer (2018) Cohort	1.82%	3.11%	3.80%	0.31%	0.82%	4.94%								4.94%	44.93	11.12	
Nurse (2010) Cohort	19.50%	3.07%	15.69%	3.25%	3.42%		22.57%					22.57%			38.68	12.93	
Nurse (2014) Cohort	19.55%	3.19%	16.07%	3.25%	3.43%		22.74%						22.74%		39.00	12.08	47.80
Nurse (2018) Cohort	19.72%	3.27%	15.89%	3.35%	3.75%		22.99%							22.99%	39.01	10.39	
Healthcare Professional (Other) (2010) Cohort	9.53%	7.35%	11.79%	2.85%	2.24%			16.88%				16.88%			36.47	14.85	
Healthcare Professional (Other) (2014) Cohort	9.66%	7.64%	12.27%	2.92%	2.33%			17.52%					17.52%		36.36	13.66	47.82
Healthcare Professional (Other) (2018) Cohort	10.27%	7.90%	12.42%	3.16%	2.59%			18.17%						18.17%	37.38	11.84	
Health Tech or Clerical (2010) Cohort	39.63%	15.61%	29.90%	15.42%	9.96%				55.23%			55.23%			33.88	14.74	
Health Tech or Clerical (2014) Cohort	39.40%	15.12%	30.31%	14.52%	9.68%				54.52%				54.52%		34.56	13.59	44.81
Health Tech or Clerical (2018) Cohort	39.43%	14.47%	29.34%	14.43%	10.06%				53.90%					53.90%	35.34	11.99	
Blue Collar (2010) Cohort	39.63%	15.61%	29.90%	15.56%	9.96%					55.23%		55.23%			33.88	14.74	
Blue Collar (2014) Cohort	39.40%	15.12%	30.31%	14.52%	9.68%					54.52%			54.52%		34.56	13.59	44.81
Blue Collar (2018) Cohort	39.43%	14.47%	29.34%	14.43%	10.06%					53.90%				53.90%	35.34	11.99	
White Collar (2010) Cohort	30.36%	13.76%	31.76%	6.44%	6.55%						44.77%	44.77%			36.43	13.67	
White Collar (2014) Cohort	31.35%	14.12%	32.40%	6.49%	6.59%						45.46%		45.46%		36.66	12.72	46.24
White Collar (2018) Cohort	30.38%	13.78%	32.11%	6.83%	7.16%						46.10%			46.10%	39.00	11.04	
Retirement Eligible (2014) Cohort	21.53%	10.39%	19.19%	7.18%	5.55%	2.54%	7.56%	5.99%	15.83%	15.83%	16.10%		31.92%		40.53	20.58	57.77
Attrite (2014) Cohort	26.21%	10.14%	24.51%	6.79%	5.05%	2.07%	8.49%	5.64%	20.15%	20.15%	16.20%		36.35%		36.71	11.91	46.84

% References Entire Cohort-Specific Population

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