Associations between Risk Perception, Smoking Behaviors, and Lung Cancer Screening in Smokers Receiving Inpatient Tobacco Treatment: A Prospective Study

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LIST OF ABBREVIATIONS

AUDIT	Alcohol Use Disorders Test
AUDIT-C	Alcohol Use Disorder Identification Test–Consumption
CDC	Centers for Disease Control
CMS	Centers for Medicare and Medicaid Services
COPD	Chronic Obstructive Pulmonary Disease
CPD	Cigarettes per day
CHD	Coronary Heart Disease
CVD	Cardiovascular Disease
IOM	Institute of Medicine
JCAHO	Joint Commission on the Accreditation of Healthcare Organizations
LDCT	Low-Dose Computed Tomography
MI	Myocardial Infarction
NLST	The National Lung Screening Trial
Pre-TTS	(Pre) Before exposure to Tobacco Treatment Services
Post-TTS	(Post) After exposure to Tobacco Treatment Services
RTQ	Readiness to Quit Ladder
SRD	Smoking-related disease
TTFC	Time to first cigarette
TTS	Tobacco Treatment Service
WHO	World Health Organization
VUMC	Vanderbilt University Medical Center

USDHHS	United States Department of Health and Human Services
USPHS	United States Public Health Service

CHAPTER I

Introduction

Scope of the Problem

Tobacco use is the leading cause of preventable death in the United States, and standard cigarettes are the most commonly consumed type of tobacco (United States Department of Health and Human Services [USDHHS], 2014). Smoking-related health conditions are a major cause of morbidity and mortality (USDHHS, 2014). Smoking, in any form, harms nearly every organ in the body and is linked to an estimated 90% of carcinomas affecting the trachea, bronchus, and lungs (American Cancer Society, 2015; Centers for Disease Control and Prevention (CDC), 2015a; CDC, 2015b; CDC, 2016; National Institute of Drug Abuse [NIDA], 2012). Lung cancer is the second most common type of cancer and the leading cause of cancer-related death in the United States, accounting for almost 25% of all cancer-related deaths (American Cancer Society, 2017).

Despite scientific evidence validating the serious health consequences of smoking cigarettes, most people do not accurately perceive the extent to which smoking increases the probability of adverse health outcomes (Boney-McCoy et al., 1992; CDC, 2007; Krosnick et al., 2017). Although the number of cigarettes consumed per smoker has decreased over time, a smoker's risk of developing a smoking-related disease or lung cancer has continually increased, when compared to the overall risk of lung cancer in the U.S. (USDHHS, 2014). In fact, cigarette smokers are 15 to 30 times more likely to be diagnosed or die from lung cancer than people who do not smoke (USDHHS, 2014). Unfortunately, most smokers do not understand or choose to ignore the severity of lung cancer or other health conditions attributable to smoking (Ayanian & Cleary, 1999; Cummings et al., 2004; Gallup Organization, 2014; Rutten et al., 2008; Weinstein, Slovic, Waters, & Gibson, 2004).

Smokers that have developed adverse medical conditions are at an increased risk for developing disabling health problems. Medical care for this unique population of smokers contributes to added costs for health care and these costs are estimated to exceed more than $300 billion each year in lost productivity and direct medical care (CDC, 2016; Fiore & Gopelrud, 2012; USDHHS, 2014; Xu et al., 2016). More than 16 million American smokers are confronted with the diagnosis of a smoking-related cardiopulmonary disease, including four of the eight leading causes of death worldwide: 1) ischemic heart disease, 2) cerebrovascular disease, 3) lower respiratory infections, and 4) chronic obstructive pulmonary

disease (CDC, 2016). Lung cancer is prevalent among smokers in the United States as well, with 222,500 new cases reported in 2014 (American Cancer Society, 2017). Because smokers do not typically take advantage of available tobacco treatment resources (WHO, 2011), national clinical guidelines were developed to guide practitioners in smoking cessation strategies and some of these include assessing motivation to quit, and advising cessation at every primary care medical encounter (Larzelere & Williams, 2012; Radziewicz et al., 2009; Song et al., 2009).

Hospitalization offers an optimal environment to deliver evidence-based treatment for tobacco dependence and serves as venue to facilitate smoking cessation and coordinate lung cancer screening services (American Cancer Society, 2015; Fiore et al., 2008; Fiore & Gopelrud, 2012; Rigotti et al., 2014; Tanni et al., 2009; USDHHS, 2014). Hospitals accredited by the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) mandate patient smokers to temporarily abstain from cigarette smoking inside of the facility and around the surrounding premises (Centers for Medicaid and Medicaid Services [CMS], 2015; Fiore & Gopelrud, 2012; JCAHO, 2015; Regan, Viana, Reyen, & Rigotti, 2012; Ylioja et al., 2017). Once admitted into the hospital, smokers are subjected to tobacco screening questions and an "opt out" discussion regarding treatment interventions that support smoking cessation (CMSa, 2015). Additional clinical practice guidelines recommend coordinated hospital services to refer older, high-risk smokers to undergo advanced lung cancer screening via low-dose computed tomography (LDCT) to detect early signs of lung cancer (Blackmon & Feinglass, 2015; CMSb, 2015; Fiore et al., 2008; Gillaspie & Allen, 2015; The National Lung Screening Trial [NLST], 2011). LDCT imaging is more effective than conventional screening methods for early identification and has been proven to reduce the incidence of lung cancer mortality by 20% (NLST, 2011).

Purpose of the Study

Some past studies have produced inconsistent results when testing whether smokers accurately estimate their own actual health risk of experiencing smoking-related illness (Weinstein, Marcus & Moser, 2004). However, general consensus indicates that smokers may discount the increased risk they face from continued smoking and do not view themselves at risk of heart disease or cancer (Ayanian & Cleary, 1999; Weinstein, 2004). In addition, a smoker's perception of health risks has been shown to predict several smoking behavior variables (e.g., a desire to quit, smoking cessation) among ambulatory smokers (Institute of Medicine [IOM], 2012; Sone et al., 2009; United States Public Health Service [USPHS], 2014). Evidence also indicates that perceived risk influences compliance with recommendations to complete lung cancer screening via LDCT in outpatient settings (Borelli et al., 2010;

Carere et al., 2015; IOM, 2012; Park et al., 2013; Waters, McQueen, & Cameron, 2014). Perceptions of smoking-related health risks refer to subjective judgments about the probability of the occurrence of negative outcomes. Although there is literature on how a smoker's perceived risk impacts smoking behaviors and related outcomes, the perceived risk of hospitalized smokers has been less well studied.

Inpatient tobacco treatment programs offer an opportunity to provide smokers with an objective estimate of risk for developing a smoking-related health condition and advice about quitting (Reid et al., 2015). In addition, the delivery of tobacco treatment interventions in a hospital setting may encourage the smoker to quit or reduced smoking frequency in an effort to enhance medical recovery (Krosnick et al, 2006; Reid et al., 2015). Others have reported that if an individual has a higher perceived risk of developing a negative health outcome at one point in time, they are more likely to engage in future health-protective behaviors (Janssen et al., 2011; Waters, McQueen, & Cameron, 2014). However, perceived risk in smokers is a complex concept and is dependent upon multiple contextual risk factors (American Cancer Society, 2015; Brewer et al., 2004; Scientific Standards for Studies on Modified Risk Tobacco Products, 2012; Waters, McQueen, & Cameron, 2014).

The purpose of this study was to evaluate a smoker's change in perceived risk for developing a smoking-related health condition before (pre-TTS) and after (post-TTS) exposure to an inpatient tobacco treatment program and examine the influence of perceived risk, in the context of smoking risk factors, on subsequent smoking-behavior outcomes. The study was conducted at Vanderbilt University Medical Center (VUMC). VUMC has implemented the national clinical guidelines and JCAHO standards, which mandate tobacco screening and inpatient tobacco treatment services for all hospitalized current smokers. The Vanderbilt University Medical Center (VUMC) Tobacco Treatment Service (TTS) program was created to provide a brief, inpatient tobacco treatment intervention for all self-identified, adult ($\geq$18 years) cigarette smokers admitted for an inpatient hospital stay. The VUMC TTS employs Certified Tobacco Treatment Specialists (CTTS) who visit each hospitalized smoker at the bedside for an "opt-out" consultation and perform evidence-based standard-of-care treatment for tobacco dependence.

Specific Aims and Hypotheses

Study aims were accomplished by using a descriptive and correlational research design to explore change in perceived risk and identify covariate factors that may moderate the relationship between perceived risk and a variety of smoking behaviors among hospitalized smokers. The following aims describe the specific study goals:

Aim 1

Identify the extent and nature of change (from before inpatient tobacco treatment [pre-TTS] to after inpatient tobacco treatment [post-TTS]) in perceived risk of smoking-related health condition among hospitalized smokers exposed to a brief, inpatient tobacco treatment program.

Aim 2

Evaluate the influence of perceived risk of smoking-related health condition, in the context of smoking risk factors, on readiness to quit smoking among hospitalized smokers exposed to a brief, inpatient tobacco treatment program.

Hypothesis 2.1. Perceived risk pre-TTS, in the context of smoking risk factors, will influence readiness to quit smoking, as evidenced by the individual's subjective desire to quit smoking as assessed by a contemplation ladder at study enrollment.

Aim 3

Determine relationships between perceived risk of smoking-related health condition, in the context of smoking risk factors, and subsequent smoking behavior outcomes among hospitalized smokers exposed to a brief, inpatient tobacco treatment program.

Hypothesis 3.1. The higher the perceived risk (pre-TTS) for developing smoking-related health condition in the context of smoking risk factors at study enrollment, the greater the likelihood of positive smoking behavior outcomes at the three-month follow-up: 1) non-smoking status (defined as self-reported, 30-day point prevalence abstinence), 2) self-report of a an attempt to quit smoking (defined as whether or not the smoker abstained from smoking cigarettes for greater than one day because they were trying to quit between study enrollment and follow-up), and 3) significant reduction in cigarette consumption (defined as $\geq$ 50% reduction in the number of cigarettes smoked per day at follow-up relative to cigarettes per day self-reported at study enrollment).

Hypothesis 3.2. The higher the perceived risk (pre-TTS) for developing smoking-related health condition, in the context of smoking risk factors at study enrollment, the greater the likelihood smokers will self-report participation in evidence-based inpatient TTS modalities, including 1) acceptance of the recommendation followed by subsequent use of pharmacologic tobacco treatment and 2) acceptance of the referral followed by subsequent involvement in behavioral tobacco treatment via the state tobacco quit line).

Aim 4

Determine the relationship between perceived risk of smoking-related health condition, in the context of smoking risk factors, and completion of lung cancer screening imaging via LDCT among older, high-risk, hospitalized smokers exposed to a brief, inpatient tobacco treatment program.

Hypothesis 4.1. The higher the perceived risk (post-TTS) for developing smoking-related health condition, in the context of smoking risk factors at study enrollment, the greater the likelihood that imaging for lung cancer screening via LDCT will be completed among eligible, high-risk smokers (acceptance of the referral for lung cancer screening followed by having the scan completed) at the three-month follow-up.

Significance of the Research

Perceived risk is a concept included in many health behavior models and has been used to inform the development and evaluation of tobacco treatment programs in both ambulatory and inpatient settings (Faseru et al., 2011; Janz & Becker, 1984; PHS, 2008; Reid et al., 2015; Rigotti et al., 2014; Rigotti, Munafo, & Stead, 2008; Rogers & Prentice-Dunn, 1997; Weinstein, 1988). Findings from tobacco intervention studies indicate that a smoker's perceptions of risks, benefits, and expectancies associated with cigarette smoking can predict smoking behaviors, sustain abstinence after discharge, and promote cancer screening (McQueen, Swank, Bastian, & Vernon, 2008; Radziewicz et al., 2009; Song et al., 2009). However, no studies, to date, have investigated the direct influence of health risk perceptions on smoking behavior variables or preventive lung cancer screening via LDCT among inpatient smokers.

In conclusion, smokers are at an increased risk for developing significant health burdens associated with development or progression of smoking-related cardiopulmonary disease and lung cancer. An inpatient hospital stay remains a relatively unexplored setting to deliver treatment interventions for tobacco dependence and coordinate lung cancer screening services for older, high-risk smokers (American Cancer Society, 2015; Tanni et al., 2009; USDHHS, 2014). This study will generate new knowledge in tobacco research related to the effects of inpatient tobacco treatment on health risk perceptions of smoking and the influence of perceived risk on short-term smoking behavior variables and lung cancer screening after hospital discharge. The study will also inform the care process of the VUMC TTS program by providing data about their patients' smoking status and report of participation in various aspects of the inpatient tobacco treatment program.

Chapter II

Literature Review and Theoretical Framework

The purpose of this chapter is to: 1) describe the health and economic implications related to cigarette smoking; 2) elucidate the influence of perceived risk for developing smoking-related health condition on smoking behavior and lung cancer screening outcomes; 3) provide a brief overview of theoretical approaches used to investigate perceived risk in relation to health behaviors and tobacco use; and 4) demonstrate how a conceptual model that synthesizes health communication and preventive behaviors is representative of relationships between study variables. Several terms are defined at the outset and these include: 'perceived risk'/'health risk perception' associated with optimistic bias, 'smoking status'/'smoker', and 'hospitalization'/ 'inpatient status'.

Introduction of Key Terms

Perceived risk is a central construct among health behavior theories that describes an individual's beliefs about the potential harms of an event or how they understand and experience a situation that may be hazardous to their health (Brewer et al., 2007; Oltedal, Moen, Klempe, & Rundmo, 2004). The term *perceived risk* represents a variety of analogous constructs known to influence human behavior that may be labeled as risk perception, perceived susceptibility, perceived vulnerability, perceived likelihood, or feelings of risk (Waters, McQueen, & Cameron, 2014). Risk can be perceived from either an individual viewpoint or in comparison to others. *Personal risk* describes how likely the individual is to independently experience a hazardous event. *Comparative risk* describes how likely a person is to experience a hazardous event compared to another person that shares similar characteristics (Waters, McQueen, & Cameron, 2014). Generally, individuals tend to believe that other people have a greater chance of experiencing a negative event than themselves and will disregard the base rate of an event occurrence (Klein & Stefanek, 2007; Oltedal et al., 2004). Conversely, *actual risk* is the objective likelihood of experiencing a hazardous health outcome over a specific time period and calculated from statistics and probability distributions (Oltedal, Moen, Klempe, & Rundmo, 2004; Waters, McQueen, & Cameron, 2014).

Smokers typically underestimate their relative risk to develop negative health consequences compared to non-smokers and often believe they have a lower risk of developing lung cancer than the average smoker (Ayanian & Cleary, 1999; Dillard & Klein, 2006; Weinstein, Marcus, & Moser, 2005). This *optimistic bias* in such comparative risk judgments remains even when the smoker has historically smoked heavily throughout their lifetime (Weinstein, 1998). Current and former smokers are also known to mistakenly believe myths that exercise can reverse most of the effects of smoking and that lung cancer is determined primarily by genes (Weinstein, Marcus, & Moser, 2005). In addition, smokers claim that, compared to the average smoker, they smoke fewer cigarettes per day, smoke cigarettes with toxins and nicotine content, inhale less deeply, are less addicted, and have a healthier lifestyle (Segerstrom, McCarthy, & Caskey, 1993; Weinstein, Marcus, & Moser, 2005). They also greatly overestimate the likelihood that their next quit attempt will be successful (Weinstein, 2004).

In this study, active *smoking status* is defined as self-reports current or recent exposure to inhaled nicotine from tobacco through a cigarette within the past month (30-day point prevalence). This definition applies to both daily and non-daily cigarette smokers but excludes other tobacco products such as cigars and pipes, and smokeless tobacco products in which nicotine is absorbed in the oral or nasal cavity, such as spit tobacco or snuff (WHO, 2017). This definition also excludes inhaling nicotine from an electronic nicotine device system, commonly referred to as e-cigarettes or vapors. Lastly, the terms *hospitalization or inpatient status*, refer to the admission of a patient into the hospital for a minimum of one overnight stay to undergo treatment that requires surveillance by medical professionals (Medicare.gov, n.d.). The definition of this term excludes emergency room admissions or same day surgery/procedure admissions.

Review of the Literature

Prevalence of Cigarette Smoking and Effects of Tobacco Use

Prevalence of Cigarette Smoking. Approximately 15% of the adult population in the United States are daily smokers (CDC, 2015; Jamal et al., 2016). Smoking prevalence is typically assessed by frequency of cigarette consumption, or the number of cigarettes smoked per day (CPD). Certain sociodemographic variables are associated with CPD. For example, CPD are greater for men (18 to 64 years), certain racial/ethnic groups (e.g., American Indian), minority groups, the unemployed, and those with less than high school education. Cigarette smoking rates are also greater within households with a combined incomed below the poverty threshold and in individuals with co-existing mental health

illnesses, alcoholism, or other substance abuse issues (CDC, 2015b; CDC, 2016; Lasser et al., 2000; Terry et al., 2017).

Health Effects of Cigarette Smoking. Cigarette smoking harms nearly every organ in the body and is a major risk factor for many chronic conditions. Smoking increases the risk of developing Type 2 diabetes, age-related macular degeneration, blindness, cataracts, hip fractures, rheumatoid arthritis, impaired immune function, periodontitis, and overall diminished health (USDHHS, 2014). Smoking is known to slow bone and wound healing, which may interfere with medical recovery from trauma or breakdown (Fiore et al., 2008). Smoking is also linked to other cancer diagnoses, such as acute myeloid leukemia and dysplasia that develops in the head, neck, esophagus, stomach, liver, pancreas, kidney, ureter, cervix, bladder, colon, and rectum (USDHHS, 2014).

More than 16 million Americans live with a smoking-related cardiopulmonary disease (CDC, 2016). Coronary heart disease (CHD) is the leading cause of death in the United States, killing more than 800,000 people a year (CDC, 2014). Cigarette smoking is a major risk factor for CHD by causing progressive narrowing of blood vessels leading to the heart (CDC, 2014; USDHHS, 2014). Other cardiovascular smoking-related diseases include peripheral arterial disease, stroke, myocardial infarction, and abdominal aortic aneurysm (USDHHS, 2014). Almost 8 million Americans have had a myocardial infarction (MI) and 7 million have had a stroke (CDC, 2017). But, people who continue to smoke after a MI or stroke are more likely to experience a second event and subsequent death (Fiore et al., 2008). The third leading cause of death in the United States is chronic obstructive pulmonary disease (COPD), which is an inflammatory lung disease that includes chronic bronchitis and emphysema (CDC, 2017; USDHHS, 2014). Among 15 million U.S. adults with COPD, 39% continue to smoke (CDC, 2011). Additional smoking-related pulmonary conditions, include asthma and pneumonia (USDHHS, 2014).

Cigarette smoking is the leading risk factor for lung cancer. Lung cancer is the leading cause of cancer-related death in the United States, accounting for almost 25% of all cancer deaths (American Cancer Society, 2017; CDC, 2014; CDC, 2017). Common symptoms experienced with a diagnosis of lung cancer are persistent cough, pleuritic chest pain, hoarseness, sputum streaked with blood, reoccurring bronchitis or pneumonia, a new onset of wheezing, weight loss and anorexia, worsening shortness of breath, lethargy, and weakness (American Cancer Society, 2015; American Cancer Society, 2017; Little, Gay, Gaspar, & Stewart, 2007; Molina et al., 2008). Approximately 90% of people diagnosed with lung cancer will ultimately die of the disease, but some do survive with early detection and effective treatment (Fiore et al., 2008; Moyer, 2014). Persons with lung cancer that continue to smoke place themselves at an elevated risk for developing a reoccurrence of cancer in a similar region (Fiore et al., 2008).

Tobacco use has caused the death of 100 million people worldwide in the 20th century (WHO, 2011). The annual death toll of cigarette and other tobacco use in the United States is approximately

400,000 to 500,000 deaths, and lung cancer is responsible for approximately half of those deaths (~155,000) (American Cancer Society, 2017; CDC, 2014; cdc.gov, updated May 31, 2017; USDHHS, 2014). Unfortunately, the mortality rate of cardiopulmonary smoking-related disease far exceeds the number of lung cancer deaths each year along with a combined total of all deaths attributed to alcohol, homicide, illicit drug use, suicide, and AIDS (CDC, 2016; CDC.gov, updated May 31, 2017; Giovino et al., 2009; IOM, 2007; NIDA, 2012; USDHHS, 2014). These health-related effects of cigarette smoking and nicotine dependence generate significant costs to the individual consumer and society.

Economic Effects of Cigarette Smoking. Of the $3 trillion of federal debt in the United States, health care expenditures attributable to cigarette use account for at least 20% of this federal debt (Kaiser Family Foundation, 2012; USPHS, 2014). Annual expenses specifically caused by smoking-related morbidity and mortality each year can equal at least $156 billion and up to $170 billion (CMS, 2015; Terry et al., 2017). Finally, an additional $6 billion in health care expenditures each year are related to second-hand cigarette smoke exposure (USDHHS, 2014). The financial burden associated with cigarette smoking is intensified by health care expenditures of more than $289 billion from lost work productivity, workplace absenteeism, shortened work lives, disability, missed opportunities for prevention of smoking-related diseases, and premature death (IOM, 2007; USDHHS, 2012). Unfortunately, taxpayers are held responsible to pay for the enormous amount of health care debt related to smoking-related health condition (USDHHS, 2014).

Nicotine Addiction and Benefits of Smoking Cessation

Nicotine Addiction. Smoking cessation is difficult for many individuals, because cigarette smoking is associated with the rapid delivery (10-60 seconds of inhalation) of nicotine to the brain which promotes cycle of nicotine addiction (Benowitz, 1996). Nicotine is a highly addictive compound which stimulates the release of the neurotransmitter dopamine, creating the transient feeling of pleasure and calmness (Benowitz, 2010). However, smoking cessation can significantly reduce a smoker's existing risk of short- and long-term health problems associated with the development of smoking-related cardiopulmonary disease and lung cancer (Godtfredsen et al., 2008; Peto et al., 2000; U.S. Preventive Services Task Force [USPSTF], 2013). Although variable among individuals, cigarette smokers become quickly addicted to nicotine (Benowitz, 2010; Danni & Harris, 2005). For example, with brief periods of smoking cessation (e.g., several hours) a smoker may experience nicotine withdrawal symptoms such as feelings of irritability, strong cravings or urges to smoke, depression/anxiety, cognitive/attention deficits, sleep disturbances, and increased appetite (Hendricks et al., 2006; National Institute for Drug Addiction

[NIDA], 2012). With long-term tobacco use, a smoker's brain experiences an upregulation of nicotinic-acetylcholine receptors, which causes the brain to require increasing amounts of nicotine to operate normally and avoid experiencing withdrawal (Benowitz, 2010; Danni & Harris, 2005). As a result, smokers develop compulsive drug seeking behaviors and continue to smoke despite negative health consequences (NIDA, 2012).

Benefits of Smoking Cessation. Of the 60 million daily smokers in the United States, most will acknowledge the harmful effects of tobacco; and more than half may express a desire to quit (NIDA, 2012). Unfortunately, 85% of smokers who try to stop smoking without tobacco cessation treatment interventions, relapse as quickly as within the first week (NIDA, 2012). Evidence-based, population-level tobacco treatment interventions/guidelines include methods for tobacco screening and assessment, along with recommendations to provide FDA-approved prescription and over-the-counter medications, offer behavioral counseling via state tobacco quit lines, and disseminate anti-smoking mass media messages (Terry et al., 2017). Nicotine replacement medications which are available in different formulations (e.g., gum, patches, and inhalers) can alleviate the physical withdrawal effects of nicotine, but cravings still often persist (NIDA, 2012). This gap in treatment is filled by applying behavioral therapy to help smokers identify triggers and implement coping strategies to manage nicotine withdrawal (NIDA, 2012). With the support of pharmacological treatment, 11 to 20% of smokers can remain abstinent for at least six months (Sutherland, 2003). Even healthy smokers can also experience a modest reduction in cardiovascular risk if they are able to reduce their level of nicotine dependence by smoking at least 50% less cigarettes per day (Hatsukami et al., 2005; Mooney, Johnson, Breslau, Beirut, & Hatsukami, 2011).

There are many sociodemographic, behavioral, environmental, and health-related variables related to smoking behaviors and health outcomes. However, the most widely accepted predictors of abstinence failure are the presence of a smoking-related disease, advanced age, less desire or readiness to quit, time to first cigarette (TTFC) within 5 minutes of waking in the morning, an indication of greater nicotine dependence and, overall diminished health (Lando, Hennrikus, McCarty, & Vessey, 2003; USDHHS, 2014). When compared to non-smokers, current and former smokers often report fewer preventive outpatient medical visits, thus increasing their risk for developing a smoking-related disease and the likelihood of requiring a hospital admission to treat conditions that have progressed to an advanced state (USDHHS, 2014). These findings further support the connection between nicotine dependence, health status, tobacco treatment, and smoking behaviors.

Tobacco Treatment and Lung Cancer Screening

Inpatient Tobacco Treatment. A hospitalization is a unique opportunity to implement tobacco treatment interventions and preventive screening activities among adult smokers. This is because: 1) A smoking-related health condition is the leading cause of hospitalizations in the United States (Fiore & Gopelrud, 2012; WHO, 2011); 2) A hospitalization may represent a vulnerable health state, in which the smoker may be more likely to appreciate a connection between their poor health and short-term risk perception (Becker & Janz, 1987); 3) Hospitalized smokers are in constant contact with health professionals during their inpatient stay and may be more willing to accept expert advice about quitting (CMSa, 2015; Johnson et al., 1999; Regan et al., 2012); 4) Hospitalized smokers must temporarily abstain from smoking due to JCAHO safety regulations (JCAHO, 2015); 5) Hospitalized smokers are a captive audience to receive evidenced-based tobacco treatment from a tobacco treatment expert and learn how smoking affects their health risk (Fiore & Gopelrud, 2012; France, Glasgow, & Marcus, 2001; Rigotti et al., 2012; Ylioja et al., 2017); and 6) During their forced abstinence, inpatient smokers may receive nicotine replacement and other therapies to mitigate nicotine withdrawal symptoms which may motivate smokers to maintain cessation after hospital discharge (Fiore & Gopelrud, 2012; France, Glasgow, & Marcus, 2001; Rigotti et al., 2012; Rigotti et al., 2014; Ylioja et al., 2017).

There are evidence-based guidelines for cessation of tobacco use in hospitalized smokers. Current guidelines were developed using data from clinical trials and modeled by the Ottawa Model for Smoking Cessation (OMSC) (Mullen, 2017; Rigotti et al., 2012; Fiore et al., 2008). The OMSC model includes specific evidence-based interventions in all hospitalized smokers and as noted above includes identifying and documenting smoking status, providing a brief counseling session and in-hospital pharmacotherapy to smokers, and offering follow-up support post-hospitalization (Mullen et al., 2017; Reid et al., 2010; Reid, Pipe, & Quinlan, 2006). Previous studies investigating the OMSC provide evidence that simple, systematic support to smoking cessation within a health care setting can lead to a significant increase in quit attempts and improve long-term cessation by an absolute 11% (from 18% to 29%) among hospitalized patients who smoke (Reid et al., 2010).

Others have examined the effectiveness of implementing the Joint Commission's standards at several large medical institutions in the U.S. (Fiore et al., 2008; Fiore et al., 2012; National Quality Forum [NQF], 2014; Rigotti et al., 2012; Rigotti et al., 2014). Active participation with inpatient tobacco treatment interventions can significantly reduce a smoker's risk of developing a smoking-related health condition and improve outcomes for smokers already living with a related heart or lung condition, regardless of the smoker's initial interest in receiving treatment (CMSa, 2015; Rigotti, Munafo, & Stead, 2008). In addition, smokers who successfully abstain for the duration of their hospital stay may

experience an increase in self-efficacy regarding quitting, which greatly improves their odds of experiencing a successful long-term behavior change (Duffy, Scholten, & Karvonen-Gutierrez, 2010; Rigotti, Munafo, Murphy, & Stead, 2001; Shmueli, Fletcher, Hall, Hall, & Prochaska, 2008). Research findings suggest that inpatient interventions for tobacco dependence are more likely to produce significant results when a follow-up assessment is completed one week to six months after hospital discharge by a quit line counselor or quit coach, automated voice response telephone call, or home visit (Faseru et al., 2011; France, Glasgow, & Marcus, 2001; Reid et al., 2015; Rigotti et al., 2015).

Low-Dose Computed Tomography (LDCT) Lung Cancer Screening. A critical factor to determine an individual's actual risk for developing lung cancer is cumulative exposure, which considers one's age, frequency of tobacco consumption (CPD), and duration of smoking (number of years since smoking initiation) (American Cancer Society, 2015; USDHHS, 2014). The incidence of a lung cancer diagnosis attributable to cumulative cigarette exposure has been verified in a multivariate model. Modeling demonstrates that current smokers 55 years and older are within the highest (60%) risk category and account for 88% of all preventable lung cancer deaths (Moyer, 2014; USPSTF, 2013). Fortunately, high-risk smokers who quit experience a reduction in lung cancer risk that continues to decline as the duration of time since smoking cessation is extended (Tindle et al., 2018). Other significant risk factors for lung cancer include: personal or family history of malignancy; radiation of the chest; diagnoses of COPD, pulmonary fibrosis, or pneumonia; and occupational or environmental exposure (American Cancer Society, 2017; CDC, 2014; Shepshelovich et al., 2015; USDHHS, 2014; USPSTF, 2013). Occupational exposure is likely in industries involved in paving, rubber, roofing, painting, and chimney sweeping. Environmental risks are associated with exposure to secondhand tobacco smoke, asbestos, radon gas released from soil and buildings, air pollution, diesel exhaust, and certain metals (USDHHS, 2014).

Most cases of lung cancer are discovered after the disease has advanced to a point where curative treatment is not possible (American Cancer Society, 2015; American Cancer Society, 2017; CDC, 2015a; Manser et al., 2013). Individuals diagnosed with late-staged lung cancer are potentially disadvantaged with a 5-year survival rate of 4% to 17% compared to an overall 5-year survival rate of 15% for men and 21% for women who do not have lung cancer (American Cancer Society, 2015; American Cancer Society, 2017, Moyer, 2014; Shepshelovich et al., 2015; USPSTF, 2013). It is evident that long-term smokers, diagnosed with chronic bronchitis or emphysema, are more likely to delay seeking medical evaluation of symptoms that suggest lung cancer due to a combination of individual and psychosocial factors and failure to recognize the seriousness of their symptoms (Smith, Pope, & Botha, 2005).

Relationships between Perceived Risk and Smoking

Tobacco literature has established that the perception of risk for developing a smoking-related cardiopulmonary disease does influence smoking behaviors and lung cancer screening among current, adult smokers. Perceived risk, in the context of cigarette use, represents a smoker's beliefs about potential harms of hazardous smoking effects to their health (Brewer et al., 2007; Oltedal, Moen, Klempe, & Rundmo, 2004). Although smokers often fail to acknowledge the impact of smoking on quality of life, health behavior theories support that higher levels of perceived risk can encourage smokers to take action to improve overall health and reduce their overall actual risk for developing a smoking-related health condition (Gibbons, McGover, & Lando, 1991; Montes et al., 2007; Onken et al., 2005; Waters, McQueen, & Cameron, 2014). Data from longitudinal studies found that perceived risk and smoking abstinence are positively associated (IOM, 2012; USPHS, 2014). Data from cross-sectional studies also indicate that smokers reporting higher levels of perceived risk are more worried about developing lung cancer and more likely to adhere to recommendations for screening procedures in order to prevent death ($p<0.05$) (Montes et al., 2007).

Risk Perception and Smoking Behaviors. To assess the findings related to perceived risk and smoking behaviors in previous tobacco intervention studies, a literature review was conducted focusing on twelve (12) studies, based on an inclusion criterion that risk perception was a predictor or outcome variable of a smoking behavior (e.g., smoking status, smoking cessation, motivation to quit, quit attempts, CPD, TTFC, cutting back, etc.). Among the included studies, perception of health risks related to smoking was examined at baseline, prior to implementation of an intervention only, immediately after implementation of an intervention only, or at both time points before and after an intervention. The study outcomes identified included change in perceived risk, lung cancer screening via LDCT, and a variety of smoking behaviors.

Relevant findings indicate a variation in baseline levels of smoking-related perceived risk among groups of smokers and identified specific variables that influence a change in perceived risk over time (Appendix A). Seven prospective studies were examined that specifically evaluated longitudinal change in perceived risk. These studies were evaluated to predict the direction of change in perceived risk experienced as a result of a tobacco-related intervention. Unfortunately, baseline perceived risk levels reported among these studies may have been biased due to the inclusion of non-smoking participants (Carere et al., 2015; Persky et al., 2010). Randomized controlled trials, not included in this review, have reported measures of perceived risk among hospitalized smokers, but risk perceptions were not the primary outcome variable nor was risk perception included as a modifying variable of smoking behavior

(Rigotti et al., 2014; Rigotti et al., 2016). None of the studies included in this review explored hospitalized smokers, but one study did present data to evaluate perceived risk among medically ill patients in an outpatient setting (Borelli et al., 2010).

In summary, there are several important findings from review of these studies on estimates of baseline perceived risk in self-identified, adult smokers and include: 2) Smokers actively seeking treatment for tobacco dependence or LDCT lung cancer screening report medium to high levels of perceived risk (Park et al., 2013; Sinicrope et al., 2010); 2) Smokers who are not actively seeking tobacco treatment or lung cancer screening report lower levels of perceived risk, if concerned about lung cancer (Carere et al., 2015; Park et al., 2013; Persky et al., 2013; Sinicrope et al., 2010); and 3) Individual characteristics of smokers were important contextual considerations when assessing their subjective opinion of smoking-related perceived risk. In order to account for the complexity of perceived risk in smokers and its effect on smoking-related outcomes, measurement should consider a variety of covariate smoking-related risk factors (McQueen, Swank, Bastian, & Vernon, 2008). Several of these contextual smoking risk factors are discussed below.

Risk Perception and Smoking Risk Factors. There are several contextual smoking risk factors that impact a smoker's perceived risk for developing smoking-related health conditions and these include: age, race, smoking history, and the presence of a co-morbid health condition. There was a significant, inverse correlation between perceived risk and smokers between the ages of 50 and 75 years, indicating that older age is associated with lower levels of perceived risk (r= -0.13, p< .05) (Bunge et al., 2008). It was also reported that younger smokers perceive higher levels of health risk related to smoking compared to middle-aged and older smokers (Sinicrope et al., 2010). Mid-range levels of perceived risk were reported among older, high-risk smokers (e.g., those with a cumulative smoking history of 30 pack years or more), while lower levels of perceived risk were reported among older smokers with a pack-year history that was not high-risk (Sinicrope et al., 2010). Finally, smokers diagnosed with hypertension reported higher levels of perceived risk, when compared to smokers diagnosed with other chronic conditions (Borrelli et al., 2010). This finding suggests that smokers with cardiovascular disease (CVD; e.g., hypertension, stroke, etc.) may believe that quitting could contribute to improvement in overall health.

Race and sex have also been found to influence health risk perceptions related to smoking. Race has been shown to influence perceptions of health risk based upon race-specific disease prevalence and cultural dissonance (Alberg & Samet, 2003; Haiman et al., 2006; Persky et al., 2013). For example, Blacks and Native Hawaiians perceive higher levels of risk for the negative health effects of smoking and this may in part because they are more susceptible than Whites, Asians (Japanese Americans), and Hispanics to complications of CVD, COPD, and lung cancer (Alberg & Samet, 2003; Haiman et al.,

2006). Black people may be less likely to adopt behaviors to lower actual risk if care is received from a racially discordant medical provider, which can potentially impede a positive change in perceived risk, motivation to quit, and participation in lung cancer screening (Persky et al., 2013). Sex can also significantly affect perceptions of health related to smoking when women acknowledge stronger associations between perceived risk, motivation to quit, and tobacco treatment outcomes (McKee et al., 2005; NIDA, 2012). There were no significant sex differences associated with perceived risk in the studies reviewed for this report.

Synthesis of Theoretical Frameworks

Perceived Risk and Outcome Expectancy

Health risk perceptions related to smoking may be influenced by a number of psychological processes, including motivational factors, emotional responses, and numeracy barriers (Klein & Stefanek, 2007). Understanding the relationships that exist between smoking beliefs, actions, and behavioral outcomes may explain how smokers regulate their behavior based upon personal expectations. Outcome expectations describe subjective beliefs that carrying out a specific behavior will lead to an expected, corresponding outcome and are highly correlated with perceived risk related to smoking (Tidey & Rohsenow, 2009). Negative smoking outcome expectancies that anticipate future health problems improve the likelihood that a smoker will continue to abstain from smoking after cessation (USDHHS, 1989). Negative smoking outcome expectancies also lead to greater success with smoking cessation within the first week of a quit attempt (Wetter et al., 1994). Conversely, positive smoking outcome expectancies often precipitate a relapse after an attempt to stop smoking, and positive outcome expectancies of smoking's effect on mood impedes successful smoking cessation (USDHHS, 1989; Wetter et al., 1994). This cognitive-behavioral link between expected outcomes of smoking actions and the concern for experiencing negative health consequences emphasizes the significance of evaluating the influence of a smoker's interpretation of perceived health risks and other subjective beliefs.

Smoking outcome expectancies reflect anticipated consequences of smoking behavior and include beliefs about positive and negative consequences (Johnson et al., 2008). Examples of smoking-related outcome expectancy statements are: "I enjoy the taste sensations while smoking" (positive); "Smoking helps me calm down when I feel nervous" (positive); and "The more I smoke, the more I risk my health" (negative). Smoking outcome expectancies are often self-fulling and, like perceived risk, are much more

likely to influence self-reported readiness to quit (RTQ), than actual smoking cessation (USDHHS, 1989). Studies identified positive associations between outcome expectancy and motivation to quit (Johnson et al., 2008; Tidey & Rohsenow, 2009). But, smoking outcome expectancies demonstrated predictive value with successful smoking cessation, which was enhanced when the smoker was exposed to evidence-based tobacco cessation interventions (Johnson et al., 2008; Tidey & Rohsenow, 2009).

Risk Perception in Health Behavior Theories

Health risk perception and similar cognitive constructs, such as outcomes expectancy, are featured among numerous prominent health behavior theories, including Social Cognitive Theory (Bandura, 1986), the Health Belief Model (Janz & Becker, 1984; Rosenstock, 1974), the Theory of Reasoned Action (Fishbein & Ajzen, 1975), the Precaution Adoption Process Model (Weinstein, Sandman, & Blalock, 2008), the Theory of Planned Behavior (Ajzen, 1985), and Self-Regulation Theory (Leventhal, Meyer, & Nerenz, 1980). Each theory posits that beliefs regarding the likelihood and magnitude of potential health outcomes shape behavior (Brewer et al., 2007). The Health Belief Model delineated separate constructs for perceptions of risk susceptibility and risk severity; however, risk severity has been less useful in explaining cancer prevention behaviors (Janz & Becker, 1984; Weinstein et at., 1989). Therefore, perceived risk in this study refers to an individual smoker's perceptions of risk susceptibility, which is defined as the likelihood of developing a smoking-related health condition if they continue to smoke.

The (modified) Model of Risk Information Seeking and Processing

The original RISP model was proposed by Griffin, Dunwoody, and Neuwirth (1999) to explicate the complicated nature of risk, how individuals perceive risk, and the potentially serious consequences associated with some health hazards. The model proposes five key concepts (Table 1) that influence behavior, which include: information processing, information seeking and avoidance, informational subjective norms, perceived hazard characteristics (perceived risk), and individual characteristics. Before modification, the RISP model assumed that elevated risk perception could increase one's desire for additional information, if the risk issue is unfamiliar (Griffin, Dunwoody, & Neuwirth, 1999). The RISP was subsequently enhanced by applying the entire model as an antecedent for preventive health behavior (Griffin, Dunwoody, & Yang, 2012).

A modified version of the Risk Information Seeking and Processing (RISP) model (Figure 1) best illustrates how behavioral intention to perform a specific act can influence behavior, when predicted by individual characteristics. Contrary to most health behavior theories, the RISP model is not limited in its focus to narrowly describe the direct interaction between health risk perception and behavior change. In the context of smoking and perceived risk, this theoretical model supports the position that smoking behaviors are influenced by the individual's perceived health risk, as predicted by individual characteristics (e.g., attitude, subjective norms, and perceived behavioral control) (Griffin, Dunwoody, & Yang, 2012).

Table 1. Key Concepts of the Risk Information Seeking and Processing Model
(Griffin, Dunwoody, & Yang, 2012)

Theoretical Concept	**Definition**	**Explanation**
Information processing	The central factor of the RISP model. Gateway between communication-related variables and their potential impact on beliefs, attitude, and behaviors.	Individuals adopt either putting forth effort into processing a message or not based upon: *Capacity* to process the information *Motivation* to go beyond heuristic processing to engage
Information seeking and avoidance	Greater need for information sufficiency is likely to motivate active information seeking, but information might be avoided if an individual perceives that they are sufficiently educated on a topic.	Predictor for information use and processing. A different response might be observed for *"routine"* exposure to risk information, versus *"non-routine"* risk exposure. An individual might devote more or less effort to avoid information that distresses or distracts them.
Informational subjective norms	Social environments influence an individual's judgment about the amount of information that they feel they need to achieve their information processing goals.	Personal beliefs about what others (especially *relevant others*) think they should know about a risk topic, or individuals' perceptions about what relevant others already know about the risk could indirectly drive seeking and processing.
Perceived hazard characteristics	Cognitive evaluations of the nature of a hazard could have a direct impact on an individual's judgment of information sufficiency about the risk.	Predictor for information use and processing. Elevated risk perception could increase one's need for additional information if the risk issue is unknown or individuals might still desire additional information.
Individual characteristics	Demographic variables and other characteristics underlie risk information seeking and processing	Predictor for information use and processing (e.g., education, past experience, relevant values, sociocultural).

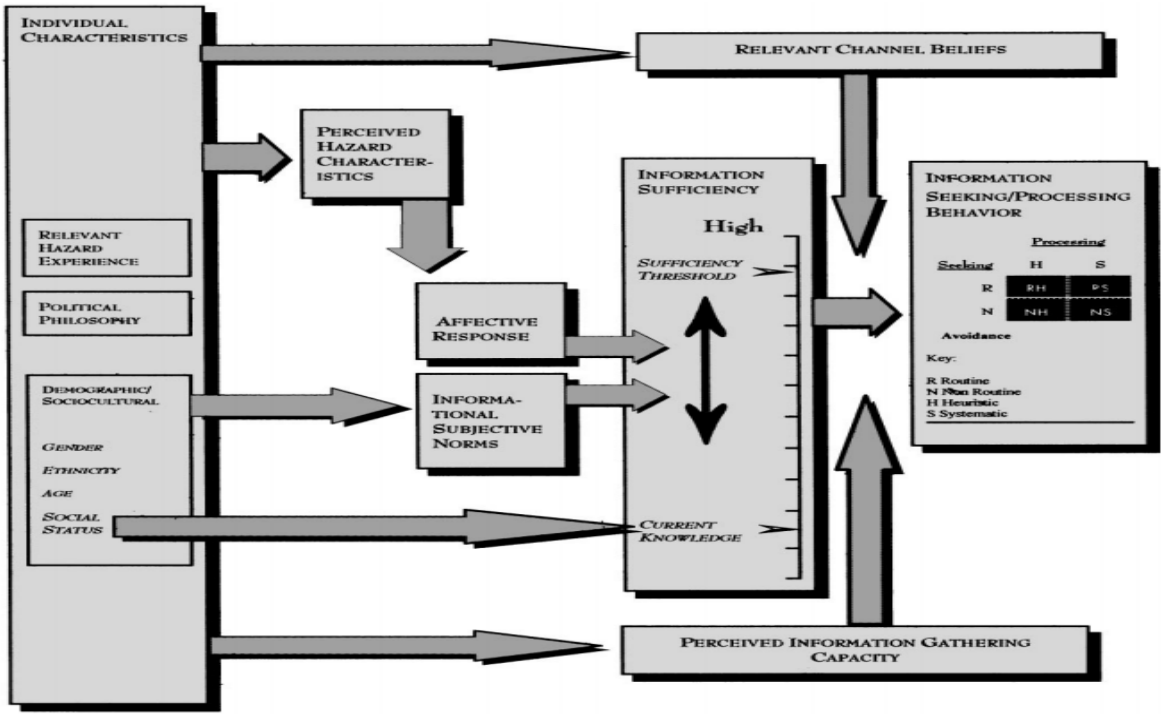


Figure 1. Model of Risk Information Seeking and Processing (RISP) (Griffin, Dunwoody, & Neuwirth, 1999).

The modified RISP Model (as an antecedent to preventive behavior) (Figure 2) has been applied in tobacco research to further illustrate associations between smoking behaviors (e.g., initiation, cessation) and the perception of smoking-related health risks and benefits (Noonan, Karvonen-Gutierrez, & Duffy, 2014; Song et al., 2009). This synthesized theoretical framework was constructed by isolating factors from the original RISP to combine with additional factors from the Heuristic-Systematic Model (HSM) of information processing and Theory of Planned Behavior (TPB) that are relevant to risk perception and communication (Ajzen, 1991; Eagly & Chaiken, 1993; Griffin, Dunwoody, & Yang, 2012). The HSM framework is a widely recognized communication model that attempts to explain how people receive and process information to form judgements about risk (Eagly & Chaiken, 1993; Trumbo, 1999). And, the TPB emphasizes the influence of individual characteristics on the process of health risk perception in relation to the development and maintenance of preventive health behaviors (Ajzen, 1991). And, the health risk perceptions operate through a similar 'dual information' process whereby a number

of individual factors influence a person's beliefs about disease risk and their reaction to risk-related information.

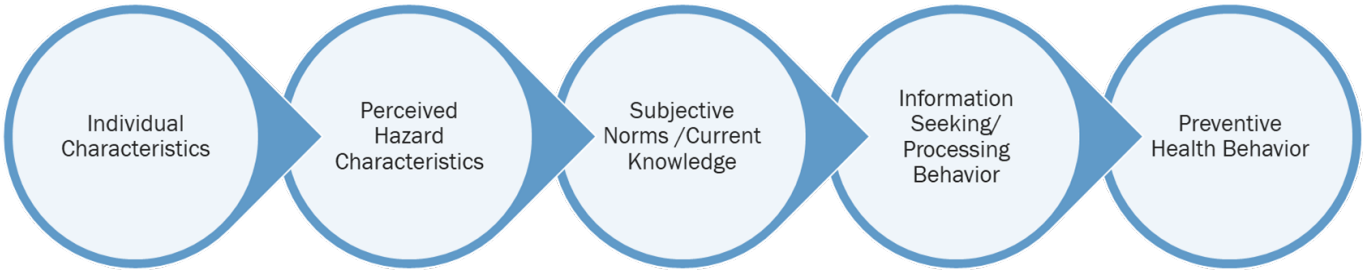


Figure 2. Modified RISP Model as an antecedent to preventive behavior. (Griffin, Dunwoody, & Yang, 2012).

A tobacco intervention study that applies the modified RISP Model to examine perceived health risk could provide an opportunity to explore potential factors that cause variance in smoking behavior outcome variables (Finney et al., 2011; Griffin, Dunwoody, & Neuwirth, 1999). However, neither the original RISP model nor its enhanced, modified version was directly tested in any of the studies included in the literature review. Empirical evidence strongly supports the likely predictive influence of individual characteristics on the relationship between perceived risk for developing a smoking-related health condition and smoking-related outcomes, such as chronic disease severity, co-morbid conditions, sociodemographic variables, and cultural factors (Benkert et al., 2009; Borrelli et al., 2010; Jacobs et al., 2006; Musa et al., 2009; Persky et al., 2013; Saha et al., 2010; Shofer et al., 2014; Sinicrope et al., 2010).

Summary of Findings

Despite the significant prevalence of smoking-related morbidity and mortality, smoker's often underestimate the likelihood of experiencing negative health consequences as a result of continued cigarette smoking. A hospitalization presents a unique opportunity to implement tobacco treatment interventions and preventive screening activities among adult smokers. Smokers admitted for an inpatient hospital stay are captive audiences to receive professional advice about quitting, gain exposure to evidence-based treatment recommendations for tobacco dependence, and be assessed for eligibility to

undergo early detection lung cancer screening via LDCT. No investigation to date has been conducted to evaluate the relationship between perceived risk and smoking behaviors or lung cancer screening among hospitalized patients. The current study seeks to fill this research gap in tobacco literature and demonstrate the contextual influence of individual characteristics on health behavior outcomes.

Chapter III

Methods

Study Overview

This study was conducted in partnership with the Tobacco Treatment Service (TTS) at Vanderbilt University Medical Center (VUMC) in order to gain access to adult, self-identified smokers admitted for an inpatient hospital stay. The purpose of this investigation was to evaluate a smoker's change in perceived risk for developing a smoking-related health condition before (pre-TTS) and after (post-TTS) participant was exposed to an inpatient TTS and, to examine the influence of perceived risk, in the context of smoking risk factors, on subsequent smoking-related outcomes. In this chapter, details are provided related to the research design, sample, the inpatient TTS protocol, data collection procedures, survey instruments, and statistical analyses. Institutional Review Board (IRB) approval was obtained from Vanderbilt University.

Research Design and Assumptions

Research Design

A non-experimental, single group, pretest-posttest, quantitative design was used to explore perceived risk in hospitalized smokers and investigate the influence of perceived risk on smoking-related outcomes, such as readiness to quit, smoking behavior variables, and lung cancer screening via LDCT. The predictor and outcome variables were determined at study enrollment and a three-month follow-up and evaluated using descriptive and correlational statistical analyses. After a single group of hospitalized smokers were exposed to a brief, inpatient tobacco treatment program, two measures of perceived risk were assessed along with smoking risk factors during study enrollment at the bedside. The single group design did not provide for a control group or any additional comparison groups. Therefore, no attempt was made to randomly assign smokers to study groups based upon level of perceived risk or any other smoking-related variable. Study outcome variables included readiness to quit which was

measured at study enrollment and smoking behaviors which were measured three-months later during follow-up via telephone or email communication.

Perceived risk was assessed in the study to understand the degree in which the smoker acknowledged their likelihood of developing a smoking-related health condition. As previously addressed, two measurements of perceived risk were compared in order to explore how the smoker's subjective beliefs regarding risk may have changed (increased, decreased, or stayed the same) after being exposed to a brief, inpatient tobacco treatment program. Due to the sample selection process, it was not feasible to assess the smoker's perceived risk before exposure to the intervention. Therefore, both perceived risk measurements were measured at study enrollment, with the baseline (e.g., pre-TTS) measurement of perceived risk assessed retrospectively. The first determination of perceived risk was measured immediately following informed consent and after TTS exposure; this determination was referred to as 'post-TTS perceived risk'. The second determination of perceived risk, referred to as "pre-TTS (retrospective) perceived risk" was measured next using an evaluation technique known as a retrospective pretest (Curtis & Drennan, 2013).

Design Assumptions

A single group, non-experimental design was used to explore how individual subjects respond to an experimental factor. This design approach is also likely to yield statistically relevant results despite limited time, resources, and number of participants (Byiersa, Reichlea, & Symonsa, 2012; Kazdin, 2010). A descriptive study design approach was utilized for Aim 1 to identify patterns and trends in perceived risk among hospitalized smokers, and a retrospective pretest of perceived risk was conducted to assess participant beliefs prior to inpatient TTS. A correlational research study design approach was utilized for the remaining aims to demonstrate if perceived risk among hospitalized smokers was related to or influenced the likelihood of the occurrence of various smoking-related outcomes. Due to limited empirical findings, smoking behaviors and related outcomes cannot be causally linked to perceived risk (Cook & Campbell, 1979; Kazdin, 2010; Shadish, Cook, & Campbell, 2002; Torgerson & Torgerson, 2008). In addition, an attempt to interpret inferential relationships using data from this study may be subject to error because of confounding variables and validity threats such as history, maturation, test effects and regression to the mean (Cook & Campbell, 1979; Shadish, Cook, & Campbell, 2002).

A retrospective pretest has been used in previously published behavioral intervention studies examining of perceived risk and other attitudes when it is not possible to use a traditional pre-post design and obtain a baseline measurement prior to the behavioral intervention (Kaushal, 2016; Klatt & Taylor-

Powell, 2005a; Rhodes & Jason, 1987; Schwartz & Sprangers, 1999; Taminiau-Bloem et al., 2015). Utilizing a retrospective pretest method, participants rate their current levels of knowledge, skills, attitudes, or behaviors at the conclusion of the intervention, however they are asked to reflect back and rate their levels of knowledge, skills, attitudes, or behaviors prior to participating in the intervention. Limitations of a retrospective pretest design approach include issues concerning the capacity of a respondent to recall previous events and self-reported scores are subject to subject bias or social desirability (Pratt, McGuigan, & Katzev, 2000). However, strengths of a retrospective pretest method can attenuate a response-shift bias, provide a point of comparison during assessment, and more accurately measure change than simply perceptions of change (Ary, Jacobs, Razavieh, & Sorensen, 2006; Howard, 1980; Pratt, McGuigan, & Katzev, 2000). Response-shift bias is a phenomenon that occurs when the respondent's internal frame of reference significantly changes in during an intervention (a 'program-produced change'). As a result, the response given at baseline, prior to the intervention may be an inaccurate overestimation or underestimation (Howard, 1980; Pratt, McGuigan, & Katzev, 2000).

Description of the Research Setting

The study was conducted in partnership with the VUMC TTS. VUMC is an academic medical facility with over 100,000 inpatient admissions annually typically from Nashville-Davidson County/Murfreesboro/Franklin, Tennessee Metropolitan area, or rural regions outside of this metropolitan area in Tennessee or Kentucky. Approximately 18% of these inpatients report current use of cigarettes. The VUMC TTS is a comprehensive clinical inpatient service created to provide evidence-based tobacco treatment methodologies to adult, inpatient smokers at VUMC. These smokers were identified by self-report during hospital admission after which their names are added to a TTS census within the electronic medical record (EMR). In 2016, the VUMC TTS census contained 5,667 smokers and 78.4% (n= 1,096) of these smokers had received the inpatient TTSs.

The VUMC TTS provides brief, inpatient tobacco treatment to all self-identified, adult cigarette smokers, and offers evidence-based treatment methods, in accordance with recommended clinical guidelines (Rigotti et al., 2014). VUMC TTS services were provided by three tobacco treatment specialists during the study period (one nurse practitioner, one physician assistant and a cardiac rehabilitation registered nurse). During the final month of study recruitment, two additional tobacco treatment specialists were hired (a registered nurse and licensed health counselor). These two newly hired staff conducted a treatment counseling encounter to one study participant each.

The TTS care process/protocol (Appendix B) requires the tobacco treatment specialist to perform a preliminary chart audit of inpatient smokers followed by a bedside visit to provide advice about quitting and managing tobacco dependence and the use of different TTS modalities. The following inpatient TTSs services were provided and/or offered to inpatient smokers:

1) An assessment of smoking status and lifetime smoking history (pack years);

2) A motivational interview to identify factors that influence behavior change;

3) Written educational materials;

4) Recommendations for pharmacotherapy;

5) A referral to the state tobacco quit line; and

6) A referral for free lung cancer screening via (LDCT), if eligible.

All elements of the TTS care protocol (Appendix B) were documented in VUMC's EMR for every patient encounter. TTS documentation included specific smoking-related information required to evaluate smokers' level of actual risk for adverse smoking outcomes and to determine eligibility for lung cancer screening via LDCT. TTS documentation also included patient responses to the recommendations/referrals for inpatient tobacco treatment services (pharmacotherapy or behavioral counseling) and/or lung cancer screening procedures via LDCT. The extent of inpatient tobacco treatment exposure for each smoker varied by how many of the six TTS services were delivered to the patient.

TTS exposure was documented by the tobacco treatment specialist designating one of four treatment categories: 1) *TTS consultation* (comprehensive exposure with at least 4 out of 6 services delivered); 2) *abbreviated TTS consultation* (limited exposure with less than 4 services delivered); 3) *TTS-declined consultation*; or 4) *TTS-not consulted*. The TTS tobacco treatment specialist applied the *not consulted* category if the smoker was not appropriate for counseling due to altered mental status or diagnosis of a terminal disease (requiring hospice or palliative care). After the initial TTS consultation for tobacco treatment, the tobacco treatment specialist might offer follow-up communication during that same hospital stay or repeat counseling and treatment if the smoker required readmission into the hospital. Care coordination in this manner provided support for recommended pharmacological tobacco treatment and reinforced previously discussed behavioral cessation strategies.

Sample and Sampling Plan

Power Analysis

A power analysis was conducted with an effect size of 0.25, an alpha level of 0.05, and 80% statistical power. Regarding the effect size, no previous studies were suitable for use in calculating the appropriate effect size for testing the study hypotheses. Instead, the effect size and target sample size were set based on results of an analysis of the measure selected to assess health risk perception in this study (HINTS 4, 2014). The analysis confirmed that a sample size of 130 adult smokers admitted for an inpatient hospital stay at VUMC would achieve 80% statistical power to detect an effect size as small as 0.25 (~6% shared variance) attributed to one independent variable (α= 0.05), assuming justification of linear relationships and without inclusion of any covariates (Cohen, 1988). Based upon this scenario, which accounted for a dropout rate of about 10%, as many as twelve (12) variables could be included in a linear regression analysis to produce stable coefficients and detect a small effect of the study's main outcome, change in perceived risk.

Sampling Plan. A recruitment plan was developed to enroll a minimum of 130 hospitalized smokers by actively recruiting two days per week and consenting at least five patients per week. Initial study procedures proposed recruitment to extend over a period of six months with the caveat that implementation of TTS clinical services and uptake of the TTS services may influence the ability to obtain the intended sample. This target sample size was deemed feasible to achieve during the proposed six-month study period given the fact that 5,667 smokers were admitted for inpatient care at VUMC between July 2014 and 2015, with 97.9% of those smokers between the ages of 18 and 77 years. However, each participating smoker was required to have been exposed to inpatient tobacco treatment via the VUMC TTS during that current hospital stay prior to recruitment and study enrollment. Participant enrollment was discussed with the research committee on a consistent basis after the study was initiated in order to reassess progress and sample estimates. Actual recruitment occurred more quickly than expected with as many as ten patients consented per week. The entire study period took place over six months from September 2016 to February 2017. Sample recruitment goals were met after approximately three months and follow-up was completed three months later.

Study Sample. Although measures of perceived risk have been examined in relation to tobacco treatment and lung cancer screening, no published data were available to prospectively estimate potential sample characteristics. The literature review conducted for this study produced a heterogeneous collection of intervention studies based on demographic factors, and all were investigated in outpatient settings. Due to the limited data published concerning perceived risk in inpatient settings, it was not possible to approximate the prevalence of older, heavy (high-risk) smokers that would be eligible for lung cancer screening because the nursing staff at VUMC were not required to assess lifetime smoking history by pack years prior to July 2015. Reports of smoking prevalence in the U.S. suggest that older, adult smokers are generally heavy smokers and eligible for lung cancer screening via LDCT. This assumption was based

on the likelihood that older smokers initiated smoking cigarettes when they were 18 years old or younger and have smoked at least one-half to one pack of cigarettes per day for 30 years (CDC, 2017). In addition, a study that analyzed data from the National Lung Screening Trial (NLST) reported that 6.2% of the U.S. (over 40 years of age) population would be eligible for lung cancer screening via LDCT (Pinsky & Berg, 2012).

Criteria for Sample Selection

Inclusion Criteria. Hospitalized smokers aged between 18 and 77 years who were seen by a tobacco treatment specialist for an initial consultation within the past two days (~48 hours) of the current inpatient stay were eligible for study enrollment. Study enrollment was confirmed after the smoker gave consent to continue participation until the follow-up time period of 3 months (~90 days). The VUMC TTS census of inpatient smokers in the EMR was accessed to identify smokers appropriate for screening. The age limits set for inclusion were based on Centers for Medicare and Medicaid (CMS) coverage guidelines for LDCT lung cancer screening and for two additional key reasons. Children (persons under the age of 18 years) who smoke are traditionally excluded from lung cancer risk prediction models (Spitz et al., 2007). Moreover, smokers older than 77 years are not typically eligible for LDCT imaging because advanced age may impede implementation of aggressive, life-saving cancer treatment interventions (American Lung Association, 2015).

Exclusion Criteria. Exclusion included the following: 1) TTS services were refused or incomplete according to documentation in the EMR; 2) existing documentation indicated a past history of lung cancer or an abnormal lung finding suspicious for malignancy (e.g., tumor, nodule, opacity, and other than COPD, asthma, or pneumonia); 3) patients were in isolation due to treatment of a communicable disease; 4) the patient was unable to comprehend, verbally respond, read, and write in English; and 4) barriers to follow-up communication were present (e.g., no personal access to a telephone or computer or the inability to communicate by either communication method).

Participant Recruitment and Informed Consent

Participant Recruitment

The VUMC TTS census of inpatient smokers was reviewed and if eligible, smokers were approached at the bedside to explain the purpose of the study and request informed consent. Consent was requested to authorize permission for the principle investigator (PI) to review documentation in the EMR related to smoking and to accept communication from the PI in thirty (1 month) and ninety days (3 months). Consenting participants were asked if they preferred to be contacted by telephone, mobile text message, or electronic mail (email) at follow-up. In addition, participants were asked to confirm the phone number already documented in the EMR and provide a second phone number (e.g., personal, family member, friend). If applicable, the cellular carrier or email address was recorded into the database. Each of these features is further described as they are discussed in the context of data collection procedures.

Informed Consent. The Vanderbilt University IRB and VUMC Office of Research granted approval to conduct research involving human subjects. Based on the inclusion criteria, the demographic and historical data concerning smoking behavior variables and comorbid health conditions of each eligible smoker were already recorded in the EMR in conjunction with services rendered by the VUMC TTS. However, separate IRB-approved recruitment procedures were necessary to allow the PI to collect pertinent information from EMR and administer the pre-post survey needed to assess change in perceived risk for developing a smoking-related health condition after exposure to a brief, inpatient tobacco treatment program.

In accordance with the review criteria of the Agency for Health Care Research and Quality (2015), the consent document briefly highlighted the importance of participation in the study, knowledge to be gained, and potential benefits of discussing their personal attitudes and opinions of health risks related to smoking. All potential study participants were spoken to in the English language and given a written copy of the consent document, also in English, that explained the study design, intended objectives, plans for follow-up, and the right to withdraw from the study at any time. No monetary compensation was offered to incentivize study participation. If the smoker agreed to study enrollment, he or she was then asked for an electronic signature to acknowledge consent through the REDCap software database (Harris et al., 2008).

Strategies to Ensure Human Subjects Protection. While investigating hospitalized, adult smokers, the disclosure of sensitive and/or personal health information (PHI) may be a source of risk for participants. Therefore, several steps were taken to protect the privacy, confidentiality, and retention of

human rights, welfare, and wellbeing of study participants (AHRQ, 2015). Risk of a privacy breach was minimized by adhering to the protocol already established by the TTS and only accessing participant information already disclosed via the standard of care at VUMC. Study data collected from EMR were stored on REDCap, a secured database safeguarded by Vanderbilt University's technological infrastructure.

The REDCap database software was utilized to create and distribute an electronic version of the questionnaires. Participant responses were entered into the REDCap database to ensure safe, secure storage and to allow export of data into a statistical package for analysis. Each live participant encounter was completed using a password protected handheld device. Data were collected using prepared scripts to increase the usability and replicability of the data. As the participant completed the survey, the PI was available for assistance. A key with participant identification numbers, medical record numbers, and patient names was kept in a secure Vanderbilt-sponsored cloud server. No identifiable information was retained about prospective participants who refused study participation. However, only de-identified data were downloaded from REDcap for analysis, and the anonymity of participants was protected using systematic aggregation. Finally, all identifiable data collected from the EMR (e.g., medical record numbers) will be destroyed after all analyses and publications related to the study have been completed and accepted.

Procedures and Data Collection

Study Procedures

After approval from the Vanderbilt University IRB, all data collection procedures were completed by the PI. Prior to study initiation, the PI job shadowed the TTS tobacco treatment specialists to become familiar with the VUMC TTS care services and protocol processes. The PI was then able to compose the script used to recruit, consent, and survey participants to contain similar language used during the delivery of TTS inpatient tobacco treatment services. This element of data collection procedures was important to minimize the potential of creating unequal groups due to the presence of confounding variables introduced during data collection.

After informed consent and confirmation of inclusion and exclusion criteria, data collection included the completion of survey instruments at the bedside, a chart audit of demographic and historical data concerning smoking risk factors and comorbid health conditions and acceptance of

tobacco treatment services (via VUMC TTS documentation), and completion of survey instruments at three-month follow-up (See Appendix C). There were three features of the recruitment and procedural methods unique to this study (Figure 3). First, post-TTS perceived risk was assessed within two days of exposure to an initial consultation for inpatient tobacco treatment. Second, perceived risk prior to inpatient tobacco treatment exposure was assessed retrospectively (by retrospective pretest) (Lamb, 2005). Third, other independent and dependent study variables were assessed after study enrollment via chart audit of the EMR.

Procedures at Study Enrollment. Study enrollment data were assessed using a brief survey (~ 5 to 10 minutes) that contained questions about their 1) current level of perceived risk for developing a smoking-related health condition; 2) level of perceived risk prior to receiving tobacco treatment via retrospective pretest; and 3) current level of motivation, or readiness, to stop smoking cigarettes (Appendix C, Study Enrollment Survey Instrument). The survey was formatted in the REDCap database and administered electronically on a hand-held computerized device. The PI remained present to answer technology-related questions during administration. Among the 134 hospitalized smokers enrolled, all completed initial survey instruments. The baseline chart audit was completed within one week after study enrollment to assess details concerning participants' smoking risk factors and acceptance of tobacco treatment services (via VUMC TTS documentation). Responses for this survey were also electronically recorded in the REDCap database. After participant recruitment concluded, an additional audit of the EMR was performed for each enrolled smoker to confirm the accuracy of the data.

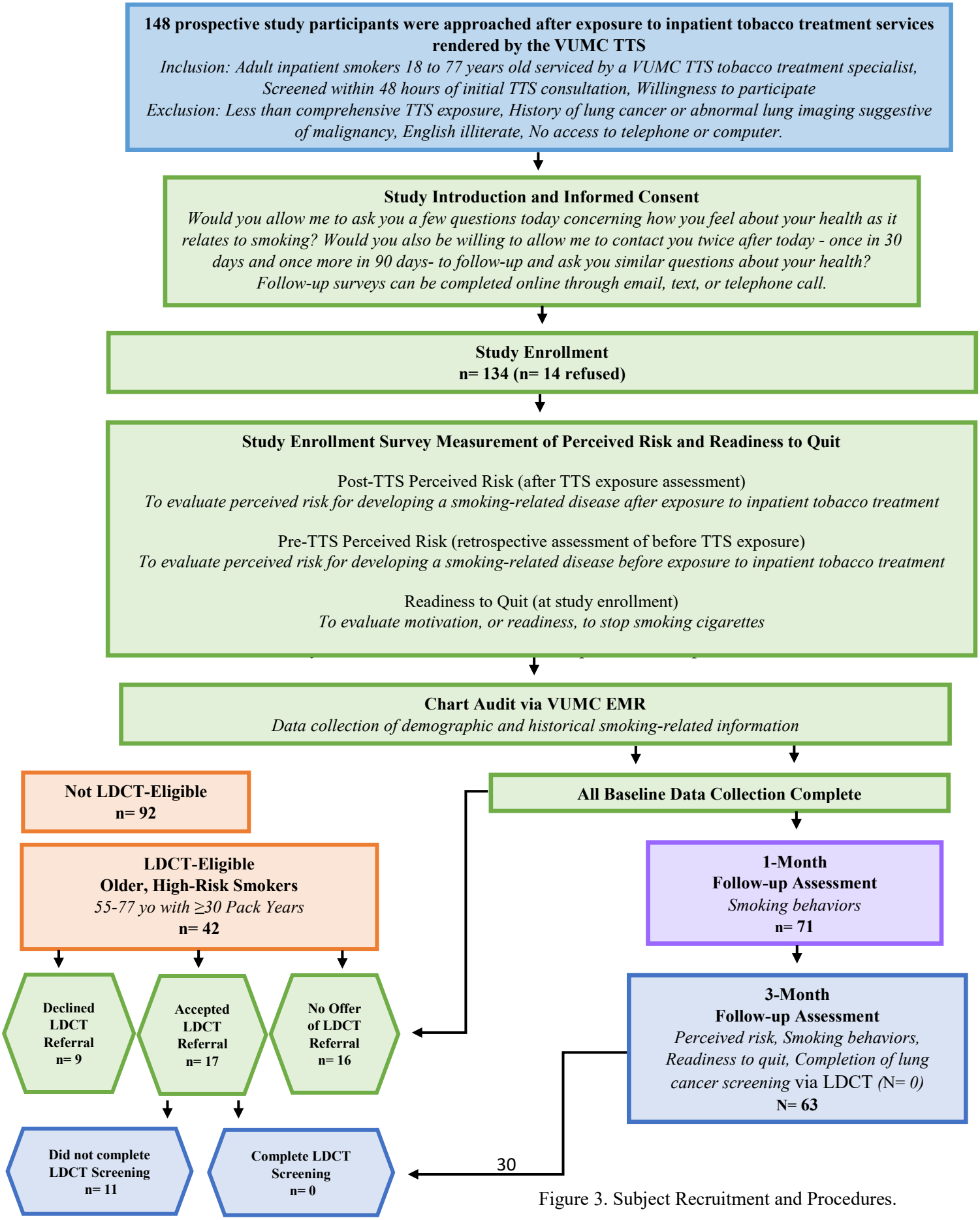


Figure 3. Subject Recruitment and Procedures.

Procedures at Follow-Up. Follow-up communication was completed with a messaging application in the REDCap database, one and three months after study enrollment. During each week of the study period, the PI searched the REDCap database to review communication timing and progress. Attrition was confirmed (at 1 and 3-month time periods) if the participant could not be reached after three separate, unsuccessful attempts (+/- 2 weeks of follow-up, separated by at least one day, and no more than seven days). Voicemail messages were not left for unanswered phone calls.

One-month follow up survey instruments were conducted via telephone only using the phone number(s) confirmed during study enrollment. Although data collected at the one-month follow-up was not analyzed in the current study, communication at this point in time provided an opportunity to capture any historical data found missing in the EMR (e.g., education level, age of smoking initiation, subjective health literacy scores, etc.). If communication was unsuccessful, a second chart audit was conducted to locate missing data. At the three-month follow-up time period, survey instruments were delivered based upon the participants' preferred method of communication (specified at study enrollment). Telephone calls were made manually, but surveys were also delivered to email and mobile text message addresses via a secure link through the REDCap database. After an attempt to electronically communicate over four weeks, participants were contacted by telephone.

Data Collection Time Points

Data collection ended for each participant after completion of the three-month survey and a final chart audit, if needed to verify self-report lung cancer screening activities. Otherwise, the smoker was designated a non-responder. Table 2 details all contact points and specifies when measurements of perceived risk, smoking risk factors, and smoking-related outcomes were examined at each data collection time point.

Table 2. Smoking Risk Factors and Behavior Outcomes Examined Across Data Collection Time Points

Key Variable Measured	Study enrollment	1 month	3 months
Perceived Risk			
Retrospective Individual (Lung Ca and SRD)	x		
Retrospective Comparative (Lung Ca and SRD)	x		
Individual (Lung Ca and SRD)	x		x
Comparative (Lung Ca and SRD)	x		x
Readiness to Quit			
Readiness to Quit Score	x		x
Smoking Behaviors			
Smoking Status**	x	x	x
Quit Attempt*	x		x
Subjective Number of Days Attempted*			x
Number of Cigarettes Smoked per Day**	x		x
Pharmacological Tobacco Treatment			
Recommendation Acceptance	x		
Self-reported Use of NRT		x	x
Self-reported Use of Prescribed Pills		x	x
Type of Medication			x
Behavioral Tobacco Treatment			
Referral Acceptance	x		
≥ 1 Counseling Session; Self-reported		x	x
Lung Cancer Screening via LDCT			
Referral Acceptance	x		
Completion of LDCT Scan***			x

SRD= Smoking-related Disease; NRT= Nicotine Replacement Medication; LDCT= Low Dose Computed Tomography

* Among current smokers

** 30-day point prevalence

*** Among participants 55-77 years old; 30 pack year smoking history

Survey Instruments for Independent Study Variables

Perceived Risk for Developing a Smoking-Related Health Condition. Perceived risk was measured at study enrollment and three-month follow-up by modifying four items from the National Cancer Institute's (NCI) Health Information National Trends Survey (HINTS). The HINTS survey systematically collects nationally representative data to gain insight into how people perceive cancer risks in order to create more effective health communication strategies across different populations (Nelson et al., 2004). Perceived risk is most accurately measured when survey items include four essential components: 1) who is at risk; 2) for what hazard; 3) over what period of time; and 4) a statement of current, personal behavior (Brewer et al., 2004). The risk perception question from the HINTS to assess personal perceived risk reads, "How likely do you think it is that you will develop ____ cancer in the future?," and to assess comparative perceived risk, "Compared to the average {man/woman} your age, would you say that you are more likely to get ____ cancer, less likely, or about as likely?" (HINTS cycle 1; HINTS 4, 2014; Nelson et al., 2004).

Similar to other smoking behavior studies, the 4-item measure in this study was modified to assess personal and comparative perceived risk for developing lung cancer or other smoking-related cardiopulmonary diseases on a five-point ordinal response scale, with each step on the five-point scale corresponding to one unit (Hamilton et al., 2015; Nelson et al., 2004-2014, HINTS Cycle 1-4, 2014; Shofer et al., 2014). Perceived risk for developing lung cancer and smoking-related disease were measured as separate concepts because while LDCT may detect abnormal findings that indicate suspicion for lung cancer, imaging may also confirm the presence of heart disease or other lung conditions (Park et al., 2013). Therefore, survey items for the current study were altered to specify 'lung cancer' for two questions describing personal and comparative beliefs and 'smoking-related disease' for an additional two questions describing personal and comparative beliefs. Responses were then prepared for analysis by calculating a single interval/ratio level summary score for the set of four (4) personal and comparative perceived risk questions (Borrelli, Hayes, Dunsiger, & Fava, 2010; Bunge et al., 2008; Carere et al., 2015; Chena & Kaphingst, 2010; Harris et al., 2012; Shofer et al., 2014). Internal consistency for previous lung cancer data using Cronbach's alpha reliability generally ranged from 0.88 to 0.93, exceeding the established acceptable criteria of 0.70 (Carter-Harris, Slaven, Monohan, & Rawl, 2016; Park et al., 2009).

Contextual Smoking Risk Factors. A survey was used to assess demographic and historical data concerning smoking risk factors and comorbid health conditions. The TTS protocol directed the tobacco treatment specialist to solicit responses for many of the contextual smoking risk factors variables of interest. As a result, the majority of the data needed for analysis was found during a chart audit of TTS documentation in the EMR. Data to assess the remaining variables were also located in

the EMR, outside of TTS progress notes. An inclusive list of all smoking risk factor variables is provided below, and several variables are described in further detail:

Sociodemographic Variables:

- Participant Age, Sex, Race, Education Level, Subjective Health Literacy, Employment Status, and Household Income below Poverty Level

Smoking Behavior Variables:

- Smoking Status, Age of Smoking Initiation, Cigarettes Smoked per Day (CPD), Time to First Cigarette (TTFC), Lifetime Smoking History (Pack Years), Concurrent Other Tobacco Use, and Quit Attempt in the past 1 year

Comorbid Smoking-Related Diseases:

- Heart Attack (CVD), Stroke, Congestive Heart Failure (CHF), Diabetes, Hypertension, High Cholesterol, Chronic Kidney Disease/Chronic Kidney Insufficiency, Cancer, Chronic Obstructive Pulmonary Disease (CPOD), Pneumonia, and Asthma.

Substance Abuse:

- Illicit Drug Use, Risk for Alcohol Withdrawal

Documented Psychiatric Diagnosis:

- e.g., Depression, Anxiety, Bipolar Disorder, etc.

Household Income. Household income below poverty level was analyzed as a dichotomous measure of poverty status according to the 2016 federal poverty level (FPL) guidelines from the U.S. Department of Health and Human Services (HHS). The poverty threshold per household size in 2016 was designated as follows: 1 = $11,880; 2 = $16,020; 3 = $20,160; 4 = $24,300; 5 = $28,440; 6 = $32,580; 7 = $36,730; and 8 = $40,890 (for households with more than 8 persons, add $4,160 to the FPL for each additional person).

Subjective Health Literacy. Subjective health literacy was measured using the Brief Health Literacy Screen (BHLS), a concise and easily administered verbal screening tool useful in identifying hospitalized patients with low health literacy (McNaughton et al., 2009; Wallston et al., 2014). The 3-item measure is routinely administered at VUMC and documented in the EMR at admission. In previous studies, the Cronbach's alpha for the BHLS was 0.80 and 0.74 among hospital patients, indicating high internal consistency reliability (McNaughton et al., 2009; Wallston et al., 2014. Tobacco literature indicates that after controlling for socio-economic factors, lower health literacy is associated with higher nicotine dependence, more positive smoking outcome expectancies, less knowledge about smoking health risks, and lower perceived risk (Stewart et al., 2013).

Lifetime Smoking History (Pack Years). A historical account of smoking habits and duration of smoking cigarettes was solicited in accordance with the TTS protocol. Pack years is a way to measure the amount a person has smoked over a long period of time (NCI, 2018). It is calculated by multiplying the number of packs of cigarettes smoked per day over time (lifetime smoking history) by the number of years the person has smoked (age of smoking initiation). For example, 1 pack year is equal to smoking 1 pack per day for 1 year, or 2 packs per day for half a year, and so on.

Nicotine Dependence. Nicotine dependence was assessed using a proxy measure the Fagerstrom Test for Nicotine Dependence (FTND), which is a standard instrument for assessing the intensity of physical addiction to nicotine (Heatherton et al., 1991). Nicotine dependence related to cigarette smoking is a significant risk factor for continued cigarette smoking and inhibits smoking cessation (Muscat, Stellman, Caraballo, & Richie, 2009; Gu, et al., 2014). The FTND contains six items that evaluate the quantity of cigarette consumption, the compulsion to use, and dependence (Heatherton et al., 1991). In the present study only 2 items from the FTND were used to determine nicotine dependence: self-reported time to the first cigarette (TTFC) and frequency (or amount) of cigarettes smoked per day (CPD).

Other studies have also used one to two questions from the FTND and found the two-item measure (α= 0.70) (Pomerleau et al., 1994) or a single-item measure, self-reported time to first cigarette (TTFC) (α= 0.78) have good reliability. TTFC is negatively associated with objective lung cancer risk (p<0.001) and various measures for smoking status (e.g., cigarettes per day [r= 0.34], plasma cotinine [r= 0.33], and urinary cotinine [r= 0.27]) (Gu et al., 2014; Muscat, Stellman, Caraballo, & Richie, 2009). The FTND score for this study also included TTFC, which was also converted from minutes to a four-point ordinal scale [1= 0-5 minutes; 2= 6-30 minutes; 3= 31-60 minutes, 4= >60 minutes].

Comorbid Smoking-Related Disease. The smoking-related diseases used to determine health status are widely associated with smoking-related outcome variables in tobacco research, such as smoking cessation and smoking-related mortality (Borrelli et al., 2010; Shofer et al., 2014). These specific diseases (with disease names listed) were included in the TTS protocol and retained for the current study. A count of smoking-related disease diagnoses was recorded and totaled from the TTS progress note and EMR. More rigorous methods to examine health status were not feasible.

Substance Abuse. Evidence of current substance use related to alcohol, cannabis (marijuana), stimulants, hallucinogens, and opioids was determined by TTS and other EMR documentation. A positive response for substance abuse was also recorded if one of the following was found in the EMR: 1) active Clinical Institute Withdrawal Assessment for Alcohol (CIWA) protocol in place; 2) positive Audit-C alcohol screen; or 3) documentation of current substance use in a progress note during the present hospitalization.

Psychiatric Diagnosis. If a psychiatric diagnosis was not already documented in the smoker's medical history, the TTS protocol mandated an evaluation for the presence of anxiousness or depressive symptoms using the 4-item, Patient Health Questionnaire-4 (PHQ-4) screening tool (Kroenke, Spitzer, Williams, & Lowe, 2009).

Survey Instruments for Dependent Study Variables

Change in Perceived Risk. To accomplish study aims of examining change in perceived risk, perceived risk was to be measured before exposure to inpatient tobacco treatment (pre-TTS) and after exposure to inpatient tobacco treatment (post-TTS). As noted above, pre-TTS assessment of perceived risk was assessed retrospectively, using a retrospective pretest (Curtis & Drennan, 2013). After responses were obtained for post-TTS perceived risk, the participant was asked to consider if interacting with the tobacco treatment specialist may have influenced their perception of smoking risks and previous responses. Then, pre-TTS (retrospective) perceived risk was determined by reading past tense questions to obtain a retrospective assessment: (e.g., 'How likely *did* you think you were to get lung cancer in your lifetime?'). Summary scores were calculated for pre-TTS and post-TSS perceived risk. The 'change' in perceived risk can be statistically evaluated in different ways. In many smoking behavior studies examining change in risk perception, clinically significant changes have been designated as a one-unit change on a 5-point scale (Borrelli, Hayes, Dunsiger, & Fava, 2010; Bunge et al., 2008; Carere et al., 2015; Chena & Kaphingst, 2010; Harris et al., 2012; Shofer et al., 2014). However, this method does not consider statistical comparisons of group means. By applying statistical analyses to compare group means, significant differences may be found when the actual change is relatively small but not clinically meaningful (Hawley, 1995). Also, this statistical comparison does not address the variability of individual outcomes within a sample.

Reliable change indices (RCIs) provide a supplemental means of analysis to comparisons of group means in outcome research with preventive interventions, but this type of measurement is not known to have been used to evaluate changes in smoking-related outcomes (Jacobson, Follette, & Revenstorf, 1984; Jacobson & Truax, 1991). As a result, the magnitude and direction of an expected change in perceived risk cannot be estimated from the literature. RCIs have been more commonly used to appreciate behavior change in clinical psychology populations as therapy progressively moves the patient from dysfunction to function (Jacobson & Truax, 1991). Measurement of an RCI is used to evaluate statistically significant individual change in relation to the how the group demonstrated aggregate change (Hawley, 1995; Massen, Bossema, & Brand 2009). This method is accomplished by establishing a cutoff

point for clinically significant change and applying an index to measure the reliability of that change. Cases that exceed the clinical cutoff point are determined to be clinically significant. These findings result in a more meaningful interpretation of the data.

Readiness to Quit (RTQ) Ladder. The RTQ Ladder (Figure 4) is a short, validated measure of readiness to consider smoking cessation that is generalizable for use with diverse populations to assess along a 10-point ordinal response scale (Abrams et al., 2003). Analyses of data collected from more than 400 smokers were significantly associated with reported intention to quit, number of previous quit attempts, perceived co-worker encouragement to quit, and socioeconomic status (Herzog, Abrams, Emmons, & Linnan, 2000). Readiness scores also predicted subsequent participation in programs designed to educate smokers about related health risks (Herzog, Abrams, Emmons, & Linnan, 2000). The RTQ Ladder, which attempts to provide a socially acceptable way to indicate lower levels of readiness to consider quitting (Biener & Abrams 1991), was administered at study enrollment and at three-month follow-up. Most smokers are not motivated to quit. Readiness to quit is an important construct in smoking behavior studies to describe an individual's desire, motivation, or intention to stop smoking cigarettes. According to the scale based on the Contemplation Ladder, a score of 10 corresponds to the statement "I have quit smoking and I will never smoke again;" and a score of 1 corresponds to the statement, "I enjoy smoking and have decided not to quit smoking for my lifetime". RTQ was statistically evaluated both as an outcome variable influenced by perceived risk and other covariate factors and also as a smoking risk factor to predict smoking behaviors and lung cancer screening.

Assessment of Motivation: Readiness to Quit Ladder

Instructions: Below are some thoughts that smokers have about quitting. On the ladder, circle the one number that shows what you think about quitting. Please read each sentence carefully before deciding.

10	I have quit smoking.
9	I have quit smoking, but I still worry about slipping back, so I need to keep working on living smoke free.
8	I still smoke, but I have begun to change, like cutting back on the number of cigarettes I smoke. I am ready to set a quit date.
7	I definitely plan to quit smoking in the next 30 days.
6	I definitely plan to quit smoking in the next 6 months.
5	I often think about quitting smoking, but I have no plans to quit.
4	I sometimes think about quitting smoking, but I have no plans to quit.
3	I rarely think about quitting smoking, and I have no plans to quit.
2	I never think about quitting smoking, and I have no plans to quit.
1	I have decided not to quit smoking for my lifetime. I have no interest in quitting.

Figure 4. Readiness to Quit Ladder (modeled after The Contemplation Ladder) (Biener and Abrams, 1991)

Smoking Behavior Outcomes. Several smoking-related behaviors were assessed as outcome variables at three-month follow-up in order to identify volitional efforts to stop smoking cigarettes. These variables include smoking status; reduced consumption of cigarettes per day; participation in pharmacological tobacco treatment; participation in behavioral tobacco treatment; and lung cancer screening via LDCT among eligible older, high-risk smokers. A simplified survey was administered at the one-month follow-up to only assess smoking status and participation in inpatient tobacco treatment modalities.

Smoking Status. Self-reported smoking status was assessed using a 30-day point prevalence for smoking cessation. Participants were asked to verify if they were smoking 'every day', 'some days', or 'not at all'. No attempt was made to biochemically verify smoking cessation because the inpatient tobacco treatment intervention was introduced as a standard of care, clinical service and not as a research protocol. Biochemical validation of smoking cessation was also not feasible due to constraints associated with cost and access to participants at follow-up.

Quit Attempt at Three-Month Follow-Up. Self-report of a quit attempt was defined as whether or not the smoker abstained from smoking cigarettes for greater than one day because they were trying to quit, between study enrollment and at three-month follow-up. A "quit attempt" was assessed by asking

the participant if they had stopped smoking cigarettes for more than one day in an effort to quit smoking between study enrollment and three-month follow-up (since being hospitalized). A "quit attempt" was first measured dichotomously [1= Yes; 2= No]. If a positive response was given, the number of days quit was assessed on a continuous scale [1-90 days].

Reduced Cigarette Consumption. The number of cigarettes smoked per day (CPD) was assessed at study enrollment using the value recorded into EMR tobacco treatment specialist, with a single number on a continuous scale [1-100 cigarettes]. At the three-month follow-up, self-reported CPD was reassessed based on the participants' smoking status. CPD was not assessed if the patient had quit for greater than 30 days. During data analysis, participant responses were evaluated to determine if they had significantly reduced the number of cigarettes smoked per day during the period of time between study enrollment and the three-month follow-up. A participant significantly 'cut back' or reduced cigarette consumption if their reduction in CPD was calculated to be greater than or equal to 50% (cigarettes per day/cutting back) relative to study enrollment CPD.

Participation in Inpatient Tobacco Treatment. Participation in inpatient tobacco treatment modalities was confirmed by reviewing documentation of recommendation/referral acceptance of pharmacological and behavioral treatment options on TTS progress notes in the EMR. At follow-up, a self-report of use or participation was solicited. Participation in pharmacological tobacco treatment was defined as participant acceptance and the subsequent use of recommended FDA-approved nicotine replacement or prescription medications between study enrollment and follow-up time periods. Participation in behavioral tobacco treatment was defined as participant acceptance of the referral for state-sponsored quit line counseling and subsequent participation in at least one telephone counseling session. Referral acceptance and active use/involvement was analyzed at study enrollment as dichotomous data [1= Yes; 2= No]. Additional questions were queried if the participant gave a positive response at follow-up. A positive response indicating active use of pharmacotherapy prompted a question to explore the type of FDA-approved prescription medication used [choices were assigned numbers from 0 to 7]. Similarly, a positive response indicating active participation with quit line counseling prompted a question to explore the number of quit line sessions the participant had completed [1-5+].

Lung Cancer Screening via LDCT. Older, high-risk smokers were offered a referral to undergo early detection, lung cancer screening via LDCT. The TTS protocol provided instructions to calculate pack years and evaluate each smoker's level of actual risk for developing adverse smoking outcomes. According to CMS guidelines for LDCT coverage eligibility, older, high-risk smokers were identified as a current or former smoker, aged 55 to 74 years with at least a 30-pack year history or quit less than 15 years ago (CMS, 2014). If a referral for LDCT was offered, the tobacco treatment specialist documented the smoker's response as 'accept' or 'did not accept' in the EMR. Completion of lung cancer screening

procedures was assessed at the three-month follow-up only because participants were not expected to have completed LDCT imaging prior to this time, given that an outside provider was responsible for scheduling the procedure. If a positive response was given to indicate the smoker had completed LDCT imaging, the participant was then asked to disclose any known imaging results. Self-reported completion of LDCT imaging required validation via a chart audit.

Pilot Testing

A pilot test was conducted during the first three weeks of participant recruitment to evaluate feasibility of participant screening procedures, recruitment processes, time required, and survey administration to measure perceived risk in smokers while in a hospital setting. Pilot testing concluded with no major modifications necessary for recruitment protocols, survey content, or interview methods. Therefore, preliminary data collected were retained and subjects recruited during the initial three weeks were included as part of the study sample. Data collected during pilot testing was not to be used to conduct any sample size estimations or hypotheses testing. However, piloting informed two additional procedural steps to mitigate recruitment and protocol adherence issues. The PI implemented a study-specific 1) "eligibility-screening checklist" and 2) an "end of day" task list to follow in conjunction with the other established recruitment and enrollment procedures. Use of the eligibility-screening checklist significantly minimized the potential of consenting an ineligible smoker into the study. Also, initial data entry, updates to the screening registry, and scheduling for one and three-month follow-up assessments for newly recruited participants were verified by completing the "end of day" task lists.

The pilot test also emphasized three areas of concern that threatened successful study implementation. First, hospitalized smokers are understudied in tobacco research and limited evidence impeded the ability predict a target sample size. To address this issue, special care was made to build rapport with smokers encountered during recruitment to improve the likelihood of enrollment and follow-up. Second, participants may not understand the objective and instructions of the retrospective pretest assessment to evaluate perceived risk prior to inpatient tobacco treatment. In response, an attempt was made to minimize the potential occurrence of a response error by communicating all instructions clearly and according to the script during the administration of each survey. Third, the success of examining the influence of perceived risk on smoking-related outcomes was heavily dependent on how thoroughly the TTS tobacco treatment specialist assessed and recorded participant historical data about smoking risk factors prior to study enrollment. This final issue was ameliorated by routinely attending TTS staff meetings to understand barriers encountered and learn of changes made to the TTS care process.

Statistical Analysis

Two fundamental goals guided procedures for the data analysis plan. The first goal was to determine if inpatient tobacco treatment (e.g., the brief bedside session delivered by the VUMC TTS) influenced a change in perceived risk for developing a smoking-related health condition among hospitalized smokers. The second goal was to determine whether perceived risk in the context of smoking risk factors influences the following smoking outcomes: readiness to quit, smoking status, participation in inpatient tobacco treatment modalities, and participation in lung cancer screening via LDCT. Smoking risk factors previously identified in tobacco literature to significantly influence smoking-related outcomes were evaluated for each aim. The predictor variables measured at study enrollment included pre-TTS (retrospective) perceived risk, post-TTS perceived risk, RTQ, TTFC, CPD, participant age, concurrent other tobacco use, comorbid smoking-related disease, subjective health literacy, household income below poverty level, and education level.

Data analyses were conducted using the Statistical Package for the Social Sciences (SPSS, 2017). After all three-month follow-up assessments were complete, preliminary analyses of descriptive statistics for all study variables were computed for evaluation of data accuracy, outliers, data transformation, issues related to collinearity, and missing data. As this was an observational study, no interim analyses were planned. Data entry accuracy was confirmed by directly importing de-identified data entries from REDCap to an SPSS data set. Tukey's boxplots were used to determine potential outliers and multicollinearity was assessed among predictor variables by examining tolerance and the Variance Inflation Factor (VIF). No outliers were identified, and none of the variables were found to be collinear. No variables were removed from preliminary analyses.

Before applying bivariate and multivariate statistical procedures, perceived risk and subjective health literacy scale scores were calculated, along with a Cronbach's alphas for comparison to similar studies. Also, participation in inpatient tobacco treatment was determined by calculating the number of participants who engaged (used medications or participated in at least one counseling session) between study enrollment and three-month follow-up divided by the number of participants who accepted a referral at study enrollment. Other variable responses were recoded to facilitate ease of analysis. In all cases, 'do not care to respond' and 'do not know' responses to survey items were recoded as missing.

Data Reduction Techniques

Sociodemographic Variables. Race, education, employment status, and household income below poverty level were recoded from categorical or ordinal variables to dichotomous variables. Although ethnicity and race were assessed separately at study enrollment, ethnicity was not included in the final analysis due to the relatively low percentage of Hispanic participants. Participant responses for race were combined into two categories: 'White' or 'non-White.' Education was recoded to reflect whether the participant had been educated at/above or below the high school level. Employment status was dichotomized into 'working' or 'not working'. Finally, annual household income was recoded to identify if the participant earned an annual household income 'above' or 'below' the 2016 federal poverty line.

Smoking Risk Factors and Outcomes. TTFC, smoking status, and reduction in cigarette consumption were recoded for data analysis. Data for TTFC were re-coded in order to classify data into categories with an equal number of units in each ordinal category. Smoking status ('every day' vs. 'some days' vs. 'not smoking at all') at the three-month follow-up assessment was recoded to reflect a dichotomous variable: 'current smoker' vs. 'non-smoker'. The 'current smoker' variable was designated to include both 'every day' and 'some days' smokers. Also, significant reduction in CPD was recoded to be analyzed as a dichotomous variable: significant CPD reduction (≥ 50%) vs. no significant CPD reduction (< 50%). Percent reduction in CPD was calculated by subtracting CPD at three-month from CPD at study enrollment then dividing the difference by CPD at study enrollment.

Management of Missing Data

Missing and incomplete data were carefully examined with the assistance of SPSS to detect any significant patterns that would prevent the study from achieving 80% power. Data were missing at random due to attrition and participants declining to respond to certain survey items (e.g., household income, education). Patterns of missing data were also random and similar between groups. An intent-to-treat (ITT) analysis was used to examine missing data to include data from all smokers who completed the study enrollment survey (n=134). This approach was chosen because estimates of the treatment effect in an ITT analysis is generally conservative and avoids potential complications during analyses that could result from missing data (Shadish, Cook, & Campbell, 2002).

Preliminary Analyses

Descriptive statistics were used to summarize sociodemographic characteristics, perceived risk, smoking-related outcomes, potential covariates (e.g., TTFC, CPD). Parametric data findings were reported whenever appropriate. A summary of the statistical methods applied to achieve study aims will follow. All hypotheses were tested using a significance level of less than or equal to 0.05. Bivariate correlation analyses were further evaluated using Bonferroni's correction ($\alpha = 0.05/10 = 0.005$).

Means and standard deviations were analyzed for continuous variables, and proportions were analyzed for categorical variables. Independent t-tests, Chi-square tests of independence, or Mann-Whitney U tests, as appropriate, were also performed to assess for significant differences between participants who responded during the three-month follow-up and non-responders who did not respond. Pearson product-moment (r), Spearman's rho (ρ), and Point-Biserial (rpb) correlational analyses were computed to examine correlations between perceived risk and smoking risk factors in hospitalized smokers measured at study enrollment. Pearson's correlation tests were used for pre-TTS (retrospective) perceived risk, participant age, age of smoking initiation, (CPD), subjective health literacy, comorbid smoking-related disease, and lifetime smoking history (pack years); Spearman's rank tests were used for post-TTS perceived risk, TTFC, and education level; and Point biserial correlation tests were used for sex, race, employment status, and household income based upon poverty level, smoking status, concurrent other tobacco use, and quit attempt in the past 1 year, illicit drug use, risk for alcohol withdrawal, and psychiatric diagnosis. Cronbach's alpha analyses demonstrated high internal consistency reliability for both perceived risk and subjective health literacy measures used in the study (pre/post-TTS perceived risk: $\alpha = 0.92$ and subjective health literacy: $\alpha = 0.89$). Change in perceived risk was evaluated using reliable change indices (RCIs). Finally, regression analyses were conducted to estimate the relationships between perceived risk, in the context of smoking risk factors, and smoking-related study outcomes.

Analyses by Study Aim

Statistical Analyses for Aim 1. The first aim was to describe the nature and extent of change in perceived risk for developing a smoking-related health condition among hospitalized smokers after exposure to a brief, inpatient tobacco treatment program. Summary scale scores were computed for pre-TTS and post-TTS perceived risk for internal consistency using a Cronbach's alpha measure of reliability. To accomplish Aim 1, the extent and nature of change in perceived risk between pre-TTS and post-TTS was examined by calculating reliable change indices for this single group of hospitalized smokers. The

calculated RCI was used to determine a cutoff score to compare change in each individual pair of pre-TTS/post-TTS perceived risk scores. The cutoff was computed by dividing the difference between the pre-TTS and post-TTS scores by the standard error of the difference between the two scores and defined in terms of the reliability of the measurement instrument (Maassen, Bossema, & Brand 2009).

Reliable change can be evaluated, in mutually exclusive populations, when the client 1) moves beyond dysfunction, if the second measurement falls at least two standard deviations above the dysfunctional mean or 2) moves into normal, if the second measurement falls at least two standard deviations above the normal mean (Jacobson, Follette, & Revenstorf, 1984; Jacobson & Truax, 1991). The RCI analysis in this study provides results that include the statistically significant level of reliable change score and an effect size. If participant change scores exceed the RCI cutoff score, then perceived risk can be said to be significantly changed, meaning that the observed change would be expected by chance alone at a probability of less than 5%. Participant change scores within the band of no reliable change are said to not be significantly change. The effect size was calculated to indicate the strength of the observed change in perceived risk, as it represents the difference between two means assuming that two groups have similar standard deviations and are of similar size (Cohen, 1988).

Statistical Analysis for Aim 2. The second aim was to identify relationship patterns between readiness to quit and pre-TTS (retrospective) perceived risk, in the context of smoking risk factors, at study enrollment. The RTQ score is a psychological measure that produces a continuous data value from 1 to 10. The ladder attempts to provide a socially acceptable way to indicate lower levels of readiness to consider quitting (Biener & Abrams 1991). A multiple linear regression analyses was ideal to examine relationships with the continuous data values corresponding to RTQ Ladder scores at study enrollment. A regression analysis could also identify how much each predictor variable uniquely contributed to the relationship with readiness to quit. However, the regression model was over fit to accommodate the number of estimates included in the original analysis due to an insufficient sample size at three-month follow-up. Therefore, simple linear regressions were examined to identify the presence of statistically significant relationships between individual smoking risk factor variables and readiness to quit. In addition, a multivariate regression analysis was conducted to estimate relationships only between readiness to quit perceived risk, and two other smoking risk factors using a significance threshold of $p< 0.1$.

Statistical Analysis for Aim 3. The third aim was to identify the statistical influence of pre-TTS (retrospective) perceived risk, in the context of smoking risk factors, on smoking behavior outcome variables (smoking status, 3-month quit attempt, reduced cigarette consumption, and participation in inpatient tobacco treatment) at the three-month follow-up. Smoking cessation prevalence rates were determined by evaluating the number of participants reporting 30-day point prevalent smoking abstinence

in relation to the number of participants who reported they continued to smoke ('every day' or 'some days') at three-month follow-up. Prevalence rates of making a quit attempt rates were determined by evaluating the number of participants self-reporting abstaining from smoking for more than one day in an effort to stop smoking in relation to the number of participants who did not self-reported abstaining between study enrollment and follow-up at three months. Finally, prevalence rates of significant reduction in cigarette consumption at three-month follow-up were determined by evaluating the number of participants who self-reported 30-day point prevalent smoking abstinence and smoked at least 50% less CPD compared to CPD at study enrollment in relation to the number of participants who did not quit or reduced their CPD by at least 50%. Participation rates of inpatient tobacco treatment modalities were evaluated to measure efficiency of the inpatient tobacco treatment program.

The aim was accomplished by conducting univariate logistic regression analyses. All smoking behavior outcome variables were analyzed as dichotomous variables. However, perceived risk and other predictor variables could not be entered into the equation simultaneously due to an insufficient sample size at the three-month follow-up. Relationships between participation in behavioral tobacco treatment via the state tobacco quit line and independent variables could not be evaluated due to poor rates of participation.

Statistical Analysis for Aim 4. The fourth aim was to identify relationship patterns between completion of lung cancer screening via LDCT and pre-TTS (retrospective) perceived risk, in the context of smoking risk factors, at three-month follow-up. There was no data available to examine potential relationships due to a complete lack of participant reporting for LDCT completion at three-month follow-up.

Chapter IV

Results

Introduction

This chapter describes the enrollment and characteristics of the sample population, identifies associations among study variables, and reports results for the four study aims to: (1) identify the extent and nature of change (from before inpatient tobacco treatment [pre-TTS] to after inpatient tobacco treatment [post-TTS]) in perceived risk of smoking-related health condition among hospitalized smokers exposed to a brief, inpatient tobacco treatment program; (2) evaluate the influence of perceived risk of smoking-related health condition, in the context of smoking risk factors, on readiness to quit smoking among hospitalized smokers exposed to a brief, inpatient tobacco treatment program; (3) determine relationships between perceived risk of smoking-related health condition, in the context of smoking risk factors, and subsequent smoking-related outcomes among hospitalized smokers exposed to a brief, inpatient tobacco treatment program; and (4) determine the relationship between perceived risk of smoking-related health condition, in the context of smoking risk factors, and completion of lung cancer screening imaging via LDCT among older, high-risk, hospitalized smokers exposed to a brief, inpatient tobacco treatment.

Characteristics of Hospitalized Smokers at Enrollment and Three-Month Follow-up

The enrollment period of hospitalized smokers exposed to inpatient tobacco treatment occurred between September 2016 and February 2017. During this time, a total of 1,398 self-identified, inpatient smokers were identified via the electronic hospital record. The majority (n= 1,096; 78.4%) of them were approached by certified tobacco treatment specialists (CTTS) from the Vanderbilt University Medical Center (VUMC) Tobacco Treatment Service (TTS) and were offered tobacco treatment counseling. Three hundred and two (302) hospitalized smokers either declined counseling or did not meet TTS inclusion criteria for consultation. For the current study, only those subjects (n= 409) who were counseled for the first time during the initial invitation were considered for participation in this study; and among this group, 148 met preliminary study eligibility criteria (Figure 5).

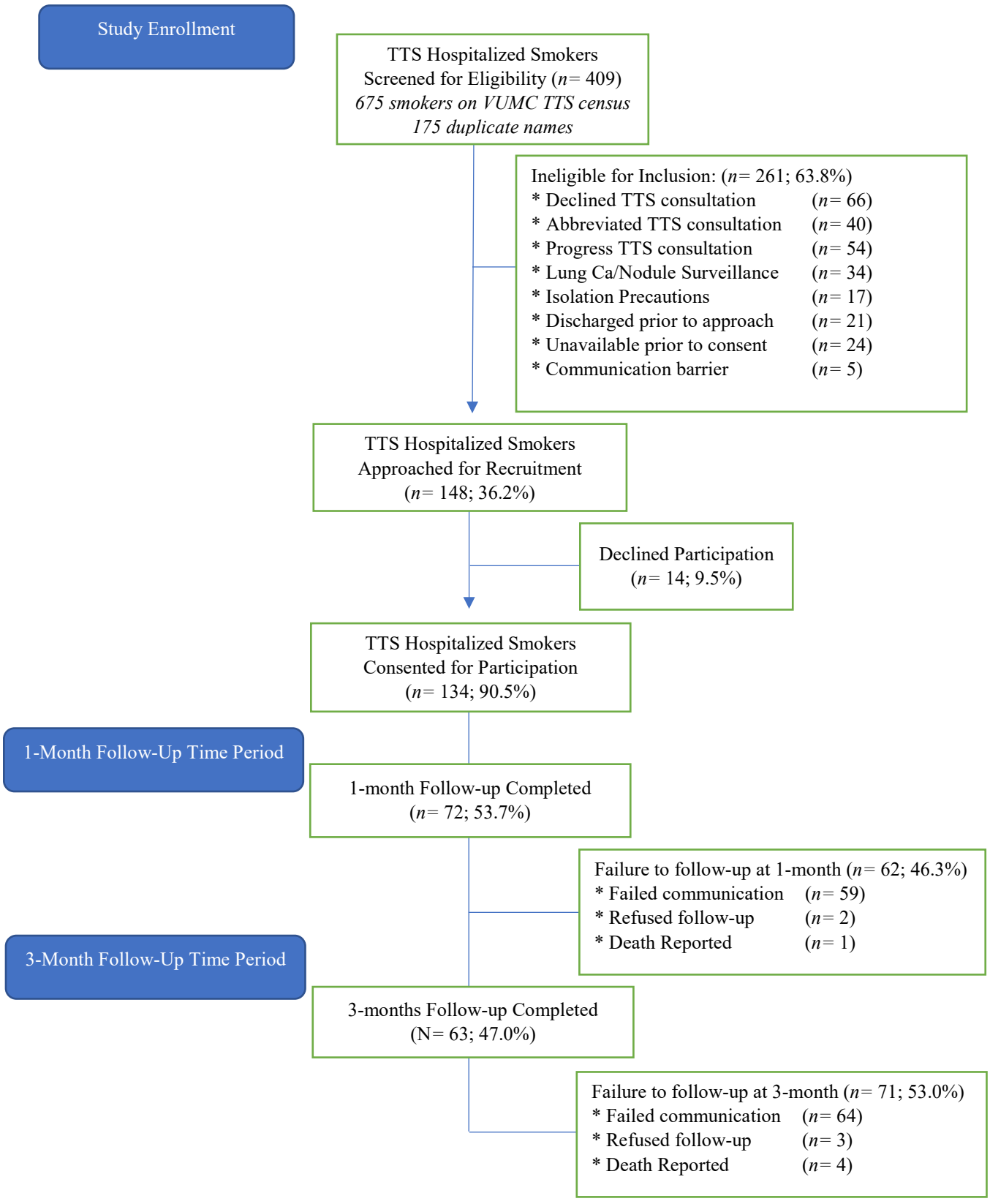


Figure 5. CONSORT Flow Diagram

Of all hospitalized smokers who were eligible for study inclusion, 14 (9.46%) declined to participate in the study. Therefore, a total of 134 subjects (90.54% of eligible patients) were enrolled in the current study. The average ages of those that refused and those that participated in the study were similar (49.14 years vs. 50.03 years, respectively), but more females (64%) refused participation compared to males (36%). Only 63 (47.0%) subjects, herein designated 'participants' completed the study (from enrollment to through the 3-month follow-up), with a 53.0% attrition rate (n= 71 non-responders). Ninety percent (90.0%) of non-responders could not be reached via telephone, electronic mail, or mobile text communication and a small percentage refused assessment (4.2%) or were deceased (5.6%). Non-responders were somewhat younger, experienced more unemployment, and were below the household income poverty level compared to the participant group (Table 3). Other demographic characteristics were not significantly different between groups. However, more non-responders accepted pharmacological recommendations compared to the participant group (Table 3). Though more non-responders than participants were positive for illicit drug use, there were no other differences in smoking characteristics and behaviors or comorbid smoking-related disease between participants and non-responders (Table 3).

Table 4 provides an overview of the medical diagnoses of all 'total' subjects initially enrolled in the study. The three most frequently reported smoking-related medical diagnoses of enrolled individuals were hypertension (59.7%), hyperlipidemia (44.0%), and COPD (41.0%); and the least commonly reported diagnoses were chronic kidney disease (11.2%), asthma (10.4%), and a previous CVA (9.7%). The most prevalent primary hospital admitting diagnoses were circulatory (31.3%), digestive (12.7%), respiratory (9.7%), and musculoskeletal (9.7%) disorders; no subjects were admitted, however, with a primary diagnosis of cancer, alcohol use or mental disorders, or disorders of the blood. Upon release from the hospital, the majority (69.3%) of subjects were discharged to return to their home in the community (Table 4). Comparing participants and non-responders, a medical diagnosis of congestive heart failure and discharge disposition significantly influenced the likelihood of study participation at three-month follow-up.

Table 3. Characteristics of Hospitalized Smokers Exposed to Inpatient Tobacco Treatment

Subject Demographic and Smoking Characteristics	**Total sample (*n*= 134)**	**Participants (N= 63)**	**Non-responders (*n*= 71)**	***p*-value**
	M ± SD Median (IQR) n (%)	M ± SD Median (IQR) n (%)	M ± SD Median (IQR) n (%)	
Sociodemographic Variables				
Participant Age	50.03 ± 13.95	53.57 ± 12.95	46.89 ± 14.14	***.005***[a*]
Sex: Male	71 (53.0%)	31 (49.2%)	40 (56.3%)	*.409*[c]
Race: White	104 (77.6%)	51 (81.0%)	53 (74.6%)	*.623*[c]
Education: High School Graduate/GED or better (*n*= 112)	78 (69.6%)	40 (66.7%)	39 (73.1%)	*.248*[c]
Subjective Health Literacy Score (*n*= 131)	13.0 [10 – 15]	14.0 [11 – 15]	12.5 [9 – 15]	*.163*[b]
Unemployed (*n*= 131)	88 (67.2%)	38 (61.3%)	50 (72.4%)	***.002***[c*]
Below the Household Income Poverty Level (*n*= 115)	61 (53.0%)	22 (42.3%)	39 (61.9%)	***.036***[c*]
Smoking Characteristics and Behaviors				
Perceived Risk Scale Score (pre-TTS, retrospective)	3.43 ± 1.05	3.36 ± 1.04	3.49 ± 1.06	*.468*[a]
Perceived Risk Scale Score (post-TTS)	4.00 [3.25 – 4.00]	4.00 [3.25 – 4.75]	4.00 [3.06 – 4.50]	*.740*[b]
Readiness to Quit Score	6.98 ± 2.20	7.13 ± 2.14	6.85 ± 2.27	*.460*[a]
Every Day Smoker	127 (94.8%)	59 (93.7%)	68 (95.8%)	*.581*[c]
Age of Smoking Initiation (*n*=133)	16.72 [13 – 18]	15.00 [13 – 18]	16.00 [13 – 18]	*.849*[b]
Cigarettes smoked per day	20.00 [10 – 20]	15.00 [8.5 – 20]	20.00 [10 – 20]	*.069*[b]
Time to First Cigarette (*n*= 132) 3= Within 5 minutes 2= 6-30 minutes 1= 31-59 minutes 0= 60 minutes or more	 67 (50.8%) 33 (25.0%) 9 (6.8%) 23 (17.2%)	 31 (50.0%) 15 (24.2%) 5 (8.1%) 11 (17.7%)	 36 (51.4%) 18 (25.7%) 4 (5.7%) 12 (17.1%)	*.957*[c]
Pack Year History (*n*= 132)	30.00 [16.25 – 49]	34.40 [19 – 50.75]	28.00 [10.88 – 46.13]	*.135*[b]
Concurrent Other Tobacco Use (*n*= 132)	19 (14.4%)	11 (17.7%)	8 (11.4%)	*.302*[c]
Quit Attempt in the past 1 year (*n*= 133)	9 (6.8%)	4 (6.3%)	5 (7.1%)	*.856*[c]
Tobacco Treatment Services				
Accepted Pharmacological Recommendations (*n*= 133)	94 (70.7%)	38 (60.3%)	56 (80.0%)	***.013***[c*]
Accepted Quit Line Referral (*n*= 127)	68 (53.5%)	26 (44.8%)	42 (60.9%)	*.071*[c]
Accepted Lung Cancer Screening Referral (*n*= 42 eligible)	17 (40.5%)	11 (47.8%)	6 (31.6%)	*.481*[c]
Eligible for LDCT, Refused Referral	9 (21.4%)	5 (21.7%)	4 (21.1%)	
Eligible for LDCT, Not Offered Service	16 (38.1%)	7 (30.4%)	9 (47.4%)	
Substance Abuse/Psychiatric Conditions				
Documented Illicit Drug Use	27 (20.1%)	9 (14.3%)	18 (25.4%)	*.111*[c]
Documented Audit-C/Risk for Alcohol Withdrawal (*n*= 133)	33 (24.6%)	14 (22.2%)	19 (27.1%)	*.512*[c]
Documented Psychiatric Diagnosis (*n*= 133)	61 (45.5%)	33 (52.4%)	28 (40.0%)	*.152*[c]

[a] Independent Samples T-test [b] Mann-Whitney [c]Chi-Square Test of Independence

Audit-C= The Alcohol Use Disorders Identification Test (modified) PHQ-4= The Patient Health Questionnaire-4 TTFC= Time to First Cigarette Subjective Health Literacy (3 to 15) Readiness to Quit scores (1 to 10) Lung Cancer Screening via LDCT: current or former smoker within 15 years; 55-77 years old; ≥30 pack year smoking history

Table 4. Prevalence of Medical Diseases and Discharge Characteristics among Hospitalized Smokers

Smoker Medical Characteristics	**Total sample (*n*= 134)**	**Participants (N= 63)**	**Non-responders (*n*= 71)**	***p*-value**
	M ± SD Median (IQR) n (%)	M (SD) Median (IQR) n (%)	M (SD) Median (IQR) n (%)	
Smoking-Related Medical History at Study Enrollment				
Hypertension	80 (59.7%)	39 (48.8%)	41 (51.3%)	*.624*
Hyperlipidemia	59 (44.0%)	32 (54.2%)	27 (45.8%)	*.137*
COPD (Chronic Bronchitis/ Emphysema)	55 (41.0%)	27 (49.1%)	28 (50.9%)	*.688*
Heart Disease (Heart Attack/CABG/PCI)	41 (30.6%)	21 (51.2%)	20 (48.8%)	*.517*
Diabetes	35 (26.1%)	20 (57.1%)	15 (42.9%)	*.163*
Pneumonia	30 (22.4%)	16 (53.3%)	14 (46.7%)	*.431*
None Reported	27 (20.9%)	12 (42.9%)	16 (57.1%)	*.620*
Congestive Heart Failure	24 (17.9%)	16 (66.7%)	8 (33.3%)	***.033****
Cancer, Not Lung	23 (17.2%)	11 (47.83%)	12 (52.17%)	*.932*
Chronic Kidney Disease	15 (11.2%)	9 (60.0%)	6 (40.0%)	*.285*
Asthma	14 (10.4%)	7 (50.0%)	7 (50.0%)	*.813*
Stroke	13 (9.7%)	4 (30.8%)	9 (69.2%)	*.219*
Number of comorbid smoking-related diseases	2 [1 – 4]	3 [1 – 4]	2 [1 – 4]	*.211*[a]
Hospitalization Primary Discharge Diagnoses at Study Enrollment				
Diseases and Disorders of the Circulatory System	46 (34.3%)	22 (47.8%)	24 (52.2%)	*.976*
Diseases and Disorders of the Digestive System	17 (12.7%)	8 (47.1%)	9 (52.9%)	-
Diseases and Disorders of the Respiratory System	10 (7.5%)	6 (60.0%)	4 (40.0%)	-
Diseases and Disorders of the MSK System	11 (8.2%)	5 (45.5%)	6 (54.5%)	-
Diseases and Disorders of the Nervous System	5 (3.7%)	3 (60.0%)	2 (40.0%)	-
Endocrine/Nutritional/Metabolic Diseases	6 (4.5%)	3 (50.0%)	3 (50.0%)	-
Diseases of the Kidney and Urinary Tract	4 (3.0%)	1 (25.0%)	3 (75.0%)	-
Mental Diseases and Disorders	1 (0.7%)	0 (0%)	1 (100%)	-
Diseases of the Hepatobiliary System and Pancreas	5 (3.7%)	1 (20.0%)	4 (80.0%)	-
Alcohol/Drug Use or Induced Mental Disorders	3 (2.2%)	2 (66.7%)	1 (33.3%)	-
Infectious/Parasitic/Systemic Diseases	9 (6.7%)	4 (44.4%)	5 (55.6%)	-
Diseases of the Skin/Subcutaneous Tissue/Breast	3 (2.2%)	1 (33.3%)	2 (66.7%)	-
Lymphatic/Heme/Onc Diseases and Disorders	2 (1.5%)	1 (50.0%)	1 (50.0%)	-
Poisonings, Toxic Effects, Injuries/Complications	12 (9.0%)	6 (50.0%)	6 (50.0%)	-
Discharge Disposition *n= 62 at 3-mo follow-up*				
Home with Self or Caregiver Care	92 (68.7%)	42 (45.7%)	50 (54.3%)	***.045****
Home with Home Health	24 (17.9%)	16 (66.7%)	8 (33.3%)	-
Skilled Nursing Facility	15 (11.2%)	4 (26.7%)	11 (73.3%)	-
Long-Term Care Facility	2 (1.5%)	0 (0%)	2 (100%)	-

Exposed to Inpatient Tobacco Treatment

Significant test: Chi-Square Test of Independence [a]Mann-Whitney

Medical Diagnoses and Discharge information source: Vanderbilt University Medical Center's EMR

Smoking characteristics and behaviors at enrollment and the three-month follow-up are shown in Table 5. The readiness to quit (RTQ) score was the only statistically significant change identified at the three-month follow-up, which decreased from 6.98 to 6.43 (p=0.03). Though not statistically significant, the Mann-Whitney U-test also determined that the number of cigarettes smoked per day (CPD) decreased by one-half from 20 to 10 (p= 0.069). Fifty percent (50.0%) of participants reported participation in inpatient tobacco treatment that included pharmacological participation by the three-month follow-up, but very few smokers (n= 2; 7.4%) reported participation in behavioral tobacco treatment (Table 5). None of the high-risk, eligible smokers completed the recommended lung cancer screening via LDCT.

Table 5. Smoking Characteristics of Participants at Enrollment (Post-TTS) and Three-Month Follow-up

Participant Characteristics (N= 63)	**Total sample post-TTS (n= 134)**	**Participants at 3-months (N= 63)**	***p*-value**
	M ± SD Median [IQR] n (%)	M ± SD Median [IQR] n (%)	
Smoking Characteristics and Behaviors			
Perceived Risk Scale Score (n= 61)	3.85 ± 1.05	3.57 ± 1.02	*.193*[a]
Readiness to Quit Score	6.98 ± 2.20	6.43 ± 2.46	***.030***[a]
Every Day or Some Days Smoker	134 (100%)	43 (68.3%)	*.587*[c]
Quit Smoking (30-day point prevalence)	-	20 (31.7%)	
Quit Attempt (n= 62)	9 (6.8%)	48 (77.4%)	*.264*[c]
Cigarettes smoked per day among current smokers (n= 42)	20 [10 – 20]	10 [4 – 20]	*.069*[b]
Significantly reduced CPD by ≥ 50% among all participants	-	40 (63.5%)	
Tobacco Treatment Services			
Pharmacological Participation (n= 38)	-	19 (50.0%)	
Quit Line Participation (n= 26)	-	2 (7.4%)	
Lung Cancer Screening Participation (n= 11)	-	0 (0%)	

[a] Paired Samples T-test [b] Mann-Whitney [c]Chi-Square Test of Independence

Bivariate Correlations between Perceived Risk and Smoking Risk Factors

Previously identified correlates of smoking-related outcomes were examined in study subjects to assess their potential association with perceived risk for developing a smoking-related health condition. These contextual smoking risk factors included: readiness to quit (RTQ), time to first cigarette (TTFC), cigarettes per day (CPD), participant age, concurrent other tobacco use, comorbid smoking-related disease, subjective health literacy, household income below poverty level, and education. (See Appendix A for comprehensive correlation matrix of all study variables). The correlation analyses matrix was then simplified by only including statistically significant associations (Table 6). Table 6 reports the simple bivariate correlations of the included smoking risk factors with the two measures of perceived risk (pre-TTS and post-TTTS) at study enrollment. Spearman's rho bivariate correlations were used to evaluate the statistical dependence between the rankings of each pair of study variables. Bonferroni corrections ($\alpha = 0.05/10 = 0.005$) were applied to examine significant correlations between perceived risk and smoking risk factors measured at study enrollment.

The inter-correlations among perceived risk and smoking risk factors provided evidence for concurrent and predictive validity. As expected, both perceived risk measures (pre-TTS and post-TTS) were significantly positively correlated with one another at the less than .001 significance level ($\rho = -.61$; $p<.001$), indicating that subjects reported comparable perceived risk scores before and after inpatient tobacco treatment. Additional statistically significant relationships included positive correlations between participant age with comorbid smoking-related disease ($\rho = -.63$; $p<.001$), where older participant age was associated with a diagnosis of more heart and lung conditions documented in the electronic medical record. Significantly negative inter-correlations were identified among the study variables as well. Post-TTS perceived risk was inversely correlated with TTFC ($\rho = -.31$; $p<.001$), such that lower post-TTS perceived risk scores were associated with the subject waiting a longer duration of TTFC at study enrollment. Other significantly negative correlations were identified between CPD with both RTQ and TTFC ($\rho = -.30$; $p<.001$ and $\rho = -.63$; $p<.001$, respectively). These findings indicate the following relationships: higher number of CPD was associated with lower ratings of motivation to quit (RTQ) and a shorter duration of TTFC in the morning.

Table 6. Significant Bivariate Associations between Perceived Risk and Smoking Risk Factors at Study Enrollment

Key Variables		V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11
V1	Perceived Risk (pre-TTS, retrospective)	-	.61**									
V2	Perceived Risk (post-TTS)		-		-.31**							
V3	Readiness to Quit			-		-.30**						
V4	Time to First Cigarette		-.31**		-	-.46**						
V5	Cigarettes Per Day			-.30**	-.46**	-						
V6	Participant Age						-		.63**			
V7	Concurrent Other Tobacco Use							-				
V8	Comorbid Smoking-Related Disease						.63**		-			
V9	Subjective Health Literacy									-		
V10	Below the Household Income Poverty Level										-	
V11	Education Level (≥ HS)											-

Note: n = 134; Spearman's Rho correlations = <.005 (adjusted p-value) and <.001**

Results Related to Aims

Results for Aim 1

All study subjects (n= 134) were asked the following questions: "How likely are you to develop lung cancer"; "How likely are you to develop a smoking-related disease?"; "How likely are you to develop lung cancer"; and "How likely are you to develop a smoking-related disease compared to other people your age?" Responses to these four items were summed and a total 'perceived risk' score was calculated. Among all subjects (n=134), the mean pre-TTS score was 3.43 ± 1.05 (*SD*) and the post-TTS score was 3.80 ± 0.97 (*SD*). Both scores fall between the neutral ('neither likely nor unlikely') and 'likely' response choices. The pre to post-TTS change was 0.37 but was not statistically significant based on the RCI calculated for change in perceived risk. The reliable change index was 0.82, indicating a meaningful, clinically significant difference. Based upon the reliable change index, subjects were categorized into three categories (Table 7). Only 23.1% demonstrated a reliable change index greater than 0.82, indicating an increase in perceived risk.

Since this is the first documented study in which these four items have been used as a proxy measure of 'perceived risk,' the internal consistency of all four items between the pre-TTS assessment and post-TTS assessment was determined using Cronbach's alpha reliability analyses. It was demonstrated that the pre- and post-TTS four items had shared covariance and likely measure the same underlying construct of perceived risk among study respondents with a Cronbach's alpha coefficient of 0.92, which demonstrated findings similar to previous studies.

Table 7. Summary Statistics of Reliable Change in Perceived Risk among Hospitalized Smokers from Pre-TTS to Post-TTS (n=134)

Reliable Change in Perceived Risk	***N***	**%**
Reliable decrease	6	4.5
None	97	72.4
Reliable increase	31	23.1

Results for Aim 2

The Readiness to Quit (RTQ) score was approximately 7 (6.98 ± 2.20) at study enrollment (and this score is assigned to the response: "I definitely plan to quit smoking in the next 30 days"). Because of the sample size, simple linear regressions were run to assess relationships between pre-TTS (retrospective) perceived risk and smoking risk factors, such as TTFC, CPD, participant age, concurrent other tobacco use, comorbid smoking-related disease, subjective health literacy, household income below poverty level, and education at study enrollment. Perceived risk was completely uncorrelated with readiness to quit. However, fewer CPD is associated with the likelihood of a higher RTQ score (β=-0.039, p<0.017) (Table 8). As such, the regression equation infers that a decrease of 10 CPD (e.g., a decrease from 20 to 10 CPD or 1 pack to ½ pack per day) is associated with an increase in the RTQ score of 0.39 points (10 x 0.039). As the relationship is linear, the increase in RTQ applies to any number of CPD.

Table 8. Simple Linear Regressions between Readiness to Quit after Inpatient Tobacco Treatment and Perceived Risk (pre-TTS) with Smoking Risk Factors (N= 134)

Simple Linear Regressions	**Unstandardized Coefficient**		**Standardized Coefficient**		**95% *C.I* Lower - Upper**		**Sig.**
Variable	B	Std. Error	Beta	t			
Pre-TTS (retrospective) perceived risk	-.113	.183	-.054	-.618	-.475	.249	.537
Post-TTS Perceived Risk	-.037	.197	-.016	-.186	-.426	.353	.853
Time to First Cigarette	.010	.006	.150	1.733	-.001	.022	.086
Cigarettes Per Day	-.039	.016	-.205	-2.410	-.072	-.007	***.017****
Participant Age	.016	.014	.099	1.148	-.011	.043	.253
Comorbid smoking-related disease	-.067	.089	-.065	-.752	-.243	.109	.454
Subjective Health Literacy	-.032	.057	-.049	-.553	-.145	.082	.582
Concurrent Other Tobacco Use	-.255	.548	-.041	-.465	-1.338	.828	.642
Income Below Poverty Level	-.708	.405	-.162	-1.750	-1.510	.094	.083
Education ≥ High School	-.642	.458	-.133	-1.403	-1.549	.265	.163

*significant at <.01

a. Readiness to quit is defined as a continuous variable

A multiple linear regression analysis (Table 9) was performed to examine statistical significance between study predictor variables and RTQ to adjust for additional cofactors that could influence smoking behavior. A significance threshold of $p< 0.1$ was used to determine inclusion of smoking risk factors examined in the simple regression analyses for RTQ. Application of threshold guidelines permitted inclusion of the following three predictor variables: CPD, TTFC, and household income below the poverty level. Pre-TTS (retrospective) perceived risk was also included in the multivariate analysis as the

main predictor variable of interest. After adjustment, pre-TTS (retrospective) perceived risk, CPD. TTFC, and household income below the poverty level did not impact RTQ (R^2= .055, p<0.181) based upon statistical significance (Table 9).

Table 9. Multiple Linear Regressions between Readiness to Quit after Inpatient Tobacco Treatment and Perceived Risk (pre-TTS) with Smoking Risk Factors (N= 134)

Multiple Linear Regressions	**Unstandardized Coefficient**		**Standardized Coefficient**			**95% *C.I* Lower - Upper**		**Sig.**
Variable	B	Std. Error	Beta		t			
(Constant)	7.853	.966			8.126	5.938	9.769	.000
Pre-TTS (retrospective) perceived risk	-.046	.212	-.200		-.215	-.466	.375	.830
Time to First Cigarette	.002	.007	.034		.316	-.012	-.017	.753
Cigarettes Per Day	-.030	.020	-.158		-1.494	-.069	.010	.138
Income Below Poverty Level	-.534	.415	-.122		-1.286	-1.357	.289	.201

a. Readiness to quit is defined as a continuous variable

Results for Aim 3

As noted above, 63 subjects (designated as 'participants') were included in the analyses for aim 3. Among these participants, smoking behavior variables or outcomes were examined such as smoking status, an attempt to quit smoking, reduced cigarette consumption and participation in inpatient tobacco treatment (either pharmacological or behavioral modalities).

Smoking Status. To evaluate 'smoking status' participants were asked, "Do you now smoke cigarettes every day, some days, or not at all?" A total of 31.7% (n= 20) of participants reported not smoking at 3-month post-TTS intervention. Of the 43 participants who continued smoking at the three-month follow-up, 31 (49.2%) participants continued to smoke every day and 12 (19.0%) reported smoking only some days. Participants who reported not smoking were slightly older (58 years vs. 51 years) than non-quitters. Also, those who reported not smoking reported lower CPD (13 CPD vs. 17 CPD pre-TTS), and a TTFC of longer than 5 minutes at study enrollment (non-smokers= 61.9% vs. smokers= 41.9%). There were no statistically significant differences between study enrollment and three-month follow-up in smoking risk factors (e.g., age, CPD, etc.) between those who reported not smoking and those who continued to smoke.

Eleven univariate binomial logistic regression analyses were performed to estimate the likelihood, or odds ratio (OR) that a study participant would report not smoking after three-months at follow-up due to significant relationships between pre-TTS (retrospective) perceived risk in the context of smoking risk

factors at study enrollment (Table 10). Perceived risk was completely unrelated to smoking status at three-month follow-up. Of the smoking risk factors examined, TTFC (OR= 1.02, 95% CI 1.00-1.03, p=0.038) was found to statistically significant to influence smoking status (Table 10). Therefore, for each unit of increase in TTFC of the day the participant was 1.02 times more likely to be a non-smoker at the 3-month follow-up. At study enrollment, the median time of TTFC for participants who did not smoke reported a median time of TTFC of 30.00 minutes and those who continued to smoke at follow-up reported a median TTFC of 5.00 minutes or less (Table 10).

Table 10. Univariate Logistic Model Estimates of Perceived Risk and Smoking Risk Factors on Smoking Status at Three-Month Follow-Up (N= 62)

Univariate Logistic Regressions			***OR***	**95% *C.I* Lower - Upper**		***p*-value**
	Not Smoking at 3 months					
Variable	**No** Median [IQR] *n* (%)	**Yes** Median [IQR] *n* (%)				
Pre-TTS (retrospective) perceived risk	3.38 [2.50 - 4.00]	3.25 [3.00 - 4.00]	1.13	.68	1.90	*.634*
Post-TTS Perceived Risk	4.00 [3.31 - 5.00]	3.75 [3.13 - 4.25]	.69	.41	1.17	*.170*
Readiness to Quit	7.00 [5.00 - 9.00	9.00 [7.00 - 9.00]	1.30	.99	1.70	*.058*
Time to First Cigarette	5.00 [5.00 - 30.00]	30.00 [5.00 - 90.00]	1.02	1.00	1.03	***.038****
Cigarettes Per Day	16.50 [10.00 - 20.00]	10.00 [4.00 - 20.00]	.96	.91	1.02	*.202*
Participant Age	51.00 [44.50 - 60.25]	60.00 [51.50 - 66.00]	1.04	.10	1.09	*.070*
Comorbid smoking-related disease	2.00 [.25 - 5.00]	3.00 [2.00 - 4.00]	1.10	.87	1.38	*.439*
Subjective Health Literacy	13.50 [12.00 - 15.00]	14.00 [11.00 - 15.00]	1.07	.88	1.29	*.518*
Concurrent Other Tobacco Use	8 (18.6%)	3 (14.3%)	.72	.17	3.09	*.668*
Income Below Poverty Level	19 (51.4%)	4 (25.0%)	.31	.09	1.16	*.083*
Education ≥ High School	26 (63.4%)	15 (75.0%)	1.73	.52	5.72	*.368*

*significant at <.05

a. Smoking Status is defined as a dichotomous variable (yes/no)

b. Column percentages

Self-Reported Quit Attempt. A self-reported quit attempt is a behavioral measure defined as whether or not the smoker abstained from smoking cigarettes for more than one day because they were trying to quit, between study enrollment study enrollment and three-month follow-up. Self-reported quit attempt was determined by a "yes" or "no" response to the following question, "During the past three months, did you quit smoking for more than one day because you were trying to quit?" At the three-month follow-up, 77.4% (n= 48) of participants reported they had tried to stop smoking since study enrollment.

Eleven univariate binomial logistic regression analyses were performed to estimate the probability that a participant would make a quit attempt between study enrollment and three-month follow-up (Table 11). Perceived risk was completely unrelated to making a quit attempt between study enrollment and the three-month follow-up. Of the smoking risk factors examined, only RTQ at study enrollment (OR= 2.08, 95% CI 1.38-3.14, $p<.001$) was statistically significant and likely to influence a self-reported quit attempt. Therefore, participants were 2.08 times more likely to self-report a quit attempt at three months for each unit increase on the RTQ ladder. The median RTQ score for participants who did not attempt to quit was 5.00, which is associated with the response, "I often think about quitting smoking, but I have no plans to quit". Participants that did attempt to quit, had a median score of 9.00 on the RTQ ladder which indicates "I have quit smoking, but I still worry about slipping back, so I need to keep working on living smoke free." Perceived risk was completely unrelated to making a quit attempt between study enrollment and three-month follow-up.

Table 11. Univariate Logistic Regression Analyses of Perceived Risk and Smoking Risk Factors on Self-Reported Quit Attempt at Three-Month Follow-Up (N= 63)

Univariate Logistic Regressions			***OR***	**95% C.I Lower - Upper**		***p*-value**
	Quit Attempt at 3 months					
Variable	**No** Median [IQR] n (%)	**Yes** Median [IQR] n (%)				
Pre-TTS (retrospective) perceived risk	4.00 [2.75 - 4.56]	3.00 [2.81 - 4.00]	.65	.35	1.22	*.178*
Post-TTS Perceived Risk	4.13 [3.00 - 4.81]	4.00 [3.25 - 4.25]	.78	.39	1.54	*.474*
Readiness to Quit	5.00 [4.75 - 6.00]	9.00 [7.00 - 9.00]	2.08	1.38	3.14	***<.001*****
Time to First Cigarette	30.00 [5.00 - 30.00]	5.00 [5.00 - 60.00]	1.01	.99	1.03	*.487*
Cigarettes Per Day	10.00 [5.00 - 20.00]	10.00 [3.00 - 16.25]	.98	.93	1.03	*.455*
Participant Age	57.00 [42.50 - 66.50]	53.00 [46.25 - 63.00]	1.01	.96	1.05	*.764*
Comorbid smoking-related disease	4.00 [.00 - 5.00]	3.00 [1.00 - 4.00]	.94	.73	1.22	*.636*
Subjective Health Literacy	14.5 [10.50 – 15.00]	13.00 [12.00 – 15.00]	.97	.79	1.19	*.768*
Concurrent Other Tobacco Use	2 (15.4%)	9 (18.8%)	1.27	.24	6.76	*.780*
Income Below Poverty Level	3 (27.3%)	18 (45.0%)	2.18	.50	9.45	*.297*
Education ≥ High School	9 (75.0%)	31 (66.0%)	.65	.15	2.72	*.552*

**significant at <.001

a. Quit Attempt is defined as a dichotomous variable (yes/no)

b. Column percentages

Reduced Cigarette Consumption. Another measure of smoking behavior was reduction in the number of cigarettes smoked per day (CPD) at the three-month follow-up assessment relative to the number of cigarettes smoked per day at study enrollment. Similar to other studies, a *significant reduction* in cigarette consumption was defined by a greater than or equal to 50% reduction in CPD, or 'cut back' between study enrollment and three-month follow-up (Hatsukami et al., 2005). Of the 63 participants, 63.5% (n= 40) reported a significant reduction in cigarette consumption by greater than or equal to 50%. Participants who reported continuing smoking reduced cigarette consumption by approximately one-third less CPD by the three-month follow-up (e.g. study enrollment = 17 CPD vs. 3-months = 11 CPD).

Eleven univariate binomial logistic regression analyses were performed to estimate the probability that a study participant would significantly lower their cigarette consumption between study enrollment and the three-month follow-up due to significant influence of pre-TTS (retrospective) perceived risk in the context of smoking risk factors at study enrollment (Table 12). Perceived risk was completely unrelated to reducing cigarette consumption by at least 50% at three-month follow-up, relative to study enrollment. Of the smoking risk factors examined, two were statistically significant to influence reduced consumption of CPD at three-month follow-up. Of the smoking risk factors examined, TTFC (OR= 1.02, 95% CI 1.00-1.05, p=0.033) and participant age (OR= 1.05, 95% CI 1.01-1.10, p=0.028) were found to statistically significant to influence reduced consumption of cigarettes (Table 12). Therefore, for each unit of increase in TTFC of the day the participant was 1.02 times more likely to lower cigarettes consumption by at least 50% at the 3-month follow-up. At study enrollment, the median time of TTFC for those who did not successfully 'cut back' at follow-up reported a median TTFC of 5.00 minutes or less while those who did 'cut back' reported a median time of TTFC of 30.00 minutes (Table 12). Also, for each year increase in age the participant was 1.05 times more likely to lower cigarettes consumption by at least 50% at the 3-month follow-up. The median age for those who did not successfully 'cut back' at follow-up was 49 years while those who did 'cut back' reported a median age of 58 years (Table 12).

Table 12. Univariate Logistic Regression Model Estimates of Perceived Risk and Smoking Risk Factors on Significant Reduction of Cigarette Consumption at Three-Month Follow-Up (*n*=63)

Univariate Logistic Regressions			**OR**	**95% C.I Lower - Upper**		***p*-value**
	Reduced CPD at 3 months					
Variable	**No** Median [IQR] n (%)	**Yes** Median [IQR] n (%)				
Pre-TTS (retrospective) perceived risk	3.50 [2.50 - 4.00]	3.13 [3.00 - 4.00]	1.07	.65	1.76	*.788*
Post-TTS Perceived Risk	4.00 [3.00 - 4.50]	3.88 [3.25 - 5.00]	.956	.54	1.67	*.874*
Readiness to Quit	6.00 [5.00 - 9.00]	7.00 [6.00 - 8.00	1.20	.94	1.53	*.146*
Time to First Cigarette	5.00 [5.00 - 30.00]	30.00 [5.00 - 60.00]	1.02	1.00	1.05	***.033****
Cigarettes Per Day	15.00 [10.00 - 20.00]	12.50 [6.25 - 20.00]	1.01	.98	1.10	*.672*
Participant Age	49.00 [39.00 - 55.00]	58.00 [49.25 – 64.50]	1.05	1.01	1.10	***.028****
Comorbid smoking-related disease	2.00 [.00 - 4.00]	3.50 [1.00 – 4.25]	1.21	.95	1.54	*.119*
Subjective Health Literacy	14.00 [12.00 - 15.00]	14.00 [11.00 - 15.00]	1.04	.87	1.23	*.683*
Concurrent Other Tobacco Use	5 (22.7%)	6 (15.0%)	.60	.16	2.25	*.449*
Income Below Poverty Level	8 (42.1%)	14 (42.4%)	1.01	.32	3.18	*.982*
Education ≥ High School	18 (81.8%)	22 (57.9%)	.31	.09	1.08	*.065*

***significant at <.05

c. Significant Reduction is defined as a dichotomous variable (yes/no)

d. Column percentages

Participation in Inpatient Tobacco Treatment. Participant smoking behaviors were also evaluated by assessing their participation in inpatient tobacco treatment. *Participation* was operationalized by evaluating participants' *acceptance* of a recommendation for pharmacological tobacco treatment or referral for behavioral tobacco treatment via their state's tobacco quit line and the subsequent *use* of the tobacco treatment modality.

Among the 63 participants, 43 (68.25%) accepted TTS pharmacological tobacco treatment recommendations. Among those who accepted, 20 participants (46.5%) reported participation in pharmacological tobacco treatment using nicotine replacement and/or FDA-approved prescription medications. Eleven univariate binomial logistic regressions were performed to estimate the probability that a study participant would engage in pharmacological tobacco treatment between study enrollment and three-month follow-up (Table 13). No significant correlations were found between perceived risk, smoking risk factors, and participation in pharmacological tobacco treatment modalities.

Table 13. Univariate Logistic Regression Model Estimates of Perceived Risk and Smoking Risk Factors on Pharmacological Participation at Three-Month Follow-Up (n=38)

Univariate Logistic Regressions			***OR***	**95% C.I. Lower - Upper**		***p*-value**
	Pharmacology Use at Follow-Up					
Variable	**No** Median [IQR] n (%)	**Yes** Median [IQR] n (%)				
Pre-TTS (retrospective) perceived risk	4.00 [2.00 – 5.00]	3.00 [2.56 - 3.50]	.78	.45	1.36	*.376*
Post-TTS Perceived Risk	4.25 [2.50 - 5.00]	4.00 [3.50 - 4.94]	1.12	.62	2.02	*.718*
Readiness to Quit	6.50 [5.00 -9.00]	7.00 [6.00 - 9.00]	1.21	.88	1.67	*.244*
Time to First Cigarette	5.00 [5.00 -30.00]	5.00 [5.00 - 30.00]	.98	.96	1.01	*.255*
Cigarettes Per Day	20.00 [9.25 -26.25]	20.00 [10.00 - 20.00]	1.01	.95	1.07	*.883*
Participant Age	54.00 [40.50 - 63.75]	49.00 [46.00 - 59.75]	.99	.94	1.05	*.778*
Comorbid smoking-related disease	1.50 [.00 - 6.00]	3.00 [1.25 - 4.00]	.94	.71	1.26	*.692*
Subjective Health Literacy	14.00 [11.50 - 15.00]	13.50 [11.25 - 14.75]	1.03	.81	1.30	*.836*
Concurrent Other Tobacco Use	4 (22.2%)	4 (21.1%)	.93	.20	4.47	*.931*
Income Below Poverty Level	7 (50.0%)	10 (62.50%)	1.67	.39	7.15	*.492*
Education ≥ High School	7 (41.2%)	11 (61.1%)	2.25	.58	8.69	*.241*

a. Pharmacological Participation is defined as a dichotomous variable (yes/no)

b. Column percentages

Among the 63 participants, 26 (41.27%) accepted a TTS referral for behavioral tobacco treatment. Only 2 (3.2%) participants reported actual participation with State Tobacco Quit line (at least one session with a quit line counselor over the telephone) between study enrollment and the three-month follow-up. Due to a nearly complete lack of participation with the state tobacco quit line, a logistic regression model was not run to identify significant associations that increased the likelihood of a participants' participation with behavioral tobacco treatment.

Results for Aim 4

Among all hospitalized smokers enrolled, 42 (65.6%) were eligible for LDCT imaging treatment between study enrollment and the three-month follow-up. However, 16 (38.1%) were not offered a referral due to a variety of potential obstacles that occur in the inpatient setting. Of the 11 (17.5%) participants that accepted the referral, none had completed the recommended imaging for lung cancer screening via LDCT by at three-month follow-up. No inferential data analysis procedures were indicated to perform due to a complete lack of participants reporting for this outcome variable.

Chapter V

Discussion

Summary of Findings

This study provides new information by examining the change in perceived risk before and after tobacco treatment counseling and by exploring the influence of contextual smoking risk factors and perceived risk on smoking-related outcomes among adult, hospitalized smokers. Perceived risk was assessed in the study to understand the degree in which the smoker acknowledged their likelihood of developing a smoking-related health condition. Study procedures were unique in that perceived risk was measured twice at study enrollment to examine changes in risk perceptions that may occur after exposure to a brief, inpatient tobacco treatment program. The first determination of perceived risk was measured immediately following informed consent and after TTS exposure; this determination assessment was referred to as "post-TTS perceived risk". The second determination of perceived risk, referred to as "pre-TTS (retrospective) perceived risk" was measured next using an evaluation technique known as a retrospective pretest (Curtis & Drennan, 2013).

The main study findings are: 1) A small, but positive change in perceived risk (as measured by a modified 4-item survey) was observed among 23% of hospitalized smokers after inpatient tobacco treatment; 2) Neither pre- nor post-TTS perceived risk statistically influenced readiness to quit at study enrollment or smoking behavior outcomes at three months; and 3) Risk factors found to positively influence smoking behavior outcomes at three-month follow-up were higher readiness to quit (RTQ) on a self-reported quit attempt and reporting education beyond high school on reduction on cigarettes per day (CPD) by at least 50%. TTFC (OR= 1.02, 95% CI 1.00-1.03, p=0.038) was found to statistically significant to influence smoking status. RTQ at study enrollment (OR= 2.08, 95% CI 1.38-3.14, p<.001) was statistically significant and likely to influence a self-reported quit attempt. TTFC (OR= 1.02, 95% CI 1.00-1.05, p=0.033) and participant age (OR= 1.05, 95% CI 1.01-1.10, p=0.028) were found to statistically significant to influence reduced cigarette consumption.

Study data did not support the independent influence of perceived risk or any smoking risk factors on key clinical services offered during inpatient tobacco treatment (pharmacological, behavioral, and lung cancer screening via LDCT). However, the prevalence of participant participation in positive smoking behaviors at three-month follow-up were notable after exposure to brief, inpatient tobacco

treatment from the VUMC TTS. This chapter discusses the major findings and presents study limitations and recommendations for future study.

Characteristics of the Sample

One hundred thirty-four (134) adult, hospitalized smokers (mean age of 50.03 ± 13.95) were recruited at study enrollment after exposure to inpatient tobacco treatment. The study sample of inpatient smokers was represented by equal gender groups and a higher percentage of White participants (77.6%; *n*= 104), which is typical of other smoking behavior studies. Also, the total sample, as exemplified by the variable 'time to quit smoking' (TTFC), was highly addicted to nicotine with 50.8% reporting a TTFC within five minutes upon waking, smoked approximately one pack of cigarettes per day (CPD) (median CPD= 20, IQR= 10 - 20), and self-reported experiencing a 30 pack-year smoking history (median reported; IQR= 16.25 – 49). Similar to the demographic profile of U.S. smokers, a large proportion of smokers in the study were considered to have low socioeconomic status (SES) (CDC, 2015). Compared to the prevalence among the U.S. population of smokers from lower-income communities (72%), 67.2% (*n*= 88) were unemployed and 53.0% (*n*= 71) reported an annual household income below the poverty level (CDC, 2015). Data collection ended for each participant after completion of the three-month survey.

Attrition rates at three-month follow-up (53.0%; *n*= 71) are comparable to or better than those of other studies examining smoking behaviors among adult smokers receiving tobacco treatment [~54% to 59%] Belita & Sidani, 2015; Faseru et al., 2011; Kim et al., 2015; [4.5%–28.6%] Ylioja et al., 2017). Differential dropout by age, employment, income, comorbid smoking-related disease, acceptance of tobacco treatment recommendations while hospitalized and evidence of a comorbid smoking-related diagnosis was evident at follow-up. Based upon statistical significance, three-month responders were more likely to be older, employed, earning a household income above the poverty level, diagnosed with congestive heart failure, and less willing to accept pharmacological tobacco treatment for smoking cessation.

Discussion of Results by Study Aim

Aim 1: Change in Perceived Risk before and after Inpatient Tobacco Treatment

In this study, among adult, hospitalized smokers (mean pre-TTS (retrospective) perceived risk score of 3.43 ± 1.05), perceived risk for developing a smoking-related health condition increased by approximately one-third (+0.37) after exposure to a brief, inpatient tobacco treatment program. The average perceived risk scores in this study were similar to perceived risk scores (M= 3.50) reported among outpatient smokers described as "medically ill" and diagnosed with more than one smoking-related health condition in previous investigations (Borrelli et al., 2010; Sinicrope et al., 2010). Despite an observed increase in perceived risk for developing a smoking-related health condition, statistical and clinically, meaningful change in perceived risk was determined by using a reliable change index (RCI). Results of the RCI found that a change in perceived risk was statistically significant if greater than or equal to ±0.82.

Comparison of a retrospective, pre-test (pre-TTS) assessment of perceived risk with results of an assessment of perceived risk at study enrollment (post-TTS) indicated a statistically significant increase in perceived risk for developing a smoking-related health condition among 23% of all hospitalized smokers in the study. However, there is consensus among outpatient tobacco research studies that a clinically significant change in perceived risk corresponds with an observed difference of at least one unit on the five-point ordinal scale between measurements (e.g., movement from 'likely' to 'very likely') (Borrelli, Hayes, Dunsiger, & Fava, 2010; Bunge et al., 2008; Carere et al., 2015; Chena & Kaphingst, 2010; Harris et al., 2012; Shofer et al., 2014). Based upon this criterion, the increase (RCI= +0.82) in perceived risk observed among hospitalized smokers in the current study did not represent a significant clinical impact and minimizes the potential influence of perceived risk on short-term smoking-related outcomes. Moreover, the conclusion of a small clinical effect on change in perceived risk as a result of inpatient tobacco treatment could not be validated given the absence of similar hospital-based studies.

Aim 2: Readiness to Quit (RTQ) at Study Enrollment

Readiness to quit smoking has been identified as a major barrier to smoking cessation and previous findings from tobacco intervention studies suggest that hospitalized smokers may be more motivated to quit smoking due to instability of their current health status (Sciamanna et al., 2000). It was

hypothesized that pre-TTS (retrospective) perceived risk would influence RTQ at study enrollment, in the context of other smoking risk factors, such as sociodemographic variables and comorbid health conditions. RTQ was operationalized by a psychological measure, the RTQ Ladder (Abrahms et al., 2003). The average "readiness" score among the total sample of hospitalized smokers was 6.98 (SD= 2.20), which indicates motivation to stop smoking 'in the next 30 days'. In a larger study with over 500 inpatient smokers exposed to inpatient tobacco treatment, the average RTQ score was 7.90 (Faseru et al., 2011). However, mandates that forbid smoking in hospitals may influence patients, who had not smoked a cigarette since admission, to consider themselves more motivated and empowered to quit smoking.

Smoking risk factors that have predicted readiness to quit in other studies include older age, lower levels of nicotine dependence, and concurrent use of other tobacco products (Poghosyan, Sheldon, & Cooley, 2012; Richardson, Xiao, & Vallone, 2012). Yet, lower CPD was the only smoking risk factor to significantly increase the likelihood of being more motivated to quit among hospitalized smokers in the current study (β= 0.039, p<0.017). Potential reasons for statistically insignificant findings among perceived risk and other smoking risk factors for this study aim are that hospitalized smokers in the total sample were generally middle-aged, were highly addicted to nicotine, and reported a prevalence of less than 15% for concurrent use of other tobacco products at study enrollment. Moreover, the algorithms used in outpatient settings to determine a smoker's level of readiness to quit smoking may not be appropriate for clinical use with inpatient smokers (Sciamanna et al., 2000).

Aim 3: Smoking Behaviors at Three-Month Follow-up

Smoking behavior outcomes were assessed three months after study enrollment. It was hypothesized that at three-month follow-up, a higher pre-TTS (retrospective) perceived risk, in the context of smoking risk factors, would increase the likelihood of the following smoking behaviors variables: 1) non-smoking status (30-day point prevalence smoking abstinence), 2) self-report of a 'quit attempt' between study enrollment and follow-up, 3) reduction in CPD by at least 50% (relative to the number of self-reported CPD at study enrollment), and 4) participation in inpatient tobacco treatment modalities (pharmacological and/or behavioral treatment via the state tobacco quit line). Among responding participants at three-month follow-up, 32% (n= 20) quit smoking, 77.4% (n= 48) self-reported an attempt to stop smoking, and 63.5% (n= 40) reduced the number of smoked CPD by at least 50%. Study results indicate that smoking status, making a 'quit attempt', and reduction in CPD were positively influenced by smoking risk factors in this study, but perceived risk was not associated with these outcomes.

Smoking Status. Predictors of smoking cessation and long-term abstinence in adults typically include TTFC within five minutes of waking (high nicotine dependence), older age, and readiness to quit (Ferguson et al., 2003; Grandes, Cortada, Arrazola, & Laka, 2003; Harris et al., 2004; Lando, Hennrikus, McCarty, & Vessey, 2003; MacKenzie, Pereira, & Mehler, 2004). Current study results provide some support of these expectations by identifying that a longer duration of TTFC at study enrollment significantly increased the likelihood of smoking cessation by self-report at three-month follow-up (OR= 1.02, 95% CI 1.00-1.03, p=0.038). Although TTFC was the only statistically significant smoking risk factor associated with smoking status, readiness to quit (OR= 1.30, 95% CI .99-1.70, p=0.058), participant age (OR= 1.04, 95% CI 0.10-1.09, p=0.070), and poverty level (OR= 0.31, 95% CI 0.09-1.16, p=.083) also demonstrated potential relationships with smoking status at three-month follow-up.

Self-Reported Quit Attempt. A self-reported quit attempt is a behavioral measure defined as whether or not the smoker abstained from smoking cigarettes for more than one day because they were trying to quit, between study enrollment study enrollment and three-month follow-up. Of the smoking risk factors examined, only RTQ at study enrollment (OR= 2.08, 95% CI 1.38-3.14, p<.001) was statistically significant and likely to influence a self-reported quit attempt at follow-up. RTQ has been positively associated with a higher number of quit attempts and more concern about future health risks related to smoking in the literature (Feng et al., 2010; Gibbons, McGovern, & Lando, 1991; Mathur & Singh, 2015). Higher perceived health risk has been correlated to greater likelihood of making a quit attempt, among smokers with adverse medical conditions in other studies (Borrelli et al., 2010). Unfortunately, perceived risk was unrelated to making a quit attempt in the current study at three-month follow-up (OR= 0.65, 95% CI 0.35-1.22, p=.178).

Reduced Cigarette Consumption. There are many sociodemographic, behavioral, environmental, and health-related variables related to smoking behaviors and health outcomes. Two of the most widely accepted independent risk factors for poor smoking outcomes are time to first cigarette (TTFC) within 5 minutes of waking in the morning and advanced age (Lando, Hennrikus, McCarty, & Vessey, 2003; USDHHS, 2014). In the current study, smoking 'significantly' less CPD by at least 50% was less probable at the three-month follow-up if the participant reported a TTFC of 5 minutes of less at study enrollment (median TTFC: 5 minutes vs. 30 minutes) and if the participant was younger on age (median age: 49 years vs 58 years). These finding support evidence that TTFC, an indicator of nicotine dependence, is a significant risk factor to consider in relation to reduced cigarette consumption. These findings also indicate the older smokers are more likely to lower their cigarette consumption to possibly prevent inherent negative health consequences associated with smoking and aging (American Lung Association, 2015; USDHHS, 2014).

Participation in Inpatient Tobacco Treatment. Initiating pharmacological tobacco treatment while hospitalized increases quit rates by 50% and bedside counseling followed by telephone support for at least one month after discharge increases smoking cessation rates by 40% (Rigotti, Clair, Munafo, & Stead, 2012). Study participants readily accepted pharmacological and behavioral tobacco treatment at study enrollment. During exposure to inpatient tobacco treatment, the majority accepted recommendations for pharmacological tobacco treatment (acceptance = 70.7%) and behavioral counseling via the state tobacco quit line (acceptance = 53.5%). In addition, 50% of participants at three-month follow-up reported use of a recommended medication to stop smoking. However, evidence asserts that hospitalized smokers require continued support after inpatient tobacco treatment, both while in the hospital and after discharge, to significantly influence smoking outcomes (Rigotti, Clair, Munafo, & Stead, 2012). Smokers enrolled in this study were not contacted after discharge with the purpose of offering supplemental tobacco treatment intervention. As a result, short-term cessation rates may fall short of comparable short-term cessation rates with previous studies. There were no significant relationships identified among perceived risk and contextual smoking risk factors to influence pharmacological tobacco treatment. Also, the small sample available for participation in behavioral tobacco treatment (7.4%, n= 2) prevented an analysis of relationships with study predictor variables. Low rates of participation among smokers referred to state tobacco quit lines is a typical finding of smoking intervention studies (Faseru et al., 2011).

Aim 4: Lung Cancer Screening via LDCT at Three-Month Follow-up

Evidence indicates that perceived risk influences compliance with recommendations to complete lung cancer screening via LDCT in outpatient settings, but LDCT screening rates among hospitalized smokers has been less well studied (Borelli et al., 2010; Carere et al., 2015; IOM, 2012; Park et al., 2013; Waters, McQueen, & Cameron, 2014). It was hypothesized that the higher the pre-TTS (retrospective) perceived risk for developing smoking-related health condition at study enrollment and three-month follow-up, the greater the likelihood that the referral for lung cancer screening via LDCT would be accepted and LDCT would be completed when assessed at the three-month follow-up. Yet, none of the 11 study participants who accepted the referral at study enrollment reported completion of LDCT imaging at the three-month follow-up.

Descriptive data analyses indicate that LDCT referrals were offered inconsistently to older, high-risk smokers who were eligible for the preventive lung cancer screening. Out of 42 eligible smokers, TTS tobacco treatment specialist did not offer referrals for lung cancer screening via LDCT to 38% (n= 16)

hospitalized smokers in the total study sample. It is possible that eligible smokers were not offered LDCT study enrollment due to obstacles related to the inpatient setting or issues discovered during the tobacco treatment consultation but not documented in the EMR. Moreover, there are other criteria for lung cancer screening including life expectancy and willingness to undergo surgery if an abnormality is found on LDCT that is not represented in the data but influenced the TTS specialist's decision to not offer preventive services.

This study cannot provide information about LDCT screening in hospitalized smokers because there was a complete lack of participation reported at three-month follow-up. It is possible that valuable associations or inferences could have been obtained from the data if the remaining eligible smokers were offered a referral for lung cancer screening via LDCT at study enrollment. However, other studies have found that participation is typically low (below 4%) among the very smokers who could benefit from early lung cancer screening via LDCT (CMSb, 2015; Jemal & Fedewa, 2017; Moyer, 2014). Hospitalized smokers in this study appeared to be more willing to accept a referral for LDCT than the general population, but participation rates were lower than expected.

Implications for Research Methods and Design

This study sought to explored health risk perceptions in 134 adult, hospitalized smokers after being exposed to a brief, inpatient tobacco treatment program and investigate the influence of perceived risk, in the context of smoking risk factors, on smoking-related outcomes. A descriptive, correlational research study design approach was utilized to conduct a non-experimental, single group, pretest-posttest, quantitative study. No prior tobacco-related investigation had been conducted to test the application of a theoretical to explore potential factors that cause variance in smoking behavior outcome variables (Finney et al., 2011; Griffin, Dunwoody, & Neuwirth, 1999). However, empirical evidence strongly supports the likely predictive influence of individual characteristics on the relationship between perceived risk for developing a smoking-related health condition and smoking-related outcomes, such as chronic disease severity, other co-morbid conditions, sociodemographic variables, and cultural factors (Benkert et al., 2009; Borrelli et al., 2010; Jacobs et al., 2006; Musa et al., 2009; Persky et al., 2013; Saha et al., 2010; Shofer et al., 2014; Sinicrope et al., 2010). The current study was able to fill this research gap in tobacco literature and demonstrate the contextual influence of individual characteristics on smoking-related outcomes. Data collection procedures at study enrollment were completed during a face-to-face encounter at the bedside while the participant was hospitalized and a subsequent chart audit.

There were three major sources of methodological issues within the study: recruitment, measurement of perceived risk, and attrition/follow-up. Recruitment of eligible hospitalized smokers was limited by the availability of the PI to approach the patient within 48 hours of receiving an initial consultation for inpatient tobacco treatment. Recruitment rates of hospitalized smokers could have increased if it had been feasible to allow the TTS tobacco treatment specialist to recruit and/or obtain informed consent at the conclusion of their counseling session for inpatient tobacco treatment. Recruitment was also limited by patient availability during daytime hours when many were in lengthy consultations with hospital providers or out of their rooms for procedures.

Perceived risk was consistently found to be an insignificant influence of smoking-related outcomes in the current study. The lack of significance could be related to measurement of the construct and/or measurement time periods. The measure of perceived risk for developing a smoking-related health condition used in the study produced an optimal Cronbach's alpha of internal consistency reliability (α= 0.92) comparable to other studies examining smokers. However, previous studies did not report reliability of perceived risk measurement in samples of hospitalized smokers. A 4-item survey was modified to assess perceived risk in the current study that included questions about concern about a smoker's likelihood of developing both lung cancer and specific smoking-related health conditions such as heart and lung conditions. Further analyses of the 4-item measure may support suspicion that two constructs are represented according to health outcome (lung cancer vs. heart or lung disease). Also, measurement of a retrospective pretest for perceived risk may have introduced bias as a result of subject bias or social desirability (Pratt, McGuigan, & Katzev, 2000). Comparison of multiple measures of perceived risk among hospitalized smokers may provide significance for the observed change in risk perceptions after inpatient tobacco treatment.

Completion of study aims was limited due to issues related to follow-up three-months after study enrollment. Attrition at the three-month follow-up assessment period significantly affected the ability to perform inferential statistical techniques to evaluate relationships among study variables. Attrition may also be a contributing factor for the small number of statistically significant findings, despite strong evidence of influence between predictor and outcomes variables in the literature. Data were collected over a six-month study period at study enrollment, one-month follow-up, and three-month follow-up; but follow-up data was only analyzed at three-months. Other studies investigating the effects of inpatient tobacco treatment interventions typically conducted follow-up assessments between six and twelve months (Rigotti, Clair, Munafo, & Stead, 2012). Extending the current study's active period beyond three-months could have potentially produced more statistically significant or impactful long-term results related to smoking behavior outcomes. Providing financial incentives for study participation and follow-

up is a more likely methodological modification that would improve follow-up and successful completion of study aims.

A more comprehensive and aggressive pursuit to obtain follow-up communication by postal mail, in person, or over a longer period of time could have minimized attrition rates. In anticipation of the high attrition rates experienced in other small-scaled tobacco treatment studies, a concerted effort was made by the PI to establish rapport with study enrollees to encourage understanding of the study purpose. In addition, multiple communication channels were accessed to interact with study participants. At study enrollment, participants were asked to provide at least two (2) telephone numbers to call and/or send mobile messages, and they were asked to provide an electronic message (email) address, as well. It appears that lower socioeconomic status among study participants was a significant influence towards communication failure given that differential drop out was evident due to poverty level and many telephone numbers were no longer in working order at the time of study follow-up.

Implications for Clinical Practice

Inpatient tobacco treatment interventions can effectively promote smoking cessation and sustained abstinence after discharge from the hospital (CMSa, 2015; Faseru et al., 2011; Nahhas et al., 2016; PHS, 2008; Reid et al., 2015; Rigotti et al., 2014; Rigotti, Munafo, & Stead, 2008). In this study, 15% (intent to treat = 20/134) of smokers in the total sample of hospitalized smokers and 32% (*n= 20*) of hospitalized smokers at three-month follow-up self-reported cessation after exposure to TTS tobacco treatment services. Previous studies within a systematic review of inpatient tobacco cessation programs indicated that the estimated effect of a high-intensity inpatient tobacco treatment intervention is smoking cessation rates of 37% at six and 12 months after hospital discharge (Rigotti, Clair, Munafo, & Stead, 2012). Inpatient tobacco treatment interventions of lower intensity have not been shown to be as effective (Rigotti, Clair, Munafo, & Stead, 2012). High-intensity interventions include multiple counseling sessions and supportive follow-up communication for at least one month after hospital discharge.

Participants were exposed to a low-intensity inpatient tobacco treatment intervention with no established protocol to provide follow-up support. However, results indicate that smoking cessation rates among participants who responded after three months were comparable to cessation rates among hospitalized smokers in previous investigations (~32% to 37% at 6 to 12 months follow-up) (Faseru et al., 2011; Rigotti, Clair, Munafo, & Stead, 2012). Results also indicate that 77.4% (*n*= 48) of responding participants at the three-month follow-up self-reported a quit attempt and 63.5% (*n*= 40) of participants reduced the number of smoked CPD by at least 50%. Brief communication between the PI and

participants during one and three-month follow-up assessments may have produced higher smoking cessation rates than what would have occurred if there were no follow-up communication at all. However, short-term cessation rates and long-term smoking abstinence would be more likely to occur had follow-up communication been facilitated by a tobacco treatment specialist.

Limitations

Sample Attrition

No published data were available to prospectively estimate potential sample characteristics. This dearth of information about perceived risk among hospitalized smokers indicated a gap in the literature and the need for this research study but limited the ability to determine the target sample size needed to achieve 80% power. Therefore, an a priori power analysis and preliminary sample size estimation was conducted to overcome potential limitations that could affect interpretation of study findings (Shadish, Cook, & Campbell, 2002). The sample size of 134 adult, inpatient smokers recruited at study enrollment is small when compared to other multi-site, inpatient tobacco treatment intervention studies, which contained thousands of participants. A sample that is too small in size inhibits the ability to identify significant relationships from the data compared to what might result in the presence of a larger effect size (Radosevic, 2005). The massive attrition experienced during follow-up assessment at three-months removed any advantage gained from the priori power analysis. The influence of demographic and clinical factors on attrition has been inconsistent across tobacco treatment intervention studies. However, results for differential drop in this study out are typical.

Data Collection

Data confirmation by self-report was the only practical method to assess the subjective and behavioral variables examined in this study**.** As a result, participants may have underestimated, exaggerated, or purposefully misreported responses concerning their smoking behaviors. Despite inherent limitations associated with using self-reported data, self-reported smoking cessation has been biochemically verified in other studies. Biochemical testing to determine smoking status, such as the measurement of exhaled carbon monoxide, was not feasible to acquire in this study due to financial

constraints. However, other studies report that self-reported CPD has been biochemically verified against measurement of exhaled carbon dioxide levels and urinary cotinine, the "gold standard" (Hennrikus et al., 2005; Rigotti et al., 1997; Studts et al., 2006).

Statistical Analyses

The statistical procedures chosen to evaluate study findings were limited largely to descriptive and univariate inferential techniques. An attempt to interpret inferential relationships using data from this study may be subject to error because of confounding variables and validity threats such as history, maturation, test effects and regression to the mean (Cook & Campbell, 1979; Shadish, Cook, & Campbell, 2002). Missing data due to attrition significantly reduced statistical power to assess outcome variables with advanced statistical analyses. Thus, descriptive relationships were evaluated between study variables by identifying statistically significant associations and differences between participation groups. Missing data were also prevalent in the study due to missed opportunities by participants to engage with quit line counseling and missed opportunities by TTS tobacco treatment specialists to offer lung cancer screening via LDCT to eligible smokers.

Implications for Future Research

Clinically relevant knowledge and beliefs about smoking are associated with cessation and intention to quit (Carosella, Ossip-Kline, Watt, & Podgorski, 2002; Cummings et al., 2004; Dillard, McCaul, & Klein, 2006; Kerr, Watson, Tolson, Lough, & Brown, 2006; Tanni et al, 2017). Yet, perceived risk for developing a smoking-related disease risk was not found to have any statistically significant influence on any of the study outcome variables among smokers who were exposed to inpatient tobacco treatment. Regardless, significant bivariate associations demonstrate evidence that perceived risk remains an important concept to consider when assessing smoking-related outcomes among hospitalized smokers. Moderate association were noted between post-TTS perceived risk and time to first cigarette (ρ= -0.31; p<.001) and pharmacological tobacco treatment (ρ= 0.30; p=.001). These findings indicate that higher perceived risk scores after exposure to inpatient tobacco treatment may be associated with less TTFC (more nicotine addiction) and accepting a recommendation for pharmacological tobacco treatment.

Limitations imposed by the lack of a comparison sample population eliminated the ability to make a statement about the generalizability of study outcomes or implications of effect size. However,

self-reported rates of engagement in positive smoking behaviors at three-month follow-up may suggest that inpatient tobacco treatment may influence perceived risk in a more impactful way with a larger sample of hospitalized, adult smokers. Low health literacy may serve as a critical and independent risk factor for poor cessation outcomes among low-socioeconomic status, racially/ethnically diverse smokers (Stewart et al., 2013). Higher subjective health literacy scores among this sample of adult, hospitalized smokers was unexpected given the level of nicotine addiction (median score: 13.0 [10 – 15]). However, the fact that most participants considered themselves capable of accessing, understanding and using basic health knowledge may have further contributed to positive smoking behaviors reported at three-month follow-up.

Further analyses of this study's data set would be valuable to identify characteristics associated with a clinically, meaningful reliable change in perceived risk based on group mean scores and those associated with clinically relevant change in perceived risk by at least one unit on the ordinal measurement scale based on general consensus (Borrelli, Hayes, Dunsiger, & Fava, 2010; Bunge et al., 2008; Carere et al., 2015; Chena & Kaphingst, 2010; Harris et al., 2012; Shofer et al., 2014). This future research study would be enhanced with a larger sample of hospitalized smokers in order to apply perceived risk and all contextual smoking risk factors simultaneously in a regression model.

Similar to the demographic profile of U.S. smokers, a large proportion of smokers in the study were considered to have low socioeconomic status (CDC, 2015). Compared to the prevalence of lower-income smokers among the U.S. population (72%), 67.2% (n= 88) of hospitalized smokers in the study were unemployed and 53.0% (n= 71) reported an annual household income below the poverty level (CDC, 2015). In the current study, an annual household income level below poverty was statistically associated with several study variables. There was a significant, positive correlation between poverty and CPD (ρ= 0.23, p=<.05); while poverty was inversely correlated with TTFC (ρ= -0.19, p=<.05), education (ρ= -0.24, p=<.05), and age (ρ= -0.23, p=<.05). Finally, there was also a significant, inverse relationship between age and concurrent use of other tobacco products (ρ= -0.17, p=<.05) among hospitalized smokers in the study; and concurrent use is likely to impede smoking cessation efforts. Furthermore, results from the current study and previous studies indicate that socioeconomic status smoking risk factors (e.g., unemployment, household income below the poverty level, etc.) among study participants have the potential to significantly influence RTQ, smoking status, making a quit attempt, reduction in CPD, and attrition (at follow-up) among hospitalized smokers (Fagan et al., 2004; Morgan, Backinger, & Leischow, 2007). Although the study sample was relatively small, consensus of study findings suggest support for generalizability of findings.

Two conclusions were made to apply to promote further investigation of socioeconomic status and hospitalized smokers. Future studies are needed with larger, more diverse populations and

prospective designs to further validate these findings and the impact of socioeconomic status and age on perceived risk, smoking behaviors, and inpatient tobacco treatment outcomes (Brewer et al., 2007; Song et al., 2009). A new study aim would hypothesize that inpatient tobacco treatment would be more effective if an approach to treatment was identified that could remove the effect of significant sociodemographic disparities related to socioeconomic status and age. Also, financial incentives for follow-up could potentially combat attrition and promote the acquisition of sample sizes large enough to compare measures of internal reliability and reliable change with a similar sample population.

Future research may also be enhanced with further in-depth analysis among groups of study participants based upon sociodemographic, smoking characteristics, and comorbid conditions (specifically, cardiopulmonary smoking-related diseases). There were several instances identified with descriptive statistical analyses where study enrollment characteristics were not congruent with factors that have been typically present when statistically significant predictions of smoking behaviors were made in previous studies. For example, readiness to quit is typically predicted to be higher among smokers who are of an older age, admitted to the hospital with a respiratory condition, report lower levels of nicotine dependence, and concurrently consume other tobacco products (Poghosyan, Sheldon, & Cooley, 2012; Richardson, Xiao, & Vallone, 2012; Shofer et al., 2014). Hospitalized smokers in this study were highly addicted to nicotine, as indicated by a smoking a pack of CPD on average and reporting a TTFC from five (5) to 30 minutes in the morning. Because one cannot conclude if the concepts and/or measures used in this study are useful in this population of hospitalized smokers, additional analysis among groups of hospitalized smokers at study enrollment and follow-up could also potentially predict attrition and various other smoking-related outcomes. These findings can be applied to enhance the recruitment plan of another study examining hospitalized smokers and estimate retention rates at follow-up.

Most smokers fail to acknowledge the short- and long-term effects of smoking that will negatively affect their quality of life (Finney Rutten et al., 2008; Montes et al., 2007; Onken et al., 2005). However, the hospitalized smokers in this study reported a moderately elevated awareness of their individual smoking-related health risks even before being exposed to the tobacco treatment intervention. Then, there was a small, but positive increase observed from pre-TTS to post-TTS perceived risk scores. When compared to outpatient smokers, hospitalized smokers not actively seeking tobacco treatment may be more willing to accept expert advice and quit smoking in order to promote medical recovery (Brewer et al., 2007; CMS, 2015; Fiore et al., 2008; Oltedal, Moen, Klempe, & Rundmo, 2004; Reid et al., 2015; Rigotti et al., 2014). Although hospitalized smokers in the study permitted TTS services, only 23% of hospitalized smokers reported a ‘statistically significant’ reliable increase in perceived risk.

As previously described, RCIs provide a supplemental means of analysis to comparisons of group means in outcome research with preventive interventions (Jacobson, Follette, & Revenstorf, 1984;

Jacobson & Truax, 1991). This study promotes new knowledge related to how measurement of a RCI can be used to evaluate clinically, significant aggregate change in risk perception related to smoking-related disease and lung cancer among hospitalized smokers. Unfortunately, the majority of the sample (72%, *n*= 97) reported no statistically significant change (RCI = < ±0.82). However, RCI may not need to be relied on as a sole measure of significance for the observed change in risk perceptions, given the observed, positive quitting behaviors among participants. Additional analyses of RCI scores could identify how many of hospitalized smokers experience a "ceiling effect" due to highly rated pre-TTS (retrospective) perceived risk scores and variables associated with reliable change. Medium to higher levels of perceived risk are expected among smokers diagnosed with hypertension (Borrelli et al., 2010) and older, high-risk smokers (Sinicrope et al., 2010). Almost 60% of the hospitalized smokers in this study had been diagnosed with hypertension, which may have contributed to the somewhat elevated pre-TTS (retrospective) perceived risk scores detected in this study. Data should be tested to understand if smokers with hypertension and other prevalent smoking-related diseases have higher perceived risk scores than those without disease.

Conclusions and Next Steps

No study to date had investigated the direct influence of perceived risk associated with smoking-related health condition among hospitalized smokers. In the current study, perceived risk was not found to have significant influence over any smoking-related outcomes. Regardless, significant bivariate associations between perceived risk and smoking risk factors demonstrate evidence that perceived risk remains an important concept to consider when examining smoking-related outcomes in hospitalized smokers. Study findings also demonstrate how exposure to a brief, inpatient tobacco treatment program can positively impact smoking intentions and short-term smoking behaviors.

Future investigation is warranted to continue exploration of health risk perceptions among hospitalized smokers to further elucidate relationships with contextual smoking risk factors and behavior outcomes in the following ways: 1) Further exploration of actual risks associated with specific adverse health conditions and cardiopulmonary smoking-related diseases may improve understanding of the perceptions of risk; 2) A secondary analysis of the data to evaluate group differences based upon the influence of nicotine dependence (e.g., CPD, TTFC) and socioeconomic status (e.g., employment status, educational attainment, household income below poverty, etc.) may provide a more reliable understanding of long-term smoking behaviors (CDC, 2018; Prochaska, Hall, Delucci, & Hall, 2014; Rigotti, Clair, Munafo, & Stead, 2012); 3) Item analyses (or other psychometric methods) of the

modified, 4-item measure of perceived risk in this study may detect cause to reduce the item count and retest the measure for reliability.

Appendix A. Additional Tables and Figures

Risk Perception Intervention Studies

Author (Year)	Aim	Sample Size	Intervention	Outcome Measures	Baseline vs. Outcomes	Effect Size	Related Findings
Borrelli, Hayes, Dunsiger, & Fava (2010) Borrelli et al. (2005)	To examine the influence of risk perception on intentions to quit smoking and post-treatment abstinence.	N=237 adult smokers receiving care from home health care nurses M age= 56 (14.1) Fagerstrom score= 6.3 (3.1) Years of smoking= 41.8 (13.6)	Treatment: Motivational Enhancement for 20-30 min and 5 min follow-up calls (ME; Motivational Interviewing + Carbon Monoxide Feedback) Control: Standard Care for 5-15 min (AHCPR Guidelines for smoking cessation)	RP: 5-point future perceived vulnerability (FPV) scale at baseline and end of treatment. [1=not at all to 5= very much) Smoking: Patient-reported cigs/day at baseline and end of treatment. FTND Score Biochemical verification at end of treatment, 2, 6, and 12 month follow-up.	RP: No baseline or EOT risk perception scores noted. No change measurement noted. Smoking: Baseline cigs/day: M= 20.5 (13.8) No EOT cigs/day noted.	RP: Unable to determine the effect of the intervention on risk perception. The author failed to publish related statistics. However, there is a medium effect of change in risk perception on continuous smoking cessation over 1 year. Smoking: Small to medium effect of motivational interviewing intervention on continuous smoking cessation (excluding small effect at 6 months. Only a small effect of 7-day point prevalence abstinence at 12 month follow-up. Continuous Abstinence- EOT OR= 2.4, 95%CI 0.2-26.9 2mo OR= 2.8, 95%CI 0.7-11.4 6mo OR= 1.7, 95%CI 0.4-6.3 12mo OR= 2.4, 95%CI 0.7-7.6 7-day point prevalence abstinence: EOT OR= 1.2, 95%CI 0.5-2.3 2mo OR= 1.0, 95%CI 0.4-2.3 6mo OR= 1.1, 95%CI 0.4-2.3 12mo OR= 1.7, 95%CI 0.7-4.3	Odds for smoking cessation increased with each one unit change in FPV. Continuous Abstinence: 2mo OR= 3.39, 95%CI 1.09-10.55, $p<.05$ 6mo OR= 4.41, 95%CI 1.32-14.75, $p<.05$ 7-day point prevalence abstinence: 2mo OR= 2.43, 95%CI 1.27-4.67, $p<.01$ 6mo OR= 3.16, 95%CI 1.16-8.57, $p<.05$
Bunge et al. (2008)	To determine if participants of a lung cancer screening CT trial with high affective risk perception showed higher levels of lung cancer-specific distress during screening.	N= 351 high risk smokers (current and former) aged between 50 and 75 years old who had an appointment for baseline CT screening M age= 60.3 (6.4) Former smoker= 25.3% All subsequent CT screenings were negative and results were received before follow-up.	Treatment: CT Screening Control: no CT screening Participants were further divided into groups based on affective risk perception at baseline. Control group was not assessed. Low affective risk group [very low, low, not low/high]: n= 274 (85.4%) High affective risk group [high, very high]: n= 47 (14.6%) [82.4% had a negative CT]	RP: 5-point affective risk perception scale at baseline and 6 month follow-up. [very low, low, not low/high, high, very high] Smoking: Status Cigs/day # Years smoking	RP: No baseline or EOT risk perception scores noted. N= 276 N= 35 (12.7%) changed RP at 6 month follow-up From high to low= 23 From low to high= 12 High risk at 6 mo: n=10.5%, $p<0.01$ (4% difference)	No effect was observed using CT screening to increase risk perception OR= 0.07, 95% CI 0.03-0.17 (personal calculation) Conversely, CT screening created a very large effect of *lowering* the risk perception of developing lung cancer. OR= 13.80, 95% CI 5.87-32.43 (personal calculation)	Only 15% of these individuals perceived their risk of developing lung cancer to be high. CT screening did not effectively increase affective risk perception with RP almost significantly lower at 6 month follow-up ($p= 0.09$).

Park et al., 2013	To assess the effects of lung screening and test result on risk perceptions that might underlie smoking behavior changes one-year following an initial screen.	N= 430 (out of 630 at baseline) current and former smokers aged between 55 and 74 years with a history of 30-pack years minimum, and no diagnosis of lung cancer M age= 61.0 Significantly more attrition was observed among current smokers. No confirmed lung cancer diagnosis at 1 year follow-up.	Treatment: CT Screening Control: none Participants were divided into groups based on smoking status at baseline. Current smoker group: n= 215 Former smoker group: n= 212 [82.4% had a negative CT at initial screen]	RP: Two 5-item measures on a 5-point scale assessing individual risk and comparative risk for lung cancer and SRD separately [very unlikely to very likely; range is 5-25 for each combined measure] *Individual*: Likelihood and danger *Comparative*: Average person Others of the same age/sex Former/current smokers Smoking: Status FTND Score Cigs/day Pack years Yrs smoking	RP: Baseline/Follow-up for current smokers: Lung Ca= M= 17.91 (3.85) M= 18.09 (3.85) SRD= M= 18.52 (4.06) M= 18.76 (4.05) Baseline/Follow-up for former smokers= M= 16.28 (3.80) M= 16.28 (3.96) SRD= M= 16.76 (4.00) M= 16.86 (4.29) Smoking: Baseline for current smokers: Cigs/day = 26.27 (9.21) Yrs smoking= 42.15 (6.07) Pack yrs= 55.12 (20.71) Fagerstrom score= 5.41 (2.23) 9.7% of baseline smokers quit a 1 year follow-up.	Small to medium effect of the CT screening between based upon smoking status. However, my study will only include current smokers. There is a small effect among current smokers for risk perception of developing lung cancer, no effect for SRD. Lung cancer RP, based on smoking status: Cohen's d= 0.4635, 95% CI 0.27-0.66 (personal calculation) SRD RP, based on smoking status: Cohen's d= 0.46, 95% CI 0.27-0.65 (personal calculation) Among current smokers, Change for lung cancer: OR 1.9, 95% CI 0.93-1.26 Change for SRD: OR 1.05, 95% CI 0.93-1.19	Baseline risk perception was approximately 3.6 on a 5-point scale for induvial and comparative risk combined for the sample. Changes in risk perception were not significantly associated with smoking status change for current smokers at one year follow-up (OR= 1.09 lung cancer, OR= 1.05 SRD). At 1 year follow-up there was a decrease in RP of lung cancer after a positive initial screen resulted in no actual diagnosis of lung cancer (*not significant p*= 0.69).
Persky, Kaphingst, Allen, & Senay (2013)	To test whether perceived provider race, independently of any related factor, influenced patient risk perception accuracy.	N= 127 African American adults aged between 25 and 40 years old, self-referred to the study via advertisement, with access to the internet and no cancer diagnosis M age= 31.6 (4.5) Objective risk was low among these	Health education virtual encounter communicating a personalized, objective risk estimate for lung cancer Treatment: racially concordant virtual doctor (appeared to be black) Control: racially discordant virtual doctor (appeared to be white)	RP: 0-100% subjective numeric measurement of personal risk Risk perception accuracy is determined by calculating the absolute value of the difference between post-test RP and the objective number provided by the virtual doctor. Smoking: Status	RP: Baseline perceived risk for lung cancer: M= 20% (18.54) Differences observed by smoking status at baseline (current/former/never smokers): $F(1,64= 12.61, p<0.001$ Post-treatment perceived risk for lung cancer: M= 7.2% (13.13) Smoking: No change. Baseline and post-treatment occurs over 24-48 hours.	RP: Very large effect of the intervention on *lowering* risk perception among all participants ($t(74)= 9.59$, $p<.0.0001$). Cohen's d= 14.4433, 95% CI 12.45-16.43 (personal calculation) A large effect size was observed of the intervention on lowering the risk perception of current smokers as well when compared to the average mean of the entire sample. Cohen's d= 0.78, 95% CI 0.28-0.07	Post-treatment risk perception scores were significantly lower than baseline. Participant smoking status did not significantly affect risk perception current smokers did rate their scores higher than former and never smokers at baseline and post-treatment. Among current smokers, there was a greater discrepancy in risk perception accuracy of

		participants (average 3.9% and only 7.8% for current smokers).				(personal calculation)	those who saw the racially discordant doctor.
Carere et al. (2015)	To determine the relationship between risk estimate and change in risk perception over time.	N= 1,464 new customers of 23andMe and Pathway Genomics M age= 47.1 (15.7) 27.8% attrition	Direct-to-consumer personal genomic testing (PGT) that provides healthy consumers with a genetic risk estimate to inform health-related decisions related to breast, prostate, colorectal, and lung cancer Participants were divided into groups based on objective genetic risk of this group of common, low risk individuals. Average risk group at 2 mo: [R <1.2]= 781 (75.1%) Elevated risk group at 2 mo: [RR ≥1.2]= 185 (19.2%)	RP: 5-point comparative risk perception scale at baseline; after ordering the test but before receiving results; 2 weeks after viewing results; and 6 months after viewing results [1= much lower than average to 5= higher than average] Smoking: Status (current/former/never)	RP: Overall it was more common to observe an increase in perceived risk after receiving results among participants in the elevated risk group. Baseline perceived risk: M= 2.3 (1.0) Lung cancer RP for elevated risk group: 2mo 92 (49.7%) reported changes in risk perception of ±1, ±2, or ±3 units. There was no report of a ±4 change. 6 mo 76 (44.2%) reported changes in risk perception of ±1, ±2, or ±3 units. There was no report of a ±4 change. Lung cancer RP for average risk group: 2mo 239 (30.6%) reported changes in risk perception of ±1, ±2, or ±3 units. There was no report of a ±4 change. 6 mo 232 (30%) reported changes in risk perception of ±1, ±2, or ±3 units. ±4 change= 1 (0.1%)	The intervention created a small to medium effect on risk perception change for lung cancer among those in both risk groups for both follow-up time points. Lung cancer RP change at 2 mo for elevated risk group: M= 0.62, 95% CI 0.49-0.75 Lung cancer RP change at 2 mo for average risk group: M= 0.18, 95% CI 0.18-0.27 LS Mean difference: M= 0.44, 95% CI 0.31-0.57, p<0.0001. OR= 2.22, 95% CI 0.36-13.61 (personal calculation)	No evidence of effect modification by smoking status
Sinicrope et al. (2010)	To describe the effect of participation in lung cancer screening on participants' risk perception, worry, and expectations regarding the accuracy of the screening result.	N= 60 individuals ≥30 years old, no diagnosis of lung cancer, with a family history of lung cancer participating in a lung cancer screening study M age= 53.3 (11.0) NL results= 40 (67%) Non-negative results= 19 (31%) 1 diagnosed with lung cancer (2%).	Treatment: CT Screening Control: none	RP: 5-point absolute and comparative lung cancer risk perception scale at baseline prior to CT screening, 1 month following CT results, and 6 months post-study after follow-up with the pulmonologist Smoking: Status (never/former/current)	RP: The number of participants that rated their absolute risk as 'likely' increased slightly over time but the higher scores on comparative risk declined, especially if a test was non-negative. Conversely, there were less participants that rated absolute and comparative risk to be low over time. Smoking: 95% were ever smokers and 43% were current smokers	RP: No effect of the intervention on increasing risk perception. Except for at 6 months there is a small effect increasing comparative risk in the negative CT result group. 1 month absolute risk between negative and non-negative CT results on high vs. low RP: OR= 0.69, 95% CI 0.15-3.09 (personal calculation) 6 month absolute risk between negative and non-negative CT results on high vs. low RP: OR= 0.64, 95% CI 0.15-2.68 (personal calculation) 1 month comparative risk between negative and non-negative CT results on high vs. low RP: OR= 0.79, 95% CI 0.07-8.43 (personal calculation) 6 month comparative risk between negative and non-negative CT results on high vs. low RP: OR= 1.54, 95% CI 0.09-26.82 (personal calculation)	Risk perception did increase among those who initially felt their risk was low or lower than others. Individuals with non-negative CT results may feel less at risk after talking to the pulmonologist who did not discuss the potential severity of their results.

**personal calculations computed using the Campbell Collaboration's online calculators. Accessed at http://www.campbellcollaboration.org/resources/effect_size_input.php.*

Comprehensive Correlation Matrix of All Study Variables

Correlations

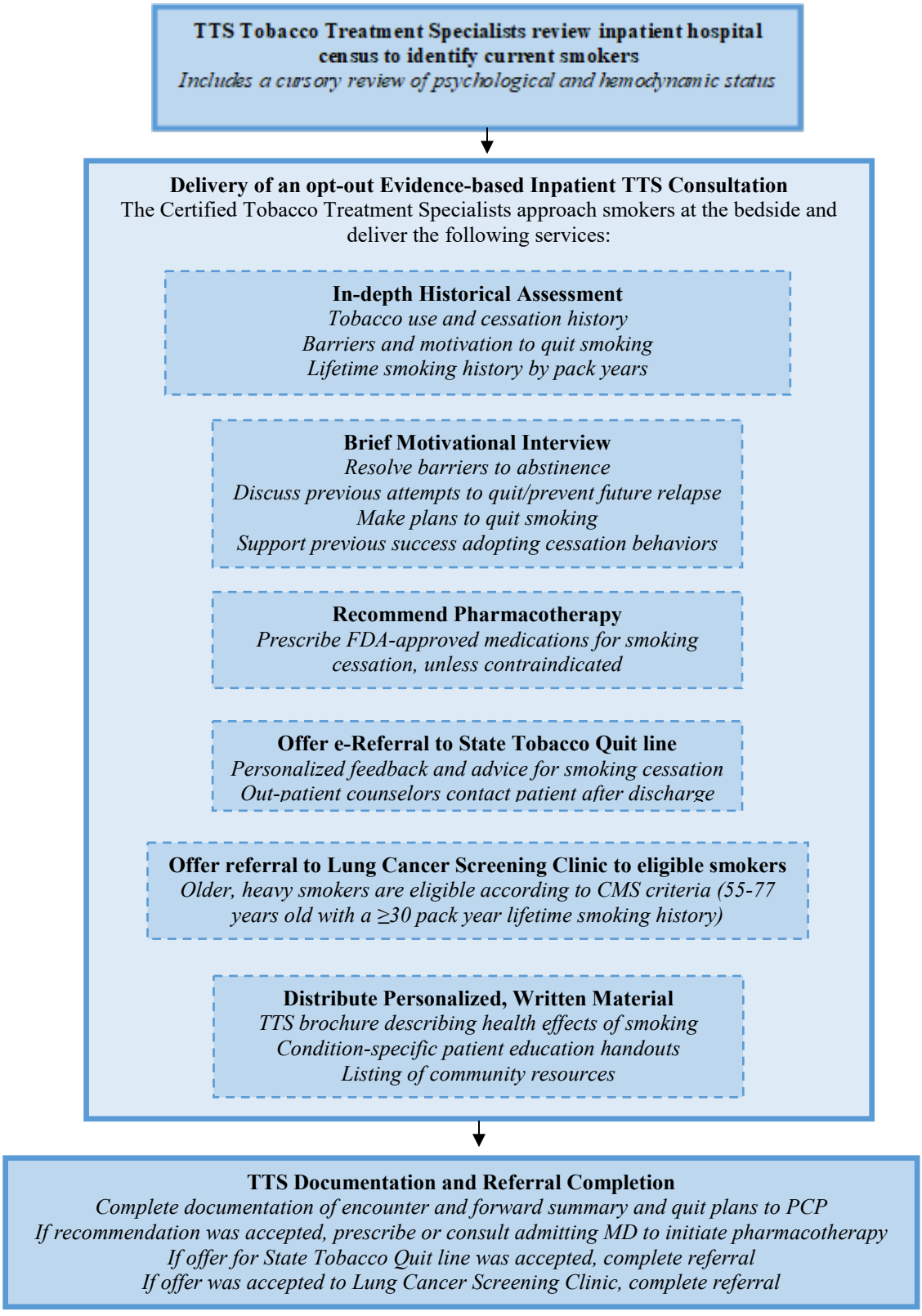
			gender	work_status	education	smoke_frequency	ttfc	race	ethnic	below_poverty	participant_age	readiness_score	health_literacy	smoke_initation	cpd	pack_years	PereivedRisk_1	PereivedRisk_2	admitdrg	dischargedrg
Spearman's rho	gender	Correlation Coefficient	1.000	.180*	-.057	-.048	-.034	-.055	-.302	-.068	.112	.159	-.066	-.174*	.048	.159	.095	.042	-.023	.011
		Sig. (2-tailed)	.	.040	.549	.585	.695	.528	.561	.468	.198	.066	.456	.045	.581	.069	.275	.633	.788	.899
		N	134	131	112	134	132	134	6	115	134	134	131	133	134	132	134	134	134	134
	work_status	Correlation Coefficient	.180*	1.000	.254**	.004	.142	-.068	-.318	-.298**	-.023	.061	.088	.265**	.051	-.156	-.122	-.148	-.089	.007
		Sig. (2-tailed)	.040	.	.008	.966	.108	.443	.539	.001	.794	.486	.322	.002	.564	.077	.164	.092	.315	.940
		N	131	131	109	131	129	131	6	112	131	131	128	130	131	129	131	131	131	131
	education	Correlation Coefficient	-.057	.254**	1.000	.065	.117	.215*	.866	-.240*	.095	-.034	.112	.226*	-.145	-.098	-.030	-.179	-.060	-.132
		Sig. (2-tailed)	.549	.008	.	.494	.222	.023	.333	.019	.318	.724	.248	.017	.126	.307	.752	.059	.528	.165
		N	112	109	112	112	110	112	3	96	112	112	109	111	112	110	112	112	112	112
	smoke_frequency	Correlation Coefficient	-.048	.004	.065	1.000	.284**	.027	.320	-.014	.071	.239**	.027	.025	-.365**	-.128	-.076	-.103	.018	-.015
		Sig. (2-tailed)	.585	.966	.494	.	.001	.753	.537	.879	.417	.005	.757	.774	.000	.142	.385	.238	.839	.863
		N	134	131	112	134	132	134	6	115	134	134	131	133	134	132	134	134	134	134
	ttfc	Correlation Coefficient	-.034	.142	.117	.284**	1.000	.027	.081	-.187*	.016	.119	-.077	.168	-.463**	-.248**	-.159	-.313**	.038	.071
		Sig. (2-tailed)	.695	.108	.222	.001	.	.755	.897	.046	.853	.175	.386	.055	.000	.004	.069	.000	.666	.416
		N	132	129	110	132	132	132	5	114	132	132	129	131	132	131	132	132	132	132
	race	Correlation Coefficient	-.055	-.068	.215*	.027	.027	1.000	-.539	.062	-.097	.093	.171	-.043	.073	.008	.025	.121	.089	.063
		Sig. (2-tailed)	.528	.443	.023	.753	.755	.	.269	.507	.263	.286	.051	.622	.401	.925	.776	.165	.304	.466
		N	134	131	112	134	132	134	6	115	134	134	131	133	134	132	134	134	134	134
	ethnic	Correlation Coefficient	-.302	-.318	.866	.320	.081	-.539	1.000	.544	-.500	.079	.188	.677	.118	-.647	.209	.045	.500	.104
		Sig. (2-tailed)	.561	.539	.333	.537	.897	.269	.	.343	.312	.881	.722	.140	.824	.165	.691	.933	.312	.844
		N	6	6	3	6	5	6	6	5	6	6	6	6	6	6	6	6	6	6
	below_poverty	Correlation Coefficient	-.068	-.298**	-.240*	-.014	-.187*	.062	.544	1.000	-.227*	-.174	-.125	-.160	.232*	.055	-.031	.125	.140	.083
		Sig. (2-tailed)	.468	.001	.019	.879	.046	.507	.343	.	.015	.063	.188	.090	.013	.561	.742	.183	.136	.376
		N	115	112	96	115	114	115	5	115	115	115	112	114	115	114	115	115	115	115
	participant_age	Correlation Coefficient	.112	-.023	.095	.071	.016	-.097	-.500	-.227*	1.000	.101	.000	-.160	-.077	.677**	.022	-.057	-.223**	-.244**
		Sig. (2-tailed)	.198	.794	.318	.417	.853	.263	.312	.015	.	.248	.999	.066	.379	.000	.798	.515	.010	.004
		N	134	131	112	134	132	134	6	115	134	134	131	133	134	132	134	134	134	134
	readiness_score	Correlation Coefficient	.159	.061	-.034	.239**	.119	.093	.079	-.174	.101	1.000	-.074	.057	-.300**	.046	-.027	.009	-.011	-.029
		Sig. (2-tailed)	.066	.486	.724	.005	.175	.286	.881	.063	.248	.	.398	.518	.000	.601	.755	.919	.898	.737
		N	134	131	112	134	132	134	6	115	134	134	131	133	134	132	134	134	134	134
	health_literacy	Correlation Coefficient	-.066	.088	.112	.027	-.077	.171	.188	-.125	.000	-.074	1.000	.168	.024	.006	.018	.097	-.043	-.018
		Sig. (2-tailed)	.456	.322	.248	.757	.386	.051	.722	.188	.999	.398	.	.056	.787	.943	.842	.269	.624	.837
		N	131	128	109	131	129	131	6	112	131	131	131	130	131	129	131	131	131	131
	smoke_initation	Correlation Coefficient	-.174*	.265**	.226*	.025	.168	-.043	.677	-.160	-.160	.057	.168	1.000	-.147	-.494**	-.048	-.105	.087	.106
		Sig. (2-tailed)	.045	.002	.017	.774	.055	.622	.140	.090	.066	.518	.056	.	.092	.000	.580	.229	.319	.224
		N	133	130	111	133	131	133	6	114	133	133	130	133	133	132	133	133	133	133
	cpd	Correlation Coefficient	.048	.051	-.145	-.365**	-.463**	.073	.118	.232*	-.077	-.300**	.024	-.147	1.000	.269**	.063	.112	-.013	-.034
		Sig. (2-tailed)	.581	.564	.126	.000	.000	.401	.824	.013	.379	.000	.787	.092	.	.002	.469	.196	.879	.698
		N	134	131	112	134	132	134	6	115	134	134	131	133	134	132	134	134	134	134
	pack_years	Correlation Coefficient	.159	-.156	-.098	-.128	-.248**	.008	-.647	.055	.677**	.046	.006	-.494**	.269**	1.000	.095	.151	-.222*	-.255**
		Sig. (2-tailed)	.069	.077	.307	.142	.004	.925	.165	.561	.000	.601	.943	.000	.002	.	.279	.084	.010	.003
		N	132	129	110	132	131	132	6	114	132	132	129	132	132	132	132	132	132	132
	PereivedRisk_1	Correlation Coefficient	.095	-.122	-.030	-.076	-.159	.025	.209	-.031	.022	-.027	.018	-.048	.063	.095	1.000	.609**	.062	.003
		Sig. (2-tailed)	.275	.164	.752	.385	.069	.776	.691	.742	.798	.755	.842	.580	.469	.279	.	.000	.475	.975
		N	134	131	112	134	132	134	6	115	134	134	131	133	134	132	134	134	134	134
	PereivedRisk_2	Correlation Coefficient	.042	-.148	-.179	-.103	-.313**	.121	.045	.125	-.057	.009	.097	-.105	.112	.151	.609**	1.000	.092	.049
		Sig. (2-tailed)	.633	.092	.059	.238	.000	.165	.933	.183	.515	.919	.269	.229	.196	.084	.000	.	.288	.577
		N	134	131	112	134	132	134	6	115	134	134	131	133	134	132	134	134	134	134
	admitdrg	Correlation Coefficient	-.023	-.089	-.060	.018	.038	.089	.500	.140	-.223**	-.011	-.043	.087	-.013	-.222*	.062	.092	1.000	.740**
		Sig. (2-tailed)	.788	.315	.528	.839	.666	.304	.312	.136	.010	.898	.624	.319	.879	.010	.475	.288	.	.000
		N	134	131	112	134	132	134	6	115	134	134	131	133	134	132	134	134	134	134
	dischargedrg	Correlation Coefficient	.011	.007	-.132	-.015	.071	.063	.104	.083	-.244**	-.029	-.018	.106	-.034	-.255**	.003	.049	.740**	1.000
		Sig. (2-tailed)	.899	.940	.165	.863	.416	.466	.844	.376	.004	.737	.837	.224	.698	.003	.975	.577	.000	.
		N	134	131	112	134	132	134	6	115	134	134	131	133	134	132	134	134	134	206

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix B. Vanderbilt University Medical Center Tobacco Treatment Service Care Processes.

VUMC TTS Care Protocol



VUMC TTS Descriptions

Historical Assessment. The *historical assessment* is performed to collect in-depth information about cigarette smoking and other tobacco use, including when smoking was initiated or how soon the first cigarette of the day is smoked after waking. Any previous cessation attempts are explored to discover how and why that decision was made and what prompted a relapse in smoking. Lifetime smoking history is calculated in pack years to summarize how the amount they smoke has changed over time. The smoker is asked to summarize their smoking history by quantifying up to three time periods of different daily smoking amounts. The specified number of cigarettes smoked each day and the corresponding number of years is entered into an algorithm table in StarPanel. The TTS StarForm computes individual pack years for each of the three time periods and then displays a value representing total pack years (by multiplying the average number of packs of cigarettes smoked per day by the number of years a person has smoked).

Motivational Interview. A *brief motivational interview* is conducted to identify barriers to smoking abstinence and facilitate plans to quit smoking by implementing psychological and behavioral techniques (e.g set quit date, delaying the time to light up after waking). Plans to quit, motivation to quit, confidence in quitting, and previous quit attempts are explored to encourage smoking cessation. Other questions are asked to uncover any underlying psychological conditions, such as anxiety or depression that may be impeding cessation. The smoker is interrogated to preemptively recognize triggers for smoking and suggest alternative behaviors to avoid smoking in those instances. These strategies are reinforced by discussing and celebrating previous success with adopting smoking cessation behaviors and encouraging the use of post-discharge resources to prevent future relapse.

Pharmacotherapy. The Tobacco Treatment Specialist recommends *pharmacotherapy* while considering contraindications utilizing the Vanderbilt Tobacco Control Order Set which features all seven FDA-approved medications to treat tobacco dependence. This order set was created for a similar tobacco treatment service in western Pennsylvania, and has been further updated to reflect the most recent evidence (Tindle, 2015). Options include: nicotine-replacement therapy (NRT) using a patch, gum, nasal spray, lozenge or inhaler or oral medications using Bupropion (Wellbutrin) or Varenicline (Chantix). National guidelines currently recommend initiating either combination therapy which combines two forms of nicotine replacement therapy (NRT) or Varenicline (Chantix) to improve the success of long-term smoking cessation. Moreover, use of a long-acting NRT (patch) with a short-acting NRT (gum, nasal spray, lozenge or inhaler) can effectively control withdrawal symptoms, enhance comfort, and increase efficacy for long-term cessation (Tindle, 2015).

The TTS StarForm contains protocols to guide dose and frequency decision-making. NRT pharmacotherapy may not be recommended or prescribed if the smoker is experiencing complications

with heart disease or abnormal heart rhythms or has been diagnosed with malignant hypertension or seizures. Oral medications may not be recommended or prescribed if there is evidence of substance abuse or poor adherence to current their medication regimen according to documentation in StarPanel. If eligible and interested, smokers can initiate the medication while hospitalized and receive a 30-day supply of one or more of the FDA-approved medications at discharge. In some cases, the Tobacco Treatment Specialist will recommend for the medication to be prescribed by the patient's primary care doctor after assessing benefits versus risks for pharmacotherapy based on the smoker's medical condition. The smoker has the option to either accept or decline pharmacotherapy recommendations.

State Tobacco Quit line. All smokers are offered a referral to the *quit line* of their respective state to receive additional behavioral counseling after hospital discharge. The bi-directional referral is completed electronically through the Information and Quality Healthcare (IQH) Portal for tobacco treatment services and once complete allows quit line counselors to contact the patient directly within two days of hospital discharge. The quit line in Tennessee and surrounding states offer five telephone sessions of behavioral counseling over three months for smokers who are ready to quit or have recently quit. Those who engage with the quit line often achieve better long-term smoking behavior outcomes and counselors encourage smokers to follow-up with their primary care doctor to obtain medications, if pharmacotherapy had not already been initiated. The smoker has the option to engage in or not engage in quit line recommendations.

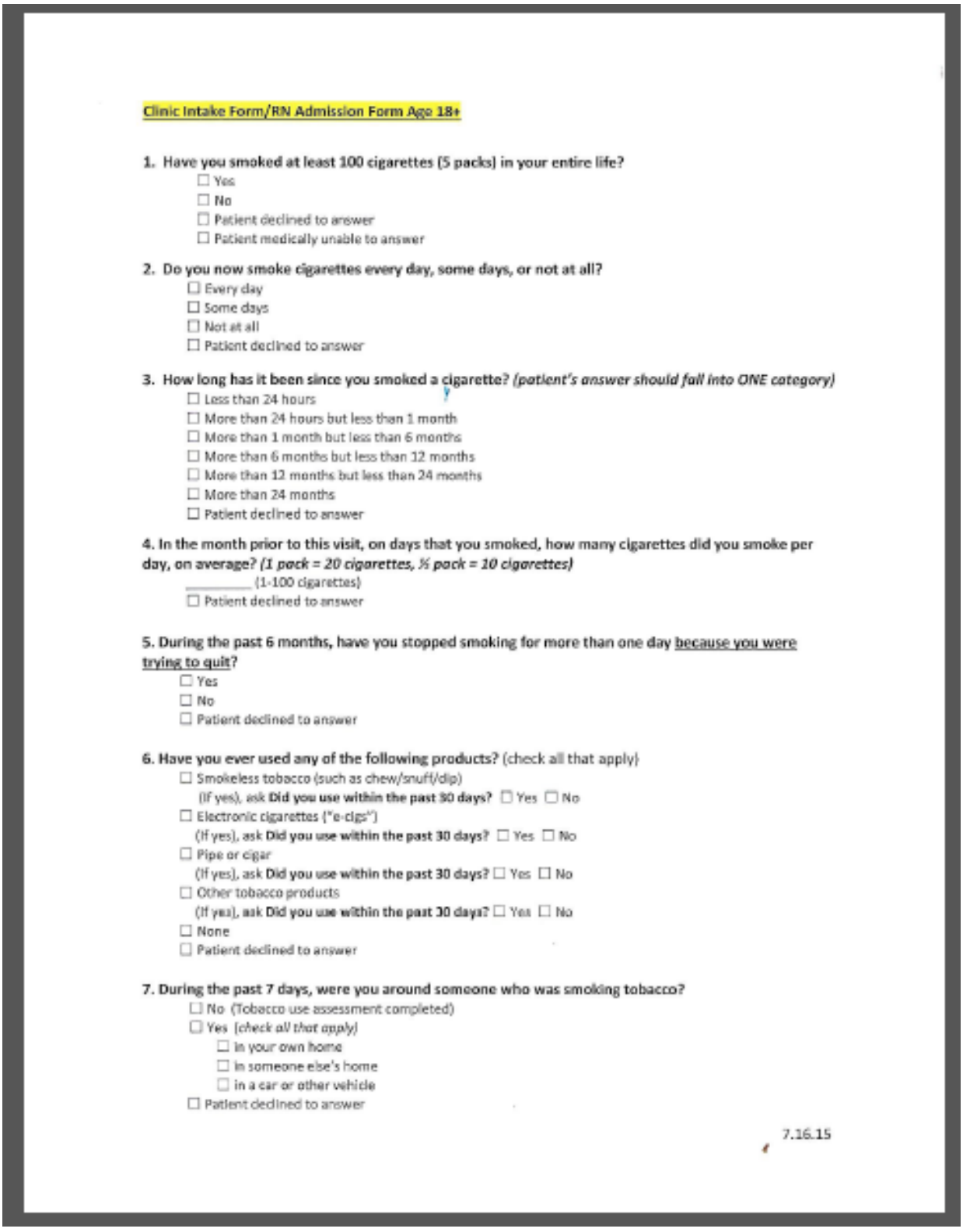
Written Materials. The smoker is given personalized, written materials that include a brochure and other educational handouts. The VUMC TTS brochure reinforces education of the impact of smoking on health and general benefits of cessation. Disease-specific handouts are presented to educate the smoker about how smoking may exacerbate the medical conditions they are diagnosed with (e.g. hypertension, diabetes, or erectile dysfunction). Finally, a detailed compilation of contact information for community resources in the Nashville area is provided to smokers along with post-discharge other resources to support cessation.

Lung Cancer Screening. Smokers are eligible to receive free lung cancer screening according to their actual risk for lung cancer by pack years. If the number of total pack years is ≥30 (high risk) and the smoker is between 55 and 77 years old, the smoker will be informed that they are at increased risk for developing lung cancer and will be referred to the LCS clinic (later in the consultation). The smoker has the option accept or decline the referral. If the number of total pack years is ≤29 (low risk) or the smoker's age is <55 years, StarPanel will not confirm elevated risk for lung cancer and no risk communication or referral is provided. LDCT screening results are typically classified as "positive" to indicate a diagnosis for lung cancer, "abnormal," or "indeterminate" to indicate the scan was concerning, or "negative," or "normal" to indicate no concern for lung cancer. A "normal" result may not exclude the

presence of other non-lung cancer abnormalities, such as chronic obstructive pulmonary disease (COPD), interstitial lung disease, coronary artery calcification, or malignancy outside of the lungs (Kim et al., 2014; Christensen & Chiles, 2015).

A unique feature of the VUMC TTS protocol is offering a referral to obtain lung cancer screening via a LDCT. Older, heavy intensity smokers are eligible for a LDCT referral for lung cancer prevention if they are aged 55 to 77 years old and report a smoking history of ≥30 pack years. Referrals are directed to the Vanderbilt Lung Cancer Screening (LCS) Clinic, a recently established specialty clinic affiliated with the Vanderbilt-Ingram Cancer Center. It is managed by radiologist and clinical researcher, John Jeffrey Carr, MD along with Kim Sandler, MD, who oversees the development of the "Lung Cancer Screening Dashboard" in StarPanel that populates when a TTS smoker agrees to be referred for LCS (located in Star Panel on the left side under the Red Heading Dashboards, sub-heading Ancillary Dashboard, called Lung Cancer). The following information/columns related to the patient are also provided: action (allows to remove patient) MRN, patient name, actions, DOB, total pack years, how long since last smoked, and indicator for lung CT exam present on chart already. An LCS Clinic nurse coordinator will access the populated list, contact the patient's primary care provider on file to inform them of their patient's eligibility per CMS guidelines for lung cancer screening, discuss benefits versus risks for screening, and, if indicated, request an order for LDCT imaging. Upon receipt of an order for the LDCT scan, the nurse coordinator will contact the patient to schedule an appointment for consultation at the Vanderbilt LCS Clinic at One Hundred Oaks or one of several satellite locations.

At the LCS Clinic initial consultative visit, a mid-level provider (e.g. nurse practitioner) will perform an evaluation to confirm eligibility for screening based upon CMS beneficiary eligibility criteria and provide additional tobacco treatment counseling for current smokers. The mid-level provider also engages the patient in shared decision making counseling (includes full disclosure about the benefits and harms of lung cancer prevention screening, the potential for follow-up diagnostic testing, prevalence of over-diagnosis and false positive rates, and total radiation exposure) to decide if they desire to proceed with LDCT screening. Patients under care at the LCS Clinic are also counseled about the importance of adherence to annual lung screening via LCDT, the chance of identifying co-morbidities during the scan, and factors that may impact diagnosis and treatment. Results of the CT scan are delivered to each patient's primary care provider for review and may be electronically released for patient review in My Vanderbilt Health. Those who complete initial LDCT screening will be offered repeated annual scans and followed over three to five years.



Clinic Intake Form/RN Admission Form Age 18+

1. Have you smoked at least 100 cigarettes (5 packs) in your entire life?
   - ☐ Yes
   - ☐ No
   - ☐ Patient declined to answer
   - ☐ Patient medically unable to answer

2. Do you now smoke cigarettes every day, some days, or not at all?
   - ☐ Every day
   - ☐ Some days
   - ☐ Not at all
   - ☐ Patient declined to answer

3. How long has it been since you smoked a cigarette? *(patient's answer should fall into ONE category)*
   - ☐ Less than 24 hours
   - ☐ More than 24 hours but less than 1 month
   - ☐ More than 1 month but less than 6 months
   - ☐ More than 6 months but less than 12 months
   - ☐ More than 12 months but less than 24 months
   - ☐ More than 24 months
   - ☐ Patient declined to answer

4. In the month prior to this visit, on days that you smoked, how many cigarettes did you smoke per day, on average? *(1 pack = 20 cigarettes, ½ pack = 10 cigarettes)*
   - _____ (1-100 cigarettes)
   - ☐ Patient declined to answer

5. During the past 6 months, have you stopped smoking for more than one day because you were trying to quit?
   - ☐ Yes
   - ☐ No
   - ☐ Patient declined to answer

6. Have you ever used any of the following products? (check all that apply)
   - ☐ Smokeless tobacco (such as chew/snuff/dip)
     (If yes), ask **Did you use within the past 30 days?** ☐ Yes ☐ No
   - ☐ Electronic cigarettes ("e-cigs")
     (If yes), ask **Did you use within the past 30 days?** ☐ Yes ☐ No
   - ☐ Pipe or cigar
     (If yes), ask **Did you use within the past 30 days?** ☐ Yes ☐ No
   - ☐ Other tobacco products
     (If yes), ask **Did you use within the past 30 days?** ☐ Yes ☐ No
   - ☐ None
   - ☐ Patient declined to answer

7. During the past 7 days, were you around someone who was smoking tobacco?
   - ☐ No (Tobacco use assessment completed)
   - ☐ Yes *(check all that apply)*
     - ☐ In your own home
     - ☐ In someone else's home
     - ☐ In a car or other vehicle
   - ☐ Patient declined to answer

7.16.15

Vanderbilt University Medical Center's Nurse Admission Form

Tobacco Treatment Service
Inpatient Consult Note

Method of Referral: ☐ RN Admission Note ☐ Provider ☐ Other:	**Initial Referral Assessment:** ☐ Consulted ☐ Not Consulted
Referral Comment:	
Patient Name:	**MRN:**
DOB:	**Age:**
Room#:	**Case #:**
Admission Date:	**Admission Dx:**
Service:	**Attending:**
Resident:	**Other Provider (NP/PA/Intern):**
PCP:	
Consult Date / Time:	
Highest level of education patient has completed:	
Allergies:	
Medications:	
Past Medical History:	
Have you ever had the following? (Chart review, verify with patient)	
Heart attack/PCTA/PCI/CABG:	**Hypertension:**
Stroke:	**High Cholesterol:**
CHF:	**Chronic Kidney Injury/CRI:**
Diabetes:	**Cancer Diagnosis:**

SMOKING HISTORY
Age Started:
How often do you smoke cigarettes? ☐ Every day ☐ Some days (# of days/30:) ☐ Not at all
How long has it been since you smoked a cigarette? (<24h, 24h-1m, 1m-6m, 6m-12m, 12-24m, >24m)

CRAVINGS
On days that you smoke/smoked, how soon after waking do/did you smoke you first cigarette?
Do/Did you sometimes awaken during the night to have a cigarette? ☐ Yes ☐ No
Do/Did you smoke menthol cigarettes? ☐ Yes ☐ No
Are you using smoking cessation medications in the hospital? ☐ Yes ☐ No ☐ NRT ☐ Bupropion ☐ Varenicline ☐ Other

PHQ-4	
Over the last 2 weeks, how often have you been bothered by the following problems?	
1. Feeling nervous, anxious or on edge	
☐ Not at all (Normal)	- Several days (Mild)
☐ More than half the days (Moderate)	- Nearly every day (Severe)
2. Not being able to stop or control worrying	
☐ Not at all (Normal)	- Several days (Mild)
☐ More than half the days (Moderate)	- Nearly every day (Severe)
3. Little interest or pleasure in doing things	
☐ Not at all (Normal)	- Several days (Mild)
☐ More than half the days (Moderate)	- Nearly every day (Severe)
4. Feeling down, depressed or hopeless	
☐ Not at all (Normal)	- Several days (Mild)
☐ More than half the days (Moderate)	- Nearly every day (Severe)

VUMC TTS StarForm

	Anxiety Score (Questions 1 & 2): Depression Score (Question 3 & 4): Total Score:
Positive PHQ-4 score discussed with Primary Team?	
PCP:	Date:
Primary Inpatient Team:	

On a scale of 1-10, with 10 being the highest, what is your craving to smoke right now?
On a scale of 1-10, with 10 being the highest, can you rate your level of anger, irritability, and frustration?

OTHER TOBACCO PRODUCTS – EVER USE			
E-Cigarettes	☐ No ☐ Yes	Last 30 days? ☐ No ☐ Yes	Frequency? ☐ Every day ☐ Some days
- Reason for use?	☐Quit Smoking ☐Experiment ☐Enjoyment ☐Flavor ☐Cut down ☐Use in non-smoking areas ☐Harm reduction ☐Price		
Smokeless Tobacco	☐ No ☐ Yes	Last 30 days? ☐ No ☐ Yes	Frequency? ☐ Every day ☐ Some days
Cigarillos	☐ No ☐ Yes	Last 30 days? ☐ No ☐ Yes	Frequency? ☐ Every day ☐ Some days
Cigars	☐ No ☐ Yes	Last 30 days? ☐ No ☐ Yes	Frequency? ☐ Every day ☐ Some days
Pipes	☐ No ☐ Yes	Last 30 days? ☐ No ☐ Yes	Frequency? ☐ Every day ☐ Some days
Water Pipe or Hookah	☐ No ☐ Yes	Last 30 days? ☐ No ☐ Yes	Frequency? ☐ Every day ☐ Some days

QUIT HISTORY		
During the past 12 months, have you stopped smoking for more than one day because you were trying to quit? ☐ Yes ☐ No		
When was your most recent quit attempt?		
How long did you stay quit during your most recent quit attempt?		
What is the longest period of time that you have ever stayed quit?		
What uncomfortable symptom(s) have you ever experienced as a result of stopping tobacco use?		
What factors led to your relapse(s)?		
☐ Boredom ☐ Stress ☐ Withdrawal symptoms	☐ Lack of support ☐ Fear of failure ☐ Depression	☐ Enjoyment of smoking ☐ Weight gain ☐ Other smokers
- What was the MAIN reason for your relapse? Circle one option above		
Prior to this hospitalization, have you ever used quit aids? ☐ Yes ☐ No		
- Quit Aids Used: ☐ NRT ☐ Bupropion ☐ Varenicline ☐ Other		

BARRIERS TO ABSTINENCE		
Do any of the people who live with you smoke?	☐ Yes	☐ No
Is anyone allowed to smoke inside your home?	☐ Yes	☐ No
Is anyone allowed to smoke inside your car?	☐ Yes	☐ No
What triggers your tobacco use NOW?		
What, if anything, is keeping you from quitting right now?		
- What is the major factor keeping you from quitting right now?		
Do you drink any caffeinated beverages? ☐ Yes (check all that apply) ☐ No		
Coffee: Tea: Caffeinated soft drinks: Other caffeinated drinks:		
CARBON MONOXIDE		
Carbon monoxide test: ☐ Accepted ☐ Refused		
Carbon monoxide level (PPM):		

VUMC TTS StarForm

AUDIT - C TEST:	
Q1: How often did you have a drink containing alcohol in the past year?	
Never	0
Monthly or less	1
2-4 times per month	2
2-3 times per week	3
4 or more times a week	4
Q2: How many drinks did you have on a typical day when you were drinking in the past year?	
None, I do not drink	0
1 or 2	0
3 or 4	1
5 or 6	2
7 to 9	3
10 or more	4
Q3: How often have you had six or more drinks on one occasion in the past year?	
Never	0
Less than monthly	1
Monthly	2
Weekly	3
Daily or almost daily	4
	AUDIT-C Total:

Positive Audit-C score discussed with Primary Team?

- ☐ Yes
- ☐ No
- ☐ Not Applicable (Audit-C score is not positive)

PCP: **Date:**

Primary Inpatient Team:

QUIT PLANS
On a scale of 1 - 10, with 10 being the highest, how important is it for you to quit right now?
On a scale of 1-10, with 10 being the highest, how confident are you to resist the urge to smoke in any situation?
Which best describes your plan about your smoking right now?

- ☐ I will stay quit now
- ☐ I will try to quit now
- ☐ I don't know if I'm going to quit
- ☐ I plan to cut down
- ☐ I do not plan to quit
- ☐ Unknown

MEDICATION RECOMMENDATIONS AND TREATMENT

ADDITIONAL INFORMATION
Do you have internet at home? ☐ Yes ☐ No
Are you interested in My Health At Vanderbilt? ☐ Yes ☐ No ☐ Already enrolled
We make an effort to contact patients after discharge for smoking cessation. Please verify your contact information and indicate your preference for mode of contact.

- ☐ Telephone (land line):
- ☐ Telephone (cellular): ☐ Call ☐ Text ☐ Either
- ☐ Email:

We work with the Tennessee Quit Line which has expert tobacco counselors available to you by phone. We refer smokers to this program.

☐ Refer after discharge	Zip Code:	Cleared for NRT use? ☐Yes ☐No
☐ Refuse e-Referral	Best hours to Call:	Pregnant? ☐Yes ☐No

VUMC TTS StarForm

What is your plan for smoking after you leave the hospital?

- ☐ I will stay quit when I leave the hospital.
- ☐ I will try to quit when I leave the hospital.
- ☐ I don't know if I'm going to quit.
- ☐ I plan to cut down.
- ☐ I do not plan to quit.
- ☐ Unknown

We enroll smokers in SmokefreeTXT, a free mobile text messaging service offered by the National Cancer Institute. Text messaging has been proven to help people quit smoking and stay quit. SmokefreeTXT provides encouragement, advice and tips.

- ☐ Accepted enrollment for (choose all that apply)
  - SmokefreeTXT (texting for all non-pregnant / non-lactating smokers)
  - SmokefreeMOM (texting for all pregnant and/or lactating moms)
  - QuitGuide (iphone app)
- ☐ Declined enrollment

We refer patients with a Body Mass Index (BMI) of >30 for a consult at Vanderbilt's Medical and Surgical Weight Loss Clinic. Vanderbilt offers a comprehensive, individualized program. ☐ Accepted referral ☐ Declined referral

Would you be interested in participating in Vanderbilt research studies related to tobacco use?

☐ Yes No

Has the patient consented to BioVU? Yes No

Would you be willing to provide a biological sample (such as a blood draw or urine test) to guide treatment? Yes No

Was the patient's family present during counseling? ☐ Yes ☐ No

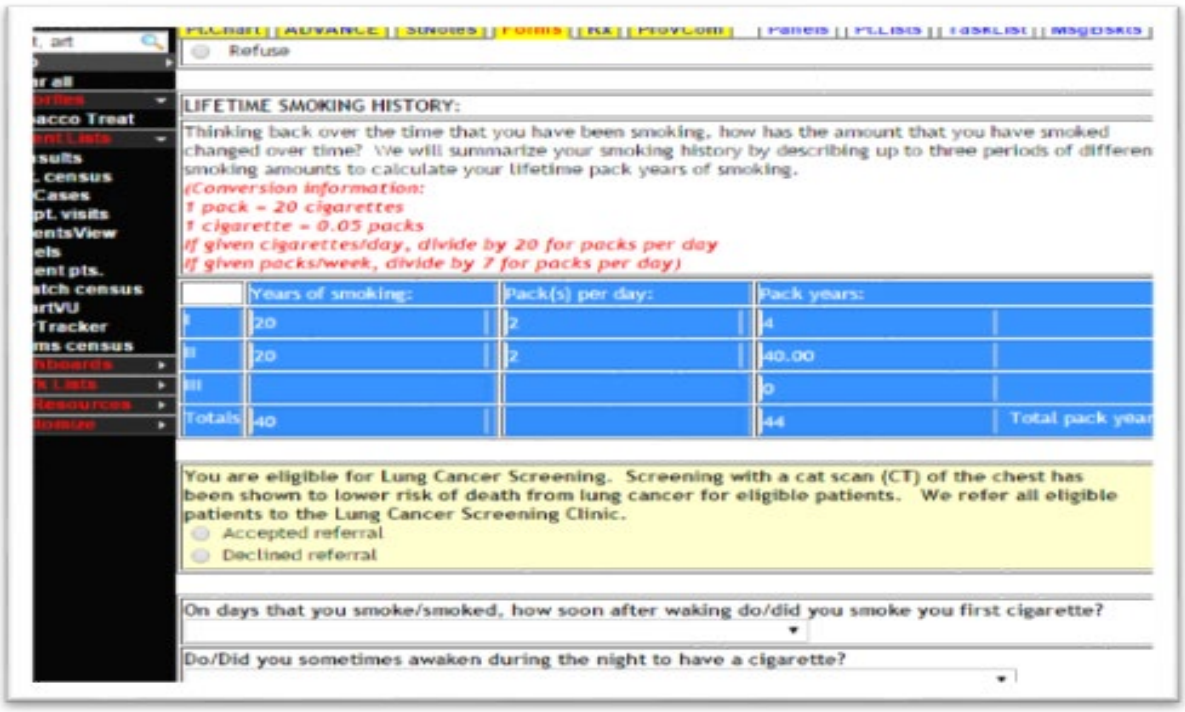
SUMMARY & RECOMMENDATIONS

PRIMARY CARE TEAM COMMUNICATION

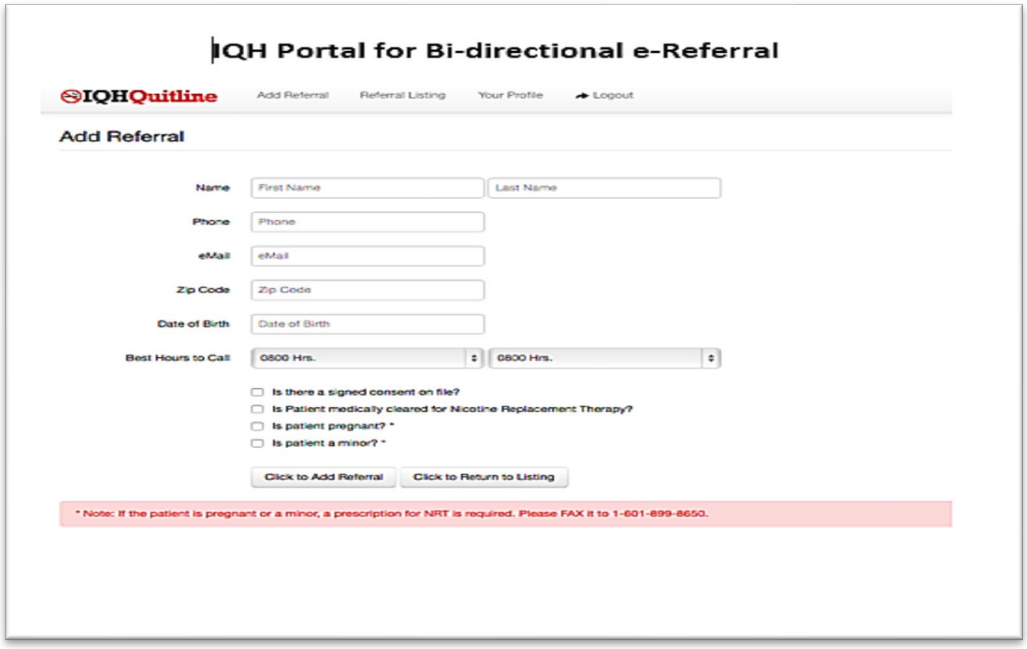
Time spent counseling (minutes):

VUMC TTS StarForm

Lifetime Smoking History (Pack Years) Assessment



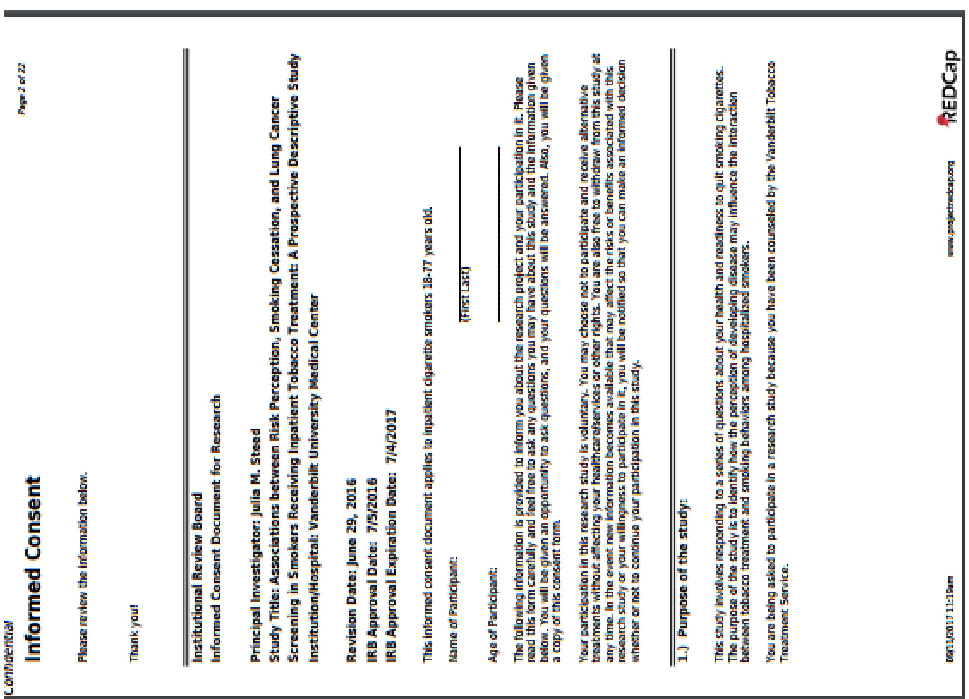
Pack Year Assessment



Quit line Referral Portal

VUMC TTS StarForm

Appendix C. Study Survey Instruments and Data Forms



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Informed Consent

Please review the information below.

Thank you!

Institutional Review Board
Informed Consent Document for Research

Principal Investigator: Julia M. Steed
Study Title: Associations between Risk Perception, Smoking Cessation, and Lung Cancer Screening in Smokers Receiving Inpatient Tobacco Treatment: A Prospective Descriptive Study
Institution/Hospital: Vanderbilt University Medical Center

Revision Date: June 29, 2016
IRB Approval Date: 7/5/2016
IRB Approval Expiration Date: 7/4/2017

This informed consent document applies to inpatient cigarette smokers 18-77 years old.

Name of Participant: ____________________ (First Last)

Age of Participant: ____________________

The following information is provided to inform you about the research project and your participation in it. Please read this form carefully and feel free to ask any questions you may have about this study and the information given below. You will be given an opportunity to ask questions, and your questions will be answered. Also, you will be given a copy of this consent form.

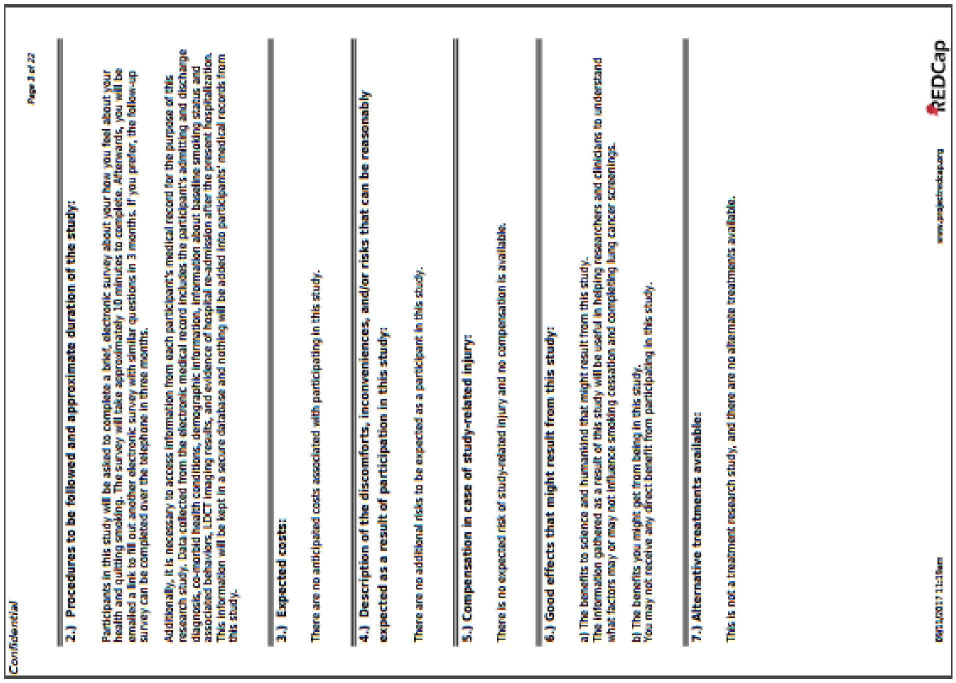
Your participation in this research study is voluntary. You may choose not to participate and receive alternative treatments without affecting your healthcare/services or other rights. You are also free to withdraw from this study at any time. In the event new information becomes available that may affect the risks or benefits associated with this research study or your willingness to participate in it, you will be notified so that you can make an informed decision whether or not to continue your participation in this study.

1.) Purpose of the study:

This study involves responding to a series of questions about your health and readiness to quit smoking cigarettes. The purpose of the study is to identify how the perception of developing disease may influence the interaction between tobacco treatment and smoking behaviors among hospitalized smokers.

You are being asked to participate in a research study because you have been counseled by the Vanderbilt Tobacco Treatment Service.

09/11/2017 11:19am www.projectredcap.org REDCap



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2.) Procedures to be followed and approximate duration of the study:

Participants in this study will be asked to complete a brief, electronic survey about your how you feel about your health and quitting smoking. The survey will take approximately 10 minutes to complete. Afterwards, you will be emailed a link to fill out another electronic survey with similar questions in 3 months. If you prefer, the follow-up survey can be completed over the telephone in three months.

Additionally, it is necessary to access information from each participant's medical record for the purpose of this research study. Data collected from the electronic medical record includes the participant's admitting and discharge diagnosis, co-morbid health conditions, demographic information, information about baseline smoking status and associated behaviors, LDCT imaging results, and evidence of hospital re-admission after the present hospitalization. This information will be kept in a secure database and nothing will be added into participants' medical records from this study.

3.) Expected costs:

There are no anticipated costs associated with participating in this study.

4.) Description of the discomforts, inconveniences, and/or risks that can be reasonably expected as a result of participation in this study:

There are no additional risks to be expected as a participant in this study.

5.) Compensation in case of study-related injury:

There is no expected risk of study-related injury and no compensation is available.

6.) Good effects that might result from this study:

a) The benefits to science and humankind that might result from this study.
The information gathered as a result of this study will be useful in helping researchers and clinicians to understand what factors may or may not influence smoking cessation and completing lung cancer screenings.

b) The benefits you might get from being in this study.
You may not receive any direct benefit from participating in this study.

7.) Alternative treatments available:

This is not a treatment research study, and there are no alternate treatments available.

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Post-TTS Enrollment Survey at the Bedside

Contact Information

Please complete the survey below.

Thank you!

Contact Information

Preferred First Name: _____

Preferred contact method for follow up survey: ○ Email ○ Text

E-mail _____

Cell Phone Number (for text survey invitation): _____

Cell phone carrier:

○ Alltel
○ AT&T
○ Nextel
○ Sprint
○ T-Mobile
○ Verizon
○ Virgin Mobile
○ Other

List of cell carrier domains to assist in revising the Email address for text invitations:

Carrier	Domain	Example
Alltel	message.alltel.com	408385322@message.alltel.com
AT&T	txt.att.net	408385322@txt.att.net
Nextel	messaging.nextel.com	408385322@messaging.nextel.com
Sprint	messaging.sprintpcs.com	408385322@messaging.sprintpcs.com
T-Mobile	tmomail.net	408385322@tmomail.net
Verizon	vtext.com	408385322@vtext.com
Virgin Mobile	vmobl.com	408385322@vmobl.com

Other phone carrier: _____

Primary phone number (for study contact) _____ (Include Area Code)

Secondary phone number (for study contact) _____ (Include Area Code)

8.) Compensation for participation:

There is no compensation available for participating in this study.

9.) Circumstances under which the Principal Investigator may withdraw you from study participation:

There are none.

10.) What happens if you choose to withdraw from study participation?

You will be eliminated from study procedures and will not be contacted any further.

11.) Contact Information.

If you should have any questions about this research study or possibly injury, please feel free to contact Julia Steed at (615) 200-7786 (Nursing PhD Student) or my Faculty Advisors, Dr. Shelagh Mulvaney at (615) 322-1198 or Dr. Ann Minnick at (615) 343-2998.

For additional information about giving consent or your rights as a participant in this study, to discuss problems, concerns, and questions, or to offer input, please feel free to contact the Institutional Review Board Office at (615) 322-2918 or toll free at (866) 224-8273.

12.) Confidentiality:

All efforts, within reason, will be made to keep your personal information in your research record confidential but total confidentiality cannot be guaranteed. All data will be de-identified and kept on a password protected database. Only members of the study team will have access to this database.

13.) Privacy:

Demographics

Please complete the survey below.

Thank you!

Today's date: _____

Household Information

Date of birth _____

Ethnicity

○ Hispanic or Latino ○ NOT Hispanic or Latino ○ Unknown / Do not care to respond

Race (check all that apply)

☐ American Indian/ Alaskan Native
☐ Asian
☐ Native Hawaiian or Other Pacific Islander
☐ Black or African American
☐ White
☐ Other
☐ Do not care to respond

Other race: _____

Gender

○ Female ○ Male ○ Other ○ Do not care to respond

Other gender: _____

How would you describe your current working status?

○ Do not care to respond
○ Not working at a job or business and not looking for work
○ Retired
○ Looking for work
○ Working, but not for pay, at a family-owned job or business
○ Working for pay at a job or business

How many people live in your household?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 or more

Is your annual household income less than $11,880?

○ No ○ Yes ○ Do not care to respond

Is your annual household income less than $16,020?

○ No ○ Yes ○ Do not care to respond

Is your annual household income less than $20,160?

○ No ○ Yes ○ Do not care to respond

Is your annual household income less than $24,300?

○ No ○ Yes ○ Do not care to respond

Is your annual household income less than $28,440?

○ No ○ Yes ○ Do not care to respond

Is your annual household income less than $32,580?

○ No ○ Yes ○ Do not care to respond

Is your annual household income less than $36,730?

○ No ○ Yes ○ Do not care to respond

Is your annual household income less than $40,890?

○ No ○ Yes ○ Do not care to respond

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Please describe how cigarette smoking may be affecting your health.

	very unlikely	unlikely	neither unlikely nor likely	likely	very likely
How likely are you to get lung cancer in your lifetime?	○	○	○	○	○
Compared to other people your age, how likely are you to get lung cancer in your lifetime?	○	○	○	○	○
How likely are you to develop a smoking-related disease (lung or heart disease) in your lifetime?	○	○	○	○	○
Compared to other people your age, how likely are you to develop a smoking-related disease (lung or heart disease) in your lifetime?	○	○	○	○	○

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Now think back to BEFORE you were counseled about smoking during this hospital stay.
How DID you think cigarette smoking was affecting your health?

	very unlikely	unlikely	neither unlikely nor likely	likely	very likely
How likely did you think you were to get lung cancer in your lifetime?	○	○	○	○	○
Compared to other people your age, how likely did you think you were to get lung cancer in your lifetime?	○	○	○	○	○
How likely did you think you were to develop a smoking-related disease (lung or heart disease) in your lifetime?	○	○	○	○	○
Compared to other people your age, how likely did you think you were to develop a smoking-related disease (lung or heart disease) in your lifetime?	○	○	○	○	○

06/13/2017 11:18am

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Post-TTS Enrollment Survey at the Bedside

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Readiness to Quit Smoking

Below are some thoughts that smokers have about quitting.
Please read each selection and indicate the one number that describes how motivated you are to quit smoking.

○ 10 | I have quit smoking and I will never smoke again.
○ 9 | I have quit smoking, but I still worry about slipping back, so I need to keep working on living smoke free.
○ 8 | I still smoke, but I have begun to change, like cutting back on the number of cigarettes I smoke. I am ready to set a quit date.
○ 7 | I definitely plan to quit smoking within the next 30 days.
○ 6 | I definitely plan to quit smoking in the next 6 months.
○ 5 | I often think about quitting smoking, but I have no plans to quit.
○ 4 | I sometimes think about quitting smoking, but I have no plans to quit.
○ 3 | I rarely think about quitting smoking, and I have no plans to quit.
○ 2 | I never think about quitting smoking, and I have no plans to quit.
○ 1 | I enjoy smoking and have decided not to quit smoking for my lifetime. I have no interest in quitting.

09/12/2017 11:19am

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Post-TTS Enrollment Survey at the Bedside

References

Acock, A. C. (2005). Working with Missing Values. *J Marriage and Family*, *67*(4), 1012-1028. Doi:10.1111/j.1741-3737.2005. 00191.x

ACORN Organization Inc. Reliable Change index. Retrieved from https://www.psychoutcomes.org/OutcomesMeasurement/ReliableChangeIndex

Abrams, D. (2003). Book Review: The Tobacco Dependence Treatment Handbook: A Guide To Best Practices, *Community Mental Health Journal*, *40*(1), 92-93. doi:10.1023/b:comh.0000015512.77670.95

Adams, S. R., Goler, N. C., Sanna, R. S., Boccio, M., Bellamy, D. J., Brown, S. D., … Schmittdiel, J. A. (2013). Patient Satisfaction and Perceived Success with a Telephonic Health Coaching Program: The Natural Experiments for Translation in Diabetes (NEXT-D) Study, Northern California, 2011. *Preventing Chronic Disease*, *10*. doi:10.5888/pcd10.130116

Agaku, I. T., King, B. A., & Dube, S. R. (2014). Cancer-Related News from the CDC. *Oncology Times*, *36*(9), 31-33. doi:10.1097/01.cot.0000449871.82909.ae

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211. Doi: 10.1016/0749-5978(91)90020-t

Ali, N., Lifford, K. J., Carter, B., McRonald, F., Yadegarfar, G., Baldwin, D., et al. (2015). Barriers to uptake among high-risk individuals declining participation in lung cancer screening: a mixed methods analysis of the UK Lung Cancer Screening (UKLS) trial. *BMJ Open*, *5*(7), e008254. Doi: 10.1136/bmjopen-2015-008254

American Cancer Society. (2015). *Cancer facts & figures-2015*. Atlanta, GA: Author. Are you a hospital inpatient or outpatient? (n.d.). Retrieved from http://medicare.gov

Aryal, U. R., & Bhatta, D. N. (2015). Perceived benefits and health risks of cigarette smoking among young adults: insights from a cross-sectional study. Tobacco Induced Diseases, 13(1), 22. http://doi.org/10.1186/s12971-015-0044-9

Ayanian, J. & Cleary, P. (1999). Perceived risks of heart disease and cancer among cigarette smokers. *The Journal of the American Medical Association, 281*, 1019-1021.

Becker, L. (1997) -Revised 04/06/99 Statistical and Clinical Significance. https://www.uccs.edu/lbecker/clinsig.html

Belita, E. & Sidani, S. (2015). Attrition in Smoking Cessation Intervention Studies: A Systematic Review. *Canadian Journal of Nursing Research,* 47(4), 21-40(20).

Biener, L., & Abrams, D. B. (1991). The Contemplation Ladder: Validation of a measure of

readiness to consider smoking cessation. Health Psychology, 10(5), 360-365.

Borrelli, B., Hayes, R. B., Dunsiger, S., & Fava, J. L. (2010). Risk perception and smoking behavior in medically ill smokers: a prospective study. *Addiction*, *105*(6), 1100-1108. doi:10.1111/j.1360-0443.2010.02900.x

Brandon TH, Juliano LM, Copeland AL. Expectancies for tobacco smoking. In: Kirsch I, editor. How expectancies shape experience. American Psychological Association; Washington, DC: 1999. pp. 263–299. Washington D.C.

Brewer, N. T., Weinstein, N. D., Cuite, C. L., & Herrington, J. E. (2004). Risk perceptions and their relation to risk behavior. *Annals of Behavioral Medicine*, *27*(2), 125-130. Doi: 10.1207/s15324796abm2702_7

Bunge, E. M., Van den Bergh, K. A., Essink-Bot, M., Van Klaveren, R. J., & De Koning, H. J. (2008). High affective risk perception is associated with more lung cancer-specific distress in CT screening for lung cancer. *Lung Cancer*, *62*(3), 385-390. doi:10.1016/j.lungcan.2008.03.029

Byiers, B. J., Reichle, J., & Symons, F. J. (2012). Single-Subject Experimental Design for Evidence-Based Practice. *American Journal of Speech-Language Pathology / American Speech-Language-Hearing Association*, *21*(4), 397–414. http://doi.org/10.1044/1058-0360(2012/11-0036)

Byrne, M. M., Weissfeld, J., & Roberts, M. S. (2008). Anxiety, Fear of Cancer, and Perceived Risk of Cancer following Lung Cancer Screening. *Medical Decision Making*, *28*(6), 917-925. Doi: 10.1177/0272989x08322013

Campaign for Tobacco-Free Kids. Tobacco and Socioeconomic Status [PDF–56.2 KB]. Washington, D.C.: Campaign for Tobacco-Free Kids,

Cahill, K., Stevens, S., Perera, R., & Lancaster, T. (2013). Pharmacological interventions for smoking cessation: An overview and network meta-analysis. *Cochrane Database of Systematic Reviews,* 5(CD009329). doi:10.1002/14651858.CD009329.pub.

Carter-Harris, L., Slaven, J. E., Monohan, P., & Rawl, S. M. (2016). Development and Psychometric Evaluation of the Lung Cancer Screening Health Belief Scales. Cancer Nursing. https://doi.org/10.1097/NCC.0000000000000386

Centers for Disease Control (CDC) (2016). Tobacco-Related Disparities. (2018, June). National Center for Chronic Disease Prevention and Health Promotion: Office on Smoking and Health Retrieved from https://www.cdc.gov/tobacco/disparities/index.htmPage

Centers for Disease Control and Prevention (CDC). (2008). Smoking-attributable mortality, years of potential life lost, and productivity losses—United States, 2000–2004. MMWR Morb Mortal Wkly Rep. 2008; 57(45):1226–1228.

Centers for Disease Control (CDC). (n.d.). Lung Cancer Screening Guidelines and Recommendations.

Chatwin, J., Povey, A., Kennedy, A., Frank, T., Firth, A., Booton, R., et al. (2014). The mediation of social influences on smoking cessation and awareness of the early signs of lung cancer. *BMC Public Health*, *14*(1), 1043. Doi: 10.1186/1471-2458-14-1043

Chen, L., & Kaphingst, K. (2011). Risk Perceptions and Family History of Lung Cancer: Differences by Smoking Status. *Public Health Genomics*, *14*(1), 26-34. Doi: 10.1159/000294151

Christensen, J. D., & Chiles, C. (2015). Low-Dose Computed Tomographic Screening for Lung Cancer. *Clinics in Chest Medicine*, *36*(2), 147-160. doi:10.1016/j.ccm.2015.02.002

Centers for Medicare and Medicaid Services [CMS]. (2012). Decision Memo for Smoking & Tobacco Use Cessation Counseling (CAG-00241N). (2015-07-31). Retrieved from https://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=130&ver=16&NcaName=Smoking+&+Tobacco+Use+Cessation+Counseling&DocID=CAG-00241N&bc=gAAAABAAEAAA&&fromdb=true.

Centers for Medicare and Medicaid Services [CMS]. (2014). Decision Memo for Screening for Lung Cancer with Low Dose Computed Tomography (LDCT) (CAG-00439N). Retrieve from https://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=274.

Centers for Medicare and Medicaid Services[a] [CMS]. (2015). Tobacco Treatment Inpatient Quality Measures. Retrieved from http://hcwp.org/wp-content/uploads/2014/06/Tobacco-Treatment-Inpatient-Quality-Measures.pdf.

Centers for Medicare and Medicaid Services[b] [CMS]. (2015). National Coverage Determination (NCD) for Screening for Lung Cancer with Low Dose Computed Tomography (LDCT). (2015-02-05). Retrieved from: https://www.cms.gov/Newsroom/MediaReleaseDatabase/Press-releases/2015-Press-releases-items/2015-02-05.html.

Chapman, S., Wong, W. L., & Smith, W. (1993). Self-exempting beliefs about smoking and health: differences between smokers and ex-smokers. American Journal of Public Health, 83(2), 215–219.

Cohen, Jacob. (1988), Statistical Power Analysis for the Behavioral Sciences – 2nd Edition. Mahwah, NJ: Lawrence Erlbaum Associates.

Cook, T.D. & Campbell, D.T. (1979) Quasi-experimentation: design and analysis issues for field settings. Boston, MA. Houghton Mifflin

Cordasco, K. (2013). Obtaining Informed Consent from Patients: Brief Update Review. In: Making Health Care Safer II: An Updated Critical Analysis of the Evidence for Patient Safety Practices. Rockville (MD): Agency for Healthcare Research and Quality (US); 2013 Mar. (Evidence

Reports/Technology Assessments, No. 211.) Chapter 39. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK133402/

Curtis, E., Drennan, J. (2013). Quantitative Health Research: Issues and Methods: Issues and Methods. UK. McGraw-Hill Education.

De Koning, H. J., Meza, R., Plevritis, S. K., Ten Haaf, K., Munshi, V. N., Jeon, J., … McMahon, P. M. (2014). Benefits and Harms of Computed Tomography Lung Cancer Screening Strategies: A Comparative Modeling Study for the U.S. Preventive Services Task Force. *Annals of Internal Medicine*, *160*(5), 311-320. Doi: 10.7326/m13-2316

DeVries, D. (2001). *Research design in social research*. London: SAGE.

Dillard, A. & Klein, W. (2006). Unrealistic optimism in smokers: Implications for smoking myth endorsement and self-protective motivation, *Journal of Health Communication, 11*, 93-102.

Drennan, J. & Hyde, A. (2008) Controlling response shift bias: the use of the retrospective pre-test design in the evaluation of a master's programme. *Assessment & Evaluation in Higher Education,* 33:6, 699-709. Doi: 10.1080/02602930701773026

Eagly, A. H., & Chaiken, S. (1997). The Psychology of Attitudes. *Journal of Marketing Research*, *34*(2), 298. Doi: 10.2307/3151869

Edwards, A., Naik, G., Ahmed, H., Elwyn, G., Pickles, T., Hood, K., & Playle, R. (2013). *Personalised risk communication for informed decision making about taking screening tests* (Issue 2). The Cochrane Collaboration.

Expedited Review of Social and Behavioral Research Activities Social and Behavioral Research Working Group Human Subjects Research Subcommittee Committee on Science National Science and Technology Council June 2008 (Protection of Human Subjects in Research. July 2015. Agency for Healthcare Research and Quality, Rockville, MD. *Accessed at:* http://www.ahrq.gov/funding/process/grant-app-basics/hsubjects.html)

Fagerlin, A., Zikmund-Fisher, B. J., & Ubel, P. A. (2011). Helping Patients Decide: Ten Steps to Better Risk Communication. *Journal of the National Cancer Institute*, *103*(19), 1436-1443. doi:10.1093/jnci/djr318

Faraone, S. V. (2008). Interpreting Estimates of Treatment Effects: Implications for Managed Care. Pharmacy and Therapeutics, 33(12), 700–711.

Faseru, B., Turner, M., Casey, G., Ruder, C., Befort, C. A., Ellerbeck, E. F., & Richter, K. P. (2010). Evaluation of an inpatient tobacco treatment service: Outcomes and lessons learned. *J. Hosp. Med*, *6*(4), 211-218. doi:10.1002/jhm.835

Feng, G., Jiang, Y., Li, Q., Yong, H., Elton-Marshall, T., Yang, J., & Li, L. (2010). Individual-level factors associated with intentions to quit smoking among smokers in six cities of China: findings from the ITC China Survey. *Tobacco Control*, *19*(2), 6-11.

Ferrer, R., & Klein, W. M. (2015). Risk perceptions and health behavior. Current Opinion in Psychology, 5, 85–89. Doi: 10.1016/j.copsyc.2015.03.012

Fiore, M. (2008). A Clinical Practice Guideline for Treating Tobacco Use and Dependence: 2008 Update. *American Journal of Preventive Medicine*, *35*(2), 158-176. doi:10.1016/j.amepre.2008.04.009

France, E. K., Glasgow, R. E., & Marcus, A. C. (2001). Smoking Cessation Interventions among Hospitalized Patients: What Have We Learned? *Preventive Medicine*, *32*(4), 376-388. doi:10.1006/pmed.2000.0824

Garson, G.D. (2015). Missing Values Analysis and Data Imputation, *Statistical Analysis Blue Book Series,* Asheboro, NC: G. David Garson and Statistical Associates Publishing.

Gilbert, N. (2001). The importance of pilot studies. Social Research Update, Winter SRU Issue 35. http://sru.soc.surrey.ac.uk/SRU35.pdf.

Griffin, R. J., Dunwoody, S., & Neuwirth, K. (1999). Proposed Model of the Relationship of Risk Information Seeking and Processing to the Development of Preventive Behaviors. *Environmental Research*, *80*(2), S230-S245. doi:10.1006/enrs.1998.3940

Griffin, R. J., Neuwirth, K., Giese, J., & Dunwoody, S. (2002). Linking the Heuristic-Systematic Model and Depth of Processing. *Communication Research*, *29*(6), 705-732. Doi: 10.1177/009365002237833

Gu, F., Wacholder, S., Kovalchik, S., Panagiotou, O. A., Reyes-Guzman, C., Freedman, N. D., … Caporaso, N. E. (2014). Time to Smoke First Morning Cigarette and Lung Cancer in a Case-Control Study. *JNCI Journal of the National Cancer Institute*, *106*(6), dju118-dju118. doi:10.1093/jnci/dju118

Guillaumier, A., Bonevski, B., Paul, C., D'Este, C., Twyman, L., Palazzi, K., & Oldmeadow, C. (2016). Self-Exempting Beliefs and Intention to Quit Smoking within a Socially Disadvantaged Australian Sample of Smokers. International Journal of Environmental Research and Public Health, 13(1), 118. http://doi.org/10.3390/ijerph13010118

Haiman, C. A., Stram, D. O., Wilkens, L. R., Pike, M. C., Kolonel, L. N., Henderson, B. E., & Le Marchand, L. (2006). Ethnic and Racial Differences in the Smoking-Related Risk of Lung Cancer. *New England Journal of Medicine*, *354*(4), 333-342. Doi: 10.1056/nejmoa033250

Harris, J. K., Karamehic-Muratovic, A., Herbers, S. H., Moreland-Russell, S., Cheskin, R., & Lindberg, K. A. (2011). Perceptions of personal risk about smoking and health among Bosnian

refugees living in the United States. *Journal of Immigrant and Minority Health*, *14*(3), 413-419. Doi: 10.1007/s10903-011-9511-4

Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics*, *42*(2), 377-381. doi:10.1016/j.jbi.2008.08.010

Hawley, D. (1995). Assessing Change with Preventive Interventions: The Reliable Change Index. Family Relations, 44(3), 278-284. Doi: 10.2307/585526Centers for Disease Control (CDC) (2015). Smoking & Tobacco Use. (2015, June). National Center for Chronic Disease Prevention and Health Promotion: Office on Smoking and Health. Retrieved from http://www.cdc.gov/tobacco/

Heatherton, T., Kozlowski, L., Frecker, R., Fagerström, K. (1991). The Fagerström Test for Nicotine Dependence: a revision of the Fagerstrom Tolerance Questionnaire, *Journal of Addiction, Sep; 86*(9), 1119-27.

Herzog, T., Abrams, D., Emmons, K., & Linnan, L. (2000). Predicting increases in readiness to quit smoking: A prospective analysis using the contemplation ladder. Psychology & Health. 15. 369-381. Doi: 10.1080/08870440008401999.

Howard, G. S. (1980). Response-shift bias. A problem in evaluating interventions with pre/ post self-reports. Evaluation Review, 4(1), 93 – 106.

Humphrey, L. L., Deffebach, M., Pappas, M., Zakher, B., & Slatore, C. G. (2014). Screening for Lung Cancer with Low-Dose Computed Tomography. *Annals of Internal Medicine*, *160*(3), 212. Doi: 10.7326/l14-5003-3

Institute of Medicine (U.S.). Committee on Scientific Standards for Studies on Modified Risk Tobacco Products. (2012). *Scientific standards for studies on modified risk tobacco products*. Washington, DC: National Academies Press.

Jacobson, N. S., & Truax, P. (1991). Clinical significance: A statistical approach to defining meaningful change in psychotherapy research. *Journal of Consulting and Clinical Psychology, 59,* 12-19.

Jacobson, J. D., Catley, D., Lee, H. S., Harrar, S. W., & Harris, K. J. (2014). Health risk perceptions predict smoking-related outcomes in Greek college students. *Psychology of Addictive Behaviors*, *28*(3), 743-751. Doi: 10.1037/a0037444

Jemal, A. & Fedewa, S. (2017). Lung Cancer Screening With Low-Dose Computed Tomography In the United States—2010 to 2015. *JAMA Oncology*; 3(9): 1278–1281. doi:10.1001/jamaoncol.2016.6416

Johnson, J. L., Budz, B., Mackay, M., & Miller, C. (1999). Evaluation of a nurse-delivered smoking cessation intervention for hospitalized patients with cardiac disease. *Heart & Lung: The Journal of Acute and Critical Care*, *28*(1), 55-64. Doi: 10.1016/s0147-9563(99)70043-9

Johnson, K., Zvolensky, M., Marshall, E., Gonzalez, A., Abrams, K., & Vujanovic, A. (2008). Linkages between Cigarette Smoking Outcome Expectancies and Negative Emotional Vulnerability. Addiction Behavior. 2008 Nov; 33(11): 1416–1424. Published online 2008 May 14. Doi: 10.1016/j.addbeh.2008.05.001

The Joint Commission. Tobacco Treatment. Retrieved April 8, 2015 from http://www.jointcommission.org/tobacco_treatment/ 2012.

Kazdin, A. (2010). Single-case research designs: Methods for clinical and applied settings. 2nd Edition, New York, NY: Oxford University Press

Kahan, D. (2010). Fixing the communications failure. *Nature*, *463*(7279), 296-297. Doi: 10.1038/463296a

Kane, R. L., & Radosevich, D. M. (2011). *Conducting health outcomes research*. Sudbury, MA: Jones and Bartlett Publishers

Kaushal, K. (2016). Response Shift Bias in Pre- and Post-test Studies. *Indian Journal of Dermatology*, *61*(1), 91. http://doi.org/10.4103/0019-5154.174036

Kim, Y. K., Sung, Y. M., Cho, S. H., Park, Y. N., & Choi, H. (2014). Reliability analysis of visual ranking of coronary artery calcification on low-dose CT of the thorax for lung cancer screening: comparison with ECG-gated calcium scoring CT. *The International Journal of Cardiovascular Imaging*, *30*(S2), 81-87. Doi: 10.1007/s10554-014-0507-8

Klatt, J. & Taylor-Powell, E. (2005). Synthesis of Literature Relative to the Retrospective Pretest Design. Paper read at American Evaluation Association, at Toronto, Ontario.

Klein, W. M., & Stefanek, M. E. (2007). Cancer Risk Elicitation and Communication: Lessons from the Psychology of Risk Perception. *CA: A Cancer Journal for Clinicians*, *57*(3), 147-167. doi:10.3322/canjclin.57.3.147

Krosnick, J., Chang, L., Sherman, S., Chassin, L., Presson, C. (2006). The Effects of Beliefs about the Health Consequences of Cigarette Smoking on Smoking Onset, Journal of Communication, Volume 56, Issue suppl_1, 1 August 2006, Pages S18–S37, https://doi.org/10.1111/j.1460-2466.2006.00281.x

Krosnick JA, Malhotra N, Mo CH, Bruera EF, Chang L, et al. (2017). Perceptions of health risks of cigarette smoking: A new measure reveals widespread misunderstanding. PLOS ONE 12(8): e0182063. https://doi.org/10.1371/journal.pone.0182063

Larzelere, M., & Williams, D., (2012). Promoting Smoking Cessation. Louisiana State University School of Medicine, New Orleans, Louisiana Am FAM Physician. 2012 Mar 15; 85(6):591-598.

Lamb, T. (2005). The Retrospective Pretest: An Imperfect but Useful Tool. *The Evaluation Exchange, 11*(2). Retrieved from http://www.hfrp.org/evaluation/the-evaluation-exchange/issue-archive/evaluation-methodology/the-retrospective-pretest-an-imperfect-but-useful-tool.

Larabie, L. C. (2005). To what extent do smokers plan quit attempts? *Tobacco Control*, *14*(6), 425-428. doi:10.1136/tc.2005.013615

Leon, A., Davis, L., & Kreamer, H. (2011). The role and interpretation of pilot studies in clinical research. *Journal of Psychiatric Research, 45*(5), 626-629.

Lin, W., & Sloan, F. (2015). Risk perceptions and smoking decisions of adult Chinese men. *Journal of Health Economics*, *39*, 60-73. doi:10.1016/j.jhealeco.2014.11.006

Lyna, P., McBride, C., Samsa, G., & Pollak, K. I. (2002). Exploring the association between perceived risks of smoking and benefits to quitting. *Addictive Behaviors*, *27*(2), 293-307. Doi: 10.1016/s0306-4603(01)00175-7

Maatoug, J., Harrabi, I., Hmad, S., Belkacem, M., Al'Absi, M., Lando, H., & Ghannem, H. (2013). Clustering of Risk Factors with Smoking Habits among Adults, Sousse, Tunisia. *Preventing Chronic Disease*, *10*. doi:10.5888/pcd10.130075

Mackay, J. & Schluger, N. (2015). Global tobacco epidemic. In R. Loddenkemper & M. Kreuter (Eds.), *The tobacco epidemic* (pp. 19-26). (2nd edition). Switzerland: Karger Medical and Scientific Publishers

Marsden, E. & Torgerson, C. (2012). Single group, pre- and post-test research designs: Some methodological concerns, *Oxford Review of Education, 38*(5), 583-616, doi: 10.1080/03054985.2012.731208

Manser, R., Letharby, A., Irving, L., Stone, C., Byrnes, G., Abramson, M., & Campbell, D. (2013). *Screening for lung cancer (review)* (Issue 6). The Cochrane Collaboration.
Marsden, E. & Torgerson, C. (2012). Single group, pre- and post-test research designs: Some methodological concerns. *Oxford Review of Education* 38:5, pages 583-616.

Martin, L., & DiMatteo, M. (2013). Perceived risk and its relationship to health-related decisions and behavior. In *The Oxford Handbook of Health Communication, Behavior Change, and Treatment Adherence* (pp. 1-33).

Mathur, S., & Singh, N. (2015). Characteristics of smokers with intentions to quit, with a focus on occupational status, race/ethnicity, and cognitive behavior. *Epidemiology Biostatistics and Public Health*, *12*(1), 1-8. Doi: 10.2427/10910

McKee. S., O'Malley, S., Salavey, P., Krishnan-Sarin., S., & Mazure, C. (2005). Perceived risks and benefits of smoking cessation: Gender-specific predictors of motivation and treatment outcome. *Addictive Behavior, 30,* 423-435.

McNaughton, C., Wallston, K. A., Rothman, R. L., Marcovitz, D. E., & Storrow, A. B. (2011). Short, Subjective Measures of Numeracy and General Health Literacy in an Adult Emergency Department Setting. *Academic Emergency Medicine : Official Journal of the Society for Academic Emergency Medicine, 18*(11), 10.1111/j.1553–2712.2011.01210.x. http://doi.org/10.1111/j.1553-2712.2011.01210.x

Moore, Carter, Nietert, & Stewart (2011). Recommendations for Planning Pilot Studies in Clinical and Translational Research. *Clinical Translational Science, 4*(5), 332-337.

Moran, S., Glazier, G., & Armstrong, K. (2003). Women smokers' perceptions of smoking-related health risks. *Journal of Women's Health, 12*(4), 363-371.

Mowery PD, Dube SR, Thorne SL, et al. Disparities in Smoking-Related Mortality among American Indians/Alaska Natives. American Journal of Preventive Medicine, 2015. doi:10.1016/j.amepre.2015.05.002 [accessed 2015 Sep 17].

Moyer, V. A. (2014). Screening for Lung Cancer: U.S. Preventive Services Task Force Recommendation Statement. *Annals of Internal Medicine*, *160*(5), 330-338. Doi: 10.7326/m13-2771

Mullen K., Manuel D., Hawken S., et al. (2017). Effectiveness of a hospital-initiated smoking cessation programme: 2-year health and healthcare outcomes. *Tobacco Control*, 26, 293-299.

Muscat, J. E., Stellman, S. D., Caraballo, R. S., & Richie, J. P. (2009). Time to First Cigarette after Waking Predicts Cotinine Levels. *Cancer Epidemiology Biomarkers & Prevention*, *18*(12), 3415-3420. doi:10.1158/1055-9965.epi-09-0737

National Lung Screening Trial Research Team. (2013). Results of Initial Low-Dose Computed Tomographic Screening for Lung Cancer. *New England Journal of Medicine*, *368*(21), 1980-1991. Doi: 10.1056/nejmoa1209120

Nelson, D., Kreps, G., Hesse, B., Croyle, R., Willis, G., Arora, N., … Alden, S. (2004). The Health Information National Trends Survey (HINTS): Development, Design, and Dissemination. *Journal of Health Communication*, *9*(5), 443-460. Doi: 10.1080/10810730490504233

O'Connor, A. (2008). *Efficacy of a training intervention on the quality of practitioners' decision support for patients deciding about place of care at the end of life: A randomized control trial: Study protocol*. (BioMed Central Ltd.) BioMed Central Ltd.

Ogles, B. M., Lambert, M. J., & Masters, K. S. (1996). *Assessing outcome in clinical practice.* Boston: Allyn and Bacon, 82-90.

Oltedal, S., Moen, B., Klempe, H., & Rundmo, T. (2004). *Explaining risk perception. An evaluation of cultural theory*. Rotunde.

Oncken, C., Mckee, S., Krishnansarin, S., Omalley, S., & Mazure, C. (2005). Knowledge and perceived risk of smoking-related conditions: a survey of cigarette smokers. *Preventive Medicine*, *40*(6), 779-784. doi:10.1016/j.ypmed.2004.09.024

Park, E. R., Gareen, I. F., Jain, A., Ostroff, J. S., Duan, F., Sicks, J. D., Rigotti, N. A. (2012). Examining whether lung screening changes risk perceptions: National Lung Screening Trial participants at 1-year follow-up. *Cancer*, *119*(7), 1306-1313. doi:10.1002/cncr.27925

Park, E. R., Ostroff, J. S., Rakowski, W., Gareen, I. F., Diefenbach, M. A., Feibelmann, S., & Rigotti, N. A. (2009). Risk Perceptions Among Participants Undergoing Lung Cancer Screening: Baseline Results from the National Lung Screening Trial. *Annals of Behavioral Medicine*, *37*(3), 268-279. Doi: 10.1007/s12160-009-9112-9

Park, E. R., Streck, J. M., Gareen, I. F., Ostroff, J. S., Hyland, K. A., Rigotti, N. A., Nichter, M. (2013). A qualitative study of lung cancer risk perceptions and smoking beliefs among national lung screening trial participants. *Nicotine & Tobacco Research*, *16*(2), 166-173. doi:10.1093/ntr/ntt133

Pedersen, J. H., & Ashraf, H. (2016). Implementation and organization of lung cancer screening. *Annals of Translational Medicine,* 4(8), 152. http://doi.org/10.21037/atm.2016.03.59

Peugh, J. L., & Enders, C. K. (2004). Missing Data in Educational Research: A Review of Reporting Practices and Suggestions for Improvement. *Review of Educational Research*, *74*(4), 525-556. Doi: 10.3102/00346543074004525

Piper, M., Smith, S., Sclam, T., Fiore, M., Jorenby, D., Fraser, D., & Baker, T. (2009). A randomized placebo-controlled clinical trial of five smoking cessation pharmacotherapies. *Archives of General Psychiatry Journal, 66*(11), 1253-1262. doi:10.1001/archgenpsychiatry.2009.142

Pinsky, P. F., & Kramer, B. S. (2015). Lung Cancer Risk and Demographic Characteristics of Current 20–29 Pack-year Smokers: Implications for Screening. *Journal of the National Cancer Institute*, *107*(11), djv226. doi:10.1093/jnci/djv226

Poghosyan, H., Kennedy Sheldon, L., & Cooley, M. E. (2012). The Impact of Computed Tomography Screening for Lung Cancer on Smoking Behaviors. *Cancer Nursing*, *35*(6), 466-475. doi:10.1097/ncc.0b013e3182406297

Pomerleau, C. S., Carton, S. M., Lutzke, M. L., Flessland, K. A., & Pomerleau, O. F. (1994). Reliability of the fagerstrom tolerance questionnaire and the fagerstrom test for nicotine dependence. *Addictive Behaviors*, *19*(1), 33-39. Doi: 10.1016/0306-4603(94)90049-3

Pratt, C., McGuigan, W., & Katzev, A. (2000). Measuring program outcomes: Using retrospective pretest methodology. American Journal of Evaluation 21 (3):341-349.

Prochaska J. and Velicer W. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion, 12*, 38–48.

Radosevich, D. (2006). Designing an Outcomes Research Study. Retrieved from https://www.researchgate.net/publication/241456996_Designing_an_Outcomes_Research_Study

Regan, S., Viana, J. C., Reyen, M., & Rigotti, N. A. (2012). Prevalence and Predictors of Smoking by Inpatients during a Hospital Stay. *Arch Intern Med*, *172*(21), 1670. doi:10.1001/2013.jamainternmed.300

Reid, Z. Z., Regan, S., Kelley, J., Streck, J. M., Ylioja, T., Tindle, H. A., Rigotti, N. A. (2015). Comparative effectiveness of post-discharge strategies for hospitalized smokers: study protocol for the Helping HAND 2 randomized controlled trial. *BMC Public Health*, *15*(1), 109. Doi: 10.1186/s12889-015-1484-0

Rhodes, J.E., Jason, L.A. (1987). The retrospective pretest: An alternative approach in evaluating drug prevention programs. *Journal of Drug Education*, 17(4), 345-356).

Rigotti, N. A., Munafo, M. R., & Stead, L. F. (2008). Smoking Cessation Interventions for Hospitalized Smokers. *Arch Intern Med*, *168*(18), 1950. doi:10.1001/archinte.168.18.1950

Rigotti, N., Clair, C., Munafo, M., & Stead, L. (2011). Interventions for smoking cessation in hospitalised patients. *Cochrane Database Systematic Review*, *5*(001837). doi:10.1002/146518858.CD001837.pub3

Rigotti, N. (2012). Strategies to help a smoker who is struggling to quit. *Journal of American Medical Association*, *308*(15), 1573-1580.

Rigotti, N., Clair, C., Munafo, M., & Stead, L. (2012). Interventions for smoking cessation in hospitalized patients. *Cochrane Database Systematic Review, 16*(CD001837). doi:10.1002/14651858.CD001837.pub3.

Rigotti, N. A., Regan, S., Levy, D. E., Japuntich, S., Chang, Y., Park, E. R., Singer, D. E. (2014). Sustained Care Intervention and Postdischarge Smoking Cessation among Hospitalized Adults. *Journal of American Medical Association*, *312*(7), 719. doi:10.1001/jama.2014.9237.

Rigotti, N., Harrington, K., Richter, K., Fellows, J., Sherman, S., Grossman, E., Chang, Y., Tindle, H., Ylioja, T., & Consortium of Hospitals Advancing Research on Tobacco. (2015). Increasing prevalence of electronic cigarette use among smokers hospitalized in 5 US cities, 2010-2013. *Nicotine Tobacco Research, 17*(2), 236-244.

Rohsenow, D. (2003). The Smoking Effects Questionnaire for adult populations: Development and psychometric properties. *Addictive Behaviors, 28*, 1257-1270.

Savoy, E., Reitzel, L. R., Scheuermann, T. S., Agarwal, M., Mathur, C., Choi, W. S., & Ahluwalia, J. S. (2014). Risk perception and intention to quit among a tri-ethnic sample of nondaily, light daily,

and moderate/heavy daily smokers. *Addictive Behaviors*, *39*(10), 1398-1403. doi:10.1016/j.addbeh.2014.05.002

Scanlan, C. (2008). Primacy effect. In P. Lavrakas (Ed.), *Encyclopedia of survey research methods.* (pp. 610-611). Thousand Oaks, CA: SAGE Publications, Inc. doi: http://dx.doi.org/10.4135/9781412963947.n397.

Sciamanna, C. N., Hoch, J. S., Duke, G. C., Fogle, M. N., & Ford, D. E. (2000). Comparison of Five Measures of Motivation to Quit Smoking among a Sample of Hospitalized Smokers. *Journal of General Internal Medicine*, *15*(1), 16–23. http://doi.org/10.1046/j.1525-1497.2000.11198.x.

Schwartz, C. & Sprangers M. (1999). Methodological approaches for assessing response shift in longitudinal health-related quality-of-life research. *Social Science Medicine, 48*(11). 1531-1548.

Segerstrom S., McCarthy W., Caskey. (1993) Optimistic bias among cigarette smokers. *Journal of Applied Social Psychology*, 23, 1606–18

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston: Houghton Mifflin.

Shofer, S., Beyea, M., Li, S., Bastian, L. A., Wahidi, M. M., Kelley, M., & Lipkus, I. M. (2014). Feasibility of using an epigenetic marker of risk for lung cancer, methylation of p16, to promote smoking cessation among US veterans. *BMJ Open Respiratory Research*, *1*(1), e000032-e000032. Doi: 10.1136/bmjresp-2014-000032

Sinicrope, P. S., Rabe, K. G., Brockman, T. A., Patten, C. A., Petersen, W. O., Slusser, J., … Petersen, G. M. (2010). Perceptions of Lung Cancer Risk and Beliefs in Screening Accuracy of Spiral Computed Tomography among High-Risk Lung Cancer Family Members. *Academic Radiology*, *17*(8), 1012-1025. doi:10.1016/j.acra.2010.04.003

Slatore, C., Baumann, C., Pappas, M., & Humphrey, L. L. (2014). Smoking Behaviors among Patients Receiving Computed Tomography for Lung Cancer Screening. Systematic Review in Support of the U.S. Preventive Services Task Force. *Annals ATS*, *11*(4), 619-627. doi:10.1513/annalsats.201312-460oc

Solberg, L. I., Boyle, R. G., Davidson, G., Magnan, S. J., & Carlson, C. L. (2001). Patient Satisfaction and Discussion of Smoking Cessation during Clinical Visits. *Mayo Clinic Proceedings*, *76*(2), 138-143. Doi: 10.1016/s0025-6196(11)63119-4

Song, A. V., Morrell, H. E., Cornell, J. L., Ramos, M. E., Biehl, M., Kropp, R. Y., & Halpern-Felsher, B. L. (2009). Perceptions of Smoking-Related Risks and Benefits as Predictors of Adolescent Smoking Initiation. *American Journal of Public Health*, *99*(3), 487-492. doi:10.2105/ajph.2008.137679

Spitz MR, Hong WK, Amos CI, Wu X, Schabath MB, Dong Q, Shete S, Etzel CJ. A risk model for prediction of lung cancer. J Natl Cancer Inst 99(9):715-26, Oct-Dec, 5/2007

IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.

Stangor, C. (2011). *Research methods for the behavioral sciences* (4th edition). Mountain View, CA: Cengage.

Stead, L., & Lancaster, T. (2012). *Combined pharmacotherapy and behavioral interventions for smoking cessation* (Issue 10). The Cochrane Collaboration.

Stewart, D. W., Adams, C. E., Cano, M. A., Correa-Fernández, V., Li, Y., Waters, A. J., Wetter, D. W., … Vidrine, J. I. (2013). Associations between health literacy and established predictors of smoking cessation. *American Journal of Public Health*, 103(7), e43-9.

Stockings, E., Bowman, J., McElwaine, K., Baker, A., Terry, M., Clancy, R., Wiggers, J. (2013). Readiness to Quit Smoking and Quit Attempts Among Australian Mental Health Inpatients. *Nicotine & Tobacco Research*, *15*(5), 942–949. http://doi.org/10.1093/ntr/nts206

Studts, J. L., Ghate, S. R., Gill, J. L., Studts, C. R., Barnes, C. N., LaJoie, A. S., … LaRocca, R. V. (2006). Validity of Self-reported Smoking Status among Participants in a Lung Cancer Screening Trial. *Cancer Epidemiology Biomarkers & Prevention*, *15*(10), 1825-1828. doi:10.1158/1055-9965.epi-06-0393

Taminiau-Bloem, E., Schwartz, C., van Zuuren, F., Koeneman, M., Visser, M., Tishelman, C., Koning, C., Sprongers, M. (2015). Using a retrospective pretest instead of a conventional pretest is replacing biases: a qualitative study of cognitive processes underlying responses to the test items. *Quality of Life Research.* Doi: 10.1007/s11136-015-1175-4

Tanni, S., Iritsu, N., Tani, M., De Camargo, P., Sampaio, M., & Godoy, I. (2009). Risk perceptions and behavior among hospitalized patients with smoking-related diseases. *Public Health Research, Practice, and Policy*, *6*(4), 1-2. Retrieved from http://www.ccdc.gov/pcd/issues/2009/oct/09_0040.htm

Thompson, D., Barrett, R., Deonarine, A., Williams, C., White-Coleman, D., Horton, S. … Thomas, A. (2014). Effect of lung cancer screening awareness on smoking cessation behavior. *Family Medicine*, *46*(10), 770-775.

Tidey, J. and Rohsenow, D. (2009). Smoking Expectancies and Intention to Quit in Smokers with Schizophrenia, Schizoaffective Disorder and Non-Psychiatric Controls. *Schizophrenia Research, 11*(2), 310-316.

Tindle, H. (2015). Comprehensive Tobacco Control: Inpatient overview (pdf)).

Torgerson, C. & Torgerson, D. (2008) Designing and running randomised trials in health, education and the social sciences: an introduction. Basingstoke, Palgrave: Macmillan

Tindle, H., Duncan, M., Greevy, R., Vasan, R., Kundu, S., Massion, P., Freiberg, M. (2018). Lifetime Smoking History and Risk of Lung Cancer: Results From the Framingham Heart Study, JNCI: Journal of the National Cancer Institute, https://doi.org/10.1093/jnci/djy041 2018

United States. Public Health Service. Office of the Surgeon General. (1989). *Reducing the health consequences of smoking 25 years of progress*. Rockville, MD: U.S. Dept. of Health and Human Services, Public Health Service, Office of the Surgeon General.

United States Public Health Service. Office of the Surgeon General. (2014). *The health consequences of smoking- 50 yeas of progress*. Rockville, MD: U.S. Dept. of Health and Human Services, Public Health Service, Office of the Surgeon General.

University of Pennsylvania Medical Center Presbyterian Tobacco Treatment Service, FY13Q1 Progress Report (pdf).

Wallston KA, Cawthon C, Rothman RL, Osborn CY, Kripalani S. (2013). Psychometric properties of the brief health literacy screen in clinical practice. J Gen Intern Med, doi: 10.1007/s11606-013-2568-0 [PMC free article] [PubMed]

Wang D, Connock M, Barton P, Fry-Smith A, Aveyard P. 'Cut down to quit' with nicotine replacement therapies in smoking cessation: a systematic review of effectiveness and economic analysis. *Health Technol Assess* 2008; 12(2)

Weinstein, N. D. (1988). The precaution adoption process. *Health Psychology*, *7*(4), 355-386. doi:10.1037//0278-6133.7.4.355

Weinstein, N. D., Rothman, A. J., & Sutton, S. R. (1998). Stage theories of health behavior: Conceptual and methodological issues. *Health Psychology*, *17*(3), 290-299. doi:10.1037//0278-6133.17.3.290

Weinstein, N., Marcus, S., & Moser, R. (2005). Smokers' unrealistic optimism about their risk. *Tobacco Control, 14*, 55-59.

Weinstein ND, Slovic P, Waters E, & Gibson G. (2004). Accuracy and optimism in smokers' beliefs about quitting. Nicotine Tob Res.; 6 (375–380).

Wetter, D., Smith, S., Kenford, S., Jorenby, D., Fiore, M., Hurt, R., Offord, K., Baker, T. (1994) Smoking outcome expectancies: Factor structure, predictive validity and discriminative validity. *Journal of Abnormal Psychology*, 103:801–811.

Wilson, S. A., Becker, L. A., & Tinker, R. H. (1997). Fifteen-month follow-up of eye movement And reprocessing (EMDR) treatment for PTSD and psychological trauma. *Journal of Consulting and Clinical Psychology, 65,* 1047-1056.

World Health Organization (WHO). (2015). Report on the global tobacco epidemic: Warning about the dangers of tobacco. Geneva: World Health Organization

World Health Organization (WHO). (2015). Report on the global tobacco epidemic: Raising

taxes on Tobacco. Geneva: World Health Organization

Wu, P., Wilson, K., Dimoulas, P., & Mills, E. (2006). Effectiveness of smoking cessation therapies: a systematic review and meta-analysis. *BMC Public Health, 6*, 300-315. Doi: 10.1186/1471-2458-6-300.

Ylioja, T., Reddy, V., Ambrosino, R., et al., (2017). Using Bioinformatics to Treat Hospitalized Smokers: Successes and Challenges of a Tobacco Treatment Service. *Joint Commission Journal on Quality and Patient Safety*, 43 (12), 621–632. doi: https://doi.org/10.1016/j.jcjq.2017.06.010