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CRITICAL CARE NURSE INTENTIONS TO REPORT TO WORK DURING AN INFLUENZA PANDEMIC

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Abstract

Critical Care Nurse Intentions to Report to Work during an Influenza Pandemic

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BACKGROUND: The influenza virus is uniquely capable of creating pandemic illness in our population. The unpredictability of pandemics necessitates plans that will allow registered nurses to expand current capacity to care for ill individuals. It has been documented that personnel resources, often nurses, are a limiting factor in the health care system's ability to care for large influxes of patients. Prior research has shown that an outbreak of an infectious disease, such as influenza, may lead to healthcare workers (HCWs) intentionally staying out of work. The potential increase in patient demand coupled with a decrease in the number of critical care nurses reporting to work will strain the ability of healthcare systems to meet the needs of patients. To date, research has not studied critical care nurses' intentions to report to work during a pandemic influenza. **PURPOSE:** The purpose of this study was to examine the percent of critical care nurses that intend to report to work during an influenza pandemic. Covariates that may influence CCNs intention to report included personal, professional, and employer characteristics. Additionally, the impact of threat (perceived susceptibility to influenza and perceived severity of an influenza pandemic) and efficacy (perceived self-efficacy and perceived efficacy of the overall response) on intentions were analyzed. **METHODS:** A cross-sectional and descriptive design was utilized. Participants were recruited through the American Association of Critical Care Nurses. The final sample totaled 245 critical care nurses from across the United States. The participants completed an adapted version of the Johns Hopkins Public Health Infrastructure Response Survey Tool (JH~PHIRST) as well as personal demographics and information on their primary employer. Data were analyzed using bivariate methods and logistic regression. **RESULTS:** This study found that nearly 87% of CCNs intend to

report during a pandemic flu, but this number drops to 78% if severity of the pandemic is factored in and further declines to 63% if the CCNs are asked to work extra. Perceived self-efficacy is a primary factor in explaining CCNs intend to report to work. CCNs with high perceived self-efficacy were6.221 (95% CI: 2.638-14.673) times more likely to report than those with low perceived self-efficacy. Perceived self-efficacy continues to significantly impact intentions to report to work when the severity of the pandemic is considered as well as when CCNs are asked to work extra. CCNs with high perceived self-efficacy are consistently, significantly more likely to intend to report than those with low perceived self-efficacy. **CONCLUSION:** Perceived self-efficacy is related to CCN intentions to report to work during a pandemic flu emergency. Future research should examine methods for increasing CCN perceived self-efficacy, including professional, educational and employment factors

Keywords: critical care nurse, pandemic, influenza, intention to report

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Table of Contents

List of Figures

List of Tables

CHAPTER ONE: INTRODUCTION

Chapter one presents an overview of the study. Sections include: background of the problem, problem significance, purpose of the study, research questions and hypotheses, conceptual framework and theoretical and conceptual definition of terms used in the study.

By definition, a disaster overwhelms the normal response mechanisms in a given geographic area or of a given institution and requires alterations from normal operations (Hick, Christian, & Sprung, 2010). Regardless of the type of disaster that occurs, the response to it requires human resources (staff), material resources (stuff), space in which to respond (structure), and existing systems to coordinate the efforts and utilization of resources. Together the necessities for disaster response efforts are known as the "4 S's" (Adams, 2009). When a disaster impacts the health of the population, nurses, as the largest cadre of healthcare workers (HCWs) in the United States (and globally) will be an integral part of the response (Institute of Medicine & Robert Wood Johnson Foundation, 2011).

Nurses work in a variety of settings and specialty areas. Depending on the type of disaster different groups of nurses may find themselves at the forefront of the response. Events that might lead to a disaster response include weather events (hurricanes, tornadoes, etc.), man-made events (chemical spills, bombings, etc.), and biologic events (infectious diseases). Research has demonstrated that HCWs and other groups of first responders (police, fire, EMS, public health) view the threat associated with responding to a disaster differently depending on the event's cause (Balicer et al., 2010; Balicer, Omer, Barnett, & Everly, 2006; Barnett et al., 2009; Errett et al., 2013). The perceived threat of the event in turn influences individuals' self-reported willingness to respond (Balicer et al., 2010, 2006; Barnett et al., 2009; Errett et al., 2013; McCabe, Barnett, Taylor, & Links, 2010). One study by Balicer and colleagues (2010) identified that nurse participants were less willing to report to work in order to respond to disasters resulting from dirty bombs and outbreaks of infectious disease. That study utilized pandemic influenza as the event cause.

Background

When a pandemic flu will next occur and what its severity will be continues to be debated in the scientific literature and by the media (Institute of Medicine, 2012; Watson, Rudge, & Coker, 2013). However, what is less contested is that, should a pandemic occur, a large number of patients would be hospitalized and require ventilator support and/or other critical care treatment modalities (Ajao et al., 2015; Daugherty, Perl, Rubinson, Bilderback, & Rand, 2009; Daugherty & Rubinson, 2011; Devereaux et al., 2008; Gabriel & Webb, 2013; Hick et al., 2010; King, Ajao, Lichenstein, & Magder, 2014; Reilly & Markenson, 2010; Rubinson et al., 2008). While attempts to model pandemic outcomes are hampered by methodological issues, they suggest that even in "a moderate pandemic like that of 1957 or 1958, nearly a million individuals are likely to require inpatient care and tens of thousands may require critical care over the course of several months" (Daugherty et al., 2009, p. 1143). This would "rapidly outstrip current US critical care capacity" (Daugherty et al., 2009, p. 1147).

Previous research on pandemic flu preparedness has focused on modeling disease spread to estimate acute care bed surge capabilities, ventilator surge needs, and standards of care for surge and overflow scenarios (Institute of Medicine, 2012). This research found that a lack of resources is often the limiting factor in the ability to care for increased numbers of patients (Daughtery & Rubinson, 2011; Rubinson, et al., 2008). Nurse staffing is often cited as one of the primary factors limiting many hospitals' surge capacity plans (Reilly & Markenson, 2010; Roccaforte & Cushman, 2007). In reporting on Bellevue Hospital's ability to respond to a disaster or other surge in New York City, Roccaforte and Cushman (2007) stated, "We have the physical capacity, equipment, and medical staff to care simultaneously for 96 critically ill patients with up to two thirds of these patients ventilated. Our nursing department estimates capacity to care for only a maximum of about 50 patients with a 2:1 ICU staffing ratio" (p. 173). The shortage of critical care nurses at this hospital alone would result in 46 potential patients being unable to receive appropriate nursing care. Furthermore, this estimate is based on the

assumption that all of the critical care nurses who are asked to respond to work would in fact be willing and able to do so. Hence, the actual nursing capacity might be lower if critical care nurses are unable or unwilling to work.

Significance and Rationale for the Study

In 2004, the World Health Organization opined that the next influenza pandemic is "inevitable and possibly imminent" (World Health Organization, 2004, para. 1). Since that proclamation the world has seen the emergence of a novel avian influenza (2005 H5N1), a pandemic influenza in 2009 (pH1N1), a sustained outbreak of novel Middle East respiratory syndrome coronavirus (MERS-CoV) that started in 2012, the 2014-2015 outbreak of Ebola virus disease (EVD) in West Africa, and the ongoing EVD outbreak in the Democratic Republic of the Congo. While globally each of these outbreaks has not caused widespread illness and disruption of services, at the local and regional levels each outbreak has caused significant stress on existing healthcare services and daily living. The 2005 the *HHS Pandemic Influenza Plan* recognized that "globally and nationally, a[n influenza] pandemic might last for more than a year, while disease outbreaks in local communities may last 5 to 10 weeks" (U.S. Department of Health and Human Services, pp. S11–3).

Previous research has indicated that fewer than 50% of healthcare workers might actually present to work during an outbreak of an infectious disease (Balicer et al., 2006; Qureshi et al., 2005). **"**The unwillingness of HCW to place themselves at risk of exposure to emerging infectious diseases" has been observed numerous times (Barnett et al., 2009, p. e6365). Notable and recent examples include the HIV/AIDS epidemic in the 1980s, the SARS outbreak in 2003, and the Ebola outbreak 2014-2015 (Barnett et al., 2009; Bensimon, Smith, Pisartchik, Sahni, & Upshur, 2012; Suwantarat & Apisarnthanarak, 2015). In each of these examples, patient care was compromised as a result of healthcare workers being unwilling to accept the risk of possible infection or being afraid of the unknown.

Given what is known about the influence of nurse staffing levels on a facility's ability to achieve surge capacity, in the United States, it is necessary to examine critical care nurses' intentions to report to work during a pandemic flu and the factors that influence these intentions. Research conducted prior to the outbreaks noted above indicated that fewer than 50% of healthcare workers might actually present to work during an outbreak of an infectious disease in the United States (Qureshi et al., 2005; Balicer et al., 2006). However, when Daugherty and associates (2009) specifically examined the willingness of all critical care healthcare workers to report to work during a pandemic flu they found that only 21% of their sample was unsure or unwilling to report. Their study was conducted at one urban teaching hospital and one community hospital in the same state. It should be noted that critical care nurses only constituted 35% of their total sample, which is less than the actual percentage of critical care healthcare workers who are nurses. The majority of the respondents were physicians (house staff and attending physicians) and medical students. Since the number of critical care nurses (CCNs) has been identified as one of the limiting factors in surge capacity, a 20% decrease in staffing can have a considerable effect on facility surge capacity planning and capabilities, all of which can impact patient outcomes. Furthermore, research on hospitalizations related to seasonal influenza, not pandemic conditions, has demonstrated a 20% increase in medically attended acute respiratory illnesses (MAARI) during peak influenza outbreak periods (PIOP), and a corresponding 7% increase in patients requiring ventilatory assistance (King et al., 2014). The 20% increase in patient demand during the peak of a typical flu season, if coupled with a 20% decrease in nurse staffing, could result in a major deficit of nurses to care for patients. One would expect that during a pandemic the increase in patient demand would likely surpass that of the typical influenza season.

By understanding critical care nurses' intentions to report to work during a pandemic flu, we can better estimate staff availability and create more informed surge capacity plans. By identifying the factors that impact critical care nurses' intentions to work during a pandemic flu, this study has the

potential to inform practice, education, research, policies, and planning at the institutional and health systems levels and guide planning to address the specific barriers to nurses' ability or intentions to respond.

Purpose of the Study

The purpose of this study was to examine whether CCNs' intention to report to work is affected by their perception of the threat pandemic flu poses to themselves and their families (perceived threat) as well as CCNs' perception of the impact reporting to work will have on patient outcomes (perceived efficacy). Personal, professional, and organizational characteristics of CCNs and their employers were also examined.

Research Questions and Hypotheses

Specifically, the following research questions were addressed:

1. What percent of respondents intend to report to work during a pandemic flu emergency?
    a. What percent of respondents intend to report to work during a pandemic flu emergency, regardless of severity?
    b. What percent of respondents intend to work beyond their regularly scheduled shifts if asked?
2. What are the unique and combined effects of perceived threat and perceived efficacy on critical care nurses' self-reported intention to report to work during a pandemic influenza?

    H2a. As perceived threat increases, CCNs' self-reported intention to report to work during a pandemic influenza will decrease.

    H2b. As perceived efficacy increases, CCNs' self-reported intention to report to work during a pandemic influenza will increase.

    H2c. The combined effects of perceived threat and perceived efficacy will impact CCNs' intentions of reporting to work during a pandemic influenza.

3. What influence do personal, professional, and organizational characteristics have on CCNs' self-reported intention to report to work during a pandemic influenza?

    H3a. Competing personal demands (family/caregiver responsibilities; additional employers) will decrease the likelihood of intention to report to work.

    H3b. Perceived positive organization characteristics will increase the likelihood of intention to report to work.

Definitions of Terms

Influenza. Influenza refers to the illness caused by influenza viruses, it is frequently referred to as "flu". The resultant illness can range from mild symptoms (cough, sore throat, fever) to severe disease resulting in hospitalization and/or death. There are two main types of influenza viruses that cause disease in humans, Type A and Type B (Centers for Disease Control & Prevention, 2017a, 2017c).

Pandemic. The World Health Organization (WHO) defines pandemic as "the worldwide spread of a new disease (World Health Organization, 2010). Madhav and colleagues provide a more nuanced definition stating, "Pandemics are large-scale outbreaks of infectious disease that can greatly increase morbidity and mortality over a wide geographic area and cause significant economic, social, and political disruption" (2018, p. 315). There are several known diseases that have pandemic potential, but one disease has a history of causing pandemics and drastically impacting humans around the world, and that is influenza.

Pandemic Influenza. This variable is also called "pandemic flu." The definition of what constitutes a "pandemic influenza" has been contested in recent years (Doshi, 2011). The World Health Organization (WHO) does not provide a definition of pandemic influenza, but instead provides a description and a phased system for declaring a pandemic (Doshi, 2011). Similarly, the current Centers for Disease Control and Prevention (CDC) recommendations on pandemic influenza preparedness and response include a framework describing the six intervals of an influenza pandemic, and it is from this

that we will draw our definition of pandemic influenza for the purposes of this study (Holloway, Rasmussen, Zaza, Cox, & Jernigan, 2014).

The *acceleration interval* is identified by "consistently increasing rate of influenza cases identified" at the local/state or federal levels "indicating established transmission" (Holloway et al., 2014, p. 16). In addition to this, response activities will indicate that the case levels and severity have reached a point that community mitigation techniques, such as school closures and telecommuting, and medical countermeasures (MCM), such as alternative care sites and deployment of supply caches, are being considered and/or implemented. Our working definition of an influenza pandemic, for the purposes of this study, will be synonymous with the scenario described by the acceleration interval of the *CDC Intervals for a Novel Influenza A Virus Pandemic* (Holloway et al., 2014).

Pandemic flu emergency. The term pandemic flu emergency is used by the authors of the Johns Hopkins Public Health Infrastructure Response Survey Tool (JH~PHIRST), the instrument used in this study, to reflect a public health emergency caused by influenza that is creating an influx of patients in to the healthcare system (Balicer et al., 2010, 2006; Barnett et al., 2009, 2014; Errett et al., 2013; Rutkow, Paul, Taylor, & Barnett, 2017).

Influenza vaccination. Influenza vaccination will be defined as the annual administration or receipt of a trivalent or quadrivalent, live-attenuated or killed influenza virus, high dose (HD) or regular, via the intramuscular injection, intradermal injection, or inhaled routes as approved for use in the prevention of influenza infection by the Food and Drug Administration (FDA). Examples of current influenza vaccination products available for use in the U.S. are reported on the CDC's *Seasonal Flu Shot* webpage (Centers for Disease Control & Prevention, 2018a).

Intention to report to work. Drawing on TRA/TPB, intention to report to work is used as an antecedent measure for the desired behavior; "intentions represent a person's motivation in the sense of her or his conscious plan or decision to exert effort to enact the behavior"(Conner & Armitage, 1998,

p. 1430). In this scenario: actually, reporting to work during a pandemic flu. It is defined to mean that a CCN would plan to present at their place of employment to work for their regularly scheduled shifts during an outbreak of pandemic influenza. In this study intention to report to work was measured by self-report.

Perceived efficacy. Is defined as "cognitions about the effectiveness, feasibility, and ease with which a recommended response alleviates or helps in avoiding a threat" and is composed of perceived self-efficacy and perceived response efficacy (Popova, 2012, p. 459). This tenant is vital in the overlap of TRA/TPB and the EPPM.

Perceived self-efficacy. A component of perceived efficacy, it is the belief "about one's ability to carry out the recommended response" (Popova, 2012, p. 459). Perceived self-efficacy was measured using the JH~PHIRST and is a subscale.

Perceived response efficacy. A component of perceived efficacy, is the belief "about how effective a response is in averting a threat" (Popova, 2012, p. 459). Perceived response efficacy was measured using the JH~PHIRST and is a subscale.

Perceived threat is defined as "cognitions about a danger or harm that exists in an environment. Perceived threat comprises two underlying dimensions: severity and susceptibility" (Popova, 2012, p. 458).

Perceived susceptibility. A component of perceived threat, perceived susceptibility is the belief "about one's risk of experiencing the event" (Popova, 2012, p. 458). Perceived susceptibility is a subscale of the JH~PHIRST, which was the instrument utilized in this study. In this study perceived susceptibility evaluated how safe the respondent felt in working during a hypothetical pandemic flu emergency and broke down potential implications with regards to the individual CCN and separately evaluated their perceptions of impacts on their close friends/family.

Perceived severity. A component of perceived threat, it is defined as the belief "about the significance or magnitude of the threat." It can also encompass the belief regarding "the consequences should a specified event occur" (Popova, 2012, p. 458). Measured as a subscale in the JH~PHIRST, in this study perceived severity assessed the participant's overall interpretation of the severity of a pandemic flu emergency, including the impact on their community and the severity of illness seen in patients.

Critical care nurse (CCN). According to the American Association of Critical Care Nurses (AACN), a CCN is a registered nurse (RN) who specializes in "human responses to life-threatening problems" and cares for critically ill patients and their families (American Association of Critical-Care Nurses, 2015a). CCNs work in a wide variety of settings (American Association of Critical-Care Nurses, 2015a). For the purposes of this study the operational definition of a CCN will be an individual who is (1) licensed as a RN; (2) an AACN member; and (3) who self-identifies as being currently employed in a critical care environment such as an intensive care unit (ICU) or critical care unit (CCU). AACN defines a critical care nurse as a registered nurse who has the knowledge and skill to care for critically ill patients who require "complex assessment, high-intensity therapies and interventions, and continuous nursing vigilance"'(American Association of Critical-Care Nurses, 2015a). In this study a nationwide sample of CCNs will be accessed through the professional organization, American Association of Critical-Care Nurses. Therefore, members of their organization who are selected for participation in the study will have to agree that they meet the definition of CCNs as defined above.

CHAPTER TWO: LITERATURE REVIEW

Chapter Two provides a review and analysis of the literature that supports the gaps making the study relevant and timely. This chapter begins with an overview of the conceptual frameworks that are used to guide the study development. Then the synthesized review of the literature includes the following topics: historical context of pandemic influenza, recent pandemics and their impact on populations and healthcare worker staffing, and healthcare surge capacity.

Conceptual Framework

This study used a combination of the Theory of Planned Behavior (TPB) and the Extended Parallel Process Model (EPPM) to guide the research. The TPB has been used in numerous studies to measure intention as an antecedent of behavior (Ajzen, 1991, 2002; Conner & Armitage, 1998; Fishbein & Ajzen, 2010; Hutchinson et al., 2007; Hutchinson & Wood, 2007). It has been used with HCWs in varied settings as well. The EPPM was used to guide the development of the Johns Hopkins Public Health Infrastructure Survey Response Tool (JH~PHIRST), the instrument utilized in this study (Balicer et al., 2006). The EPPM has been used to guide public health research and develop studies investigating the behaviors of HCWs as well (Witte & Allen, 2000; Witte, Cameron, McKeon, & Berkowitz, 1996). Furthermore, the EPPM overlaps with the constructs of the Health Belief Model (HBM), the most commonly utilized model in the health behavior literature (Goulet, 2014).

Theory of Planned Behavior/Theory of Reasoned Action

The tenets of the Theory of Planned Behavior propose that the attitudes towards a behavior, subjective norms, and perceived behavioral control directly influence an individual's intention and subsequent engagement in a given behavior (Ajzen, 1991). "Many factors may facilitate or impede performance of a behavior. Some of these factors, including skills and willpower, are internal to the individuals while other factors, such as task demands and the actions of another person, are located externally (Ajzen, 1985)" (Ajzen, 2002, p. 675). The EPPM assesses some of the external factors that

contribute to intentions in a more explicit way than TPB does; hence the need for two theories in this study.

Using TPB, intentions towards engaging in a given behavior are measured as "assumed to be the immediate antecedent of the behavior" (Ajzen, 2002, p. 665). Furthermore, "intentions represent a person's motivation in the sense of her or his conscious plan or decision to exert effort to enact the behavior" (Conner & Armitage, 1998, p. 1430). The individual's attitude(s) towards the behavior "refers to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (Ajzen, 1991, p. 188). The subjective norm is considered to be the "perceived social pressure to perform or not perform the behavior" (Ajzen, 1991, p. 188). And finally,

> [P]erceived behavioral control in the theory of planned behavior refers generally to people's expectations regarding the degree to which they are capable of performing a given behavior, the extent to which they have the requisite resources and believe they can overcome whatever obstacles they may encounter (Ajzen, 2002, pp. 676–677).

Ajzen (2002) posits that "whether these resources and obstacles are internal or external to the person is immaterial. The theory is concerned only with the extent to which they are believed to be present and are perceived to facilitate or impede performance of the behavior under consideration" (pp. 676–677).

Ajzen himself presented the similarities and overlap between perceived behavioral control and the concept of self-efficacy, writing, "The present view of perceived behavioral control, however, is most compatible with Bandura's concept of perceived self-efficacy which 'is concerned with judgments of how well one can execute courses of action required to deal with prospective situations'" (Ajzen, 1991, p. 184). The concept of perceived self-efficacy will be expanded on in the section below on the EPPM.

TRA/TPB is a dynamic and applicable theory in that "at the core, the processes underlying all human social behavior are essentially the same and can be described by reference to a small set of constructs" (Fishbein & Ajzen, 2010, p. 17). The TRA/TPB is considered to be a "complete model of the determinants of intentions and behaviour (i.e., all other influences are assumed to exert their impact via changes in components of the model)" (Conner, Sutherland, Kennedy, Grearly, & Berry, 2008, p. 911)

and as such it has been used to guide studies of a number of different behaviors with health consequences (Ajzen, 1991; Conner & Armitage, 1998; Conner et al., 2008; Fishbein & Ajzen, 2010; Hutchinson et al., 2007; Sutherland, Fantasia, & Hutchinson, 2015).

TRA/TPB holds that "the most important determinant of a person's behavior is a person's behavioral intention" (Montano & Kasprzyk, 2008, para. 2). Behavioral intentions are formed by attitude and subjective norms (Montano & Kasprzyk, 2008). As a result, an individual's perception of these three beliefs leads "to the formation of a behavioral *intention*...Intention is thus assumed to be the immediate antecedent of behavior" (Ajzen, 2002, p. 665). Fishbein and Ajzen (2010) stated, "in combination, attitude toward the behavior, perceived norm, and perception of behavioral control lead to the formation of a *behavioral intention*, or a *readiness to perform the behavior*" (p. 21). All of these individual attributes are influenced by external factors as well.

Behavioral intention, influenced by individual attitudes toward the behavior, normative beliefs, and perceived behavioral control, is the motivation for an individual to either engage in a given behavior or not (Ajzen, 1991; Fishbein & Ajzen, 2010; Montano & Kasprzyk, 2008). Attitudes toward the behavior are "overall evaluations of the behavior by the individual" (Conner et al., 2008, p. 910). Normative beliefs "reflect individuals' views of whether significant people in their lives would approve or disapprove of the behavior" (Hutchinson & Wood, 2007, p. 141). The third variable, perceived behavioral control, "indicates that not all health behaviors are within the sole control of the individual" but rather that individuals consider whether or not they believe they possess the knowledge, skills, or ability to perform the behavior in question (Hutchinson & Wood, 2007, p. 141). Perceived behavioral control is similar to the construct of perceived self-efficacy, which stems from Bandura's social cognitive theory, and is a key component of the extended parallel process model (Hutchinson & Wood, 2007, p. 142; Witte & Allen, 2000). Perceived behavioral control is an important construct to assess as it "indicates important potential avenues for intervention, e.g., control beliefs can be improved through

skill building, practice, positive reinforcement, and role modelling" (Hutchinson & Wood, 2007, p. 142). External factors found to have a strong influence on the individual include organizational factors (Sutherland et al., 2015). For example, a CCN who believes that reporting to work during an influenza pandemic will not put him/herself at risk and will positively impact patient outcomes is more likely to indicate their intention to report to work.

Extended Parallel Process Model

The four constructs of the EPPM (perceived self-efficacy, perceived response efficacy, perceived susceptibility, and perceived severity), influence the "fear of a threatening condition, which impacts engagement in the ... behavior(s) through fear-control processing (low self-efficacy, high perceived susceptibility and severity), or danger-control processing (high self-efficacy, high perceived susceptibility and severity)" (Goulet, 2014, p. 12). However, if the perceived threat of the condition is low (low perceived susceptibility, low severity), then regardless of the perceived efficacy, the desired behavior/message will be disregarded.

Within the EPPM, self-efficacy is one component of perceived efficacy, with the other being response efficacy (Popova, 2012; Witte & Allen, 2000). The differentiation between the two types of efficacy reflects that self-efficacy encompasses "beliefs about one's ability to carry out the recommended response" and perceived response-efficacy is "beliefs about how effective a response is in averting a threat" (Popova, 2012, p. 459). In summation, the perceived efficacy is defined as "cognitions about the effectiveness, feasibility, and ease with which a recommended response alleviates or helps in avoiding a threat" (Popova, 2012, p. 459).

The concept of perceived threat is defined as "cognitions about a danger or harm that exists in an environment. Perceived threat comprises two underlying dimensions: severity and susceptibility" (Popova, 2012, p. 458). Popova (2012) defines the construct of perceived severity, within the EPPM, as

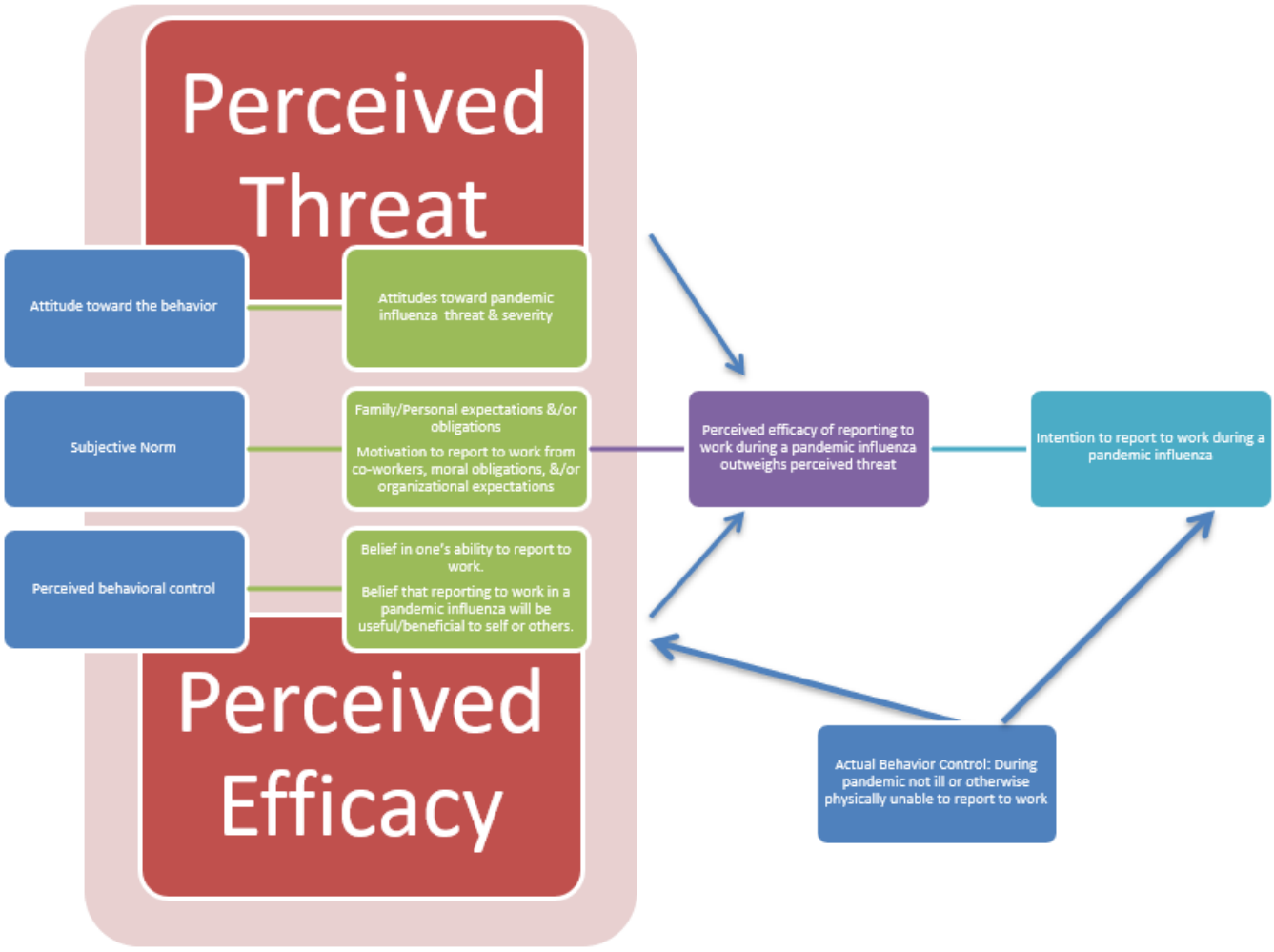
"beliefs about the significance or magnitude of the threat" and the "beliefs concerning the consequences should a specified event occur" (p. 458). Perceived susceptibility is simply "beliefs about one's risk of experiencing the event" (Popova, 2012, p. 458).

The EPPM is categorized as a fear appeal theory. Fear appeal theories tend to fall into one of three groups (drive theories, parallel response models, and subjective expected utility models); EPPM incorporates each of these perspectives into one theory (Witte & Allen, 2000). This model purports that an individual will undergo a two-fold appraisal of a fear stimulus and respond in one of three ways. This model served as the theoretical basis for the Johns Hopkins' Public Health Infrastructure Response Survey Tool (JH-PHIRST), the instrument adapted for use in this study. One component missing from the EPPM as it currently stands is that while individual perceptions shape and direct behaviors, people do not often operate in an isolated environment. In the situation we are evaluating, CCNs are also employees of an organization, members of a profession, and members of family/friend groups. Understanding the impact of these external relationships and their impact on behavior necessitated expanding the theoretical framework used to include organizational and professional characteristics, something that the TRA/TPB has previously been used for.

Convergence of TRA/TPB and EPPM

In this study TRA/TPB was used in conjunction with the EPPM, as together these two theories consider the multiplicative influences that may be present in a CCN's intent to report to work during a pandemic flu. Grounding the study design in theory allows for the results to be translatable to interventions. Figure1 is a pictorial representation of the interplay of the two theories with regards to behavioral intentions. Crucial to this theory overlap is the idea that self-efficacy and response efficacy contribute to behavioral intention and the study measures intention (Siu, 2008). The use of a theory-guided tool in assessing this problem was crucial to identifying which concepts and constructs to include in the survey and to guide the interpretation of results.

Figure 1. *Theory of Reasoned Action/Theory of Planned Behavior and Extended Parallel Process Model*



Synthesized Review of the Literature

Influenza

Influenza is an acute respiratory illness that is caused by influenza viruses (McCullers, 2016). Influenza viruses have their natural hosts in animal reservoirs, they are zoonotic diseases, and the virus is categorized into three types: A, B, and C (Centers for Disease Control & Prevention, 2017c; McCullers, 2016). Circulating strains of influenza A and influenza B viruses result in annual epidemics of influenza illness; influenza C viruses cause mild illness in humans and are not believed to be responsible for epidemics (Centers for Disease Control & Prevention, 2017c).

Influenza A viruses are divided into subtypes based on the expression of the surface proteins hemagglutinin and neuraminidase (Centers for Disease Control & Prevention, 2017a). There are 18 known subtypes of hemagglutinin and 11 known subtypes of neuraminidase, resulting in numerous possible combinations of the proteins. Influenza A viruses are named by their expression of these protein combinations; for example an H5N1 has a hemagglutinin 5 protein and a neuraminidase 1 protein. It is influenza A viruses that would likely create a pandemic as "several times a century, novel influenza A viruses cross over from the animal reservoirs of the world and establish new, dominant lineages in humans" (McCullers, 2016, p. 1). Once a novel strain of influenza A virus crosses to humans it is typically more pathogenic than the existing strains of influenza circulating, potentially creating a pandemic; it adapts and circulates for a period of time before being replaced by yet another new viral strain (McCullers, 2016).

In order to be considered a pandemic influenza the suspected virus must meet three conditions: (1) it must have a novel assortment of a hemagglutinin protein, (2) it must spread worldwide, and (3) it must cause disease (McCullers, 2016). While wild waterfowl are the natural reservoirs for influenza A viruses, they are often found in domesticated birds as well and it is there that they can come into contact with humans and cross over (Centers for Disease Control & Prevention, 2017c). However, swine play an important role in the creation of novel influenza strains with pandemic potential. Pigs have a dual sensitivity to viruses from both humans and other animals, including birds (Kim, Kim, Pascua, & Choi, 2016). Frequently pigs can be found to have coinfections of viruses from several species and as a result they serve as "genetic mixing vessels" for influenza viruses that may result in a pandemic influenza (Kim et al., 2016, p. 505). Two existing viral strains can recombine within a single swine host to potentially form 256 recombinant viral strains, one of which could be the source of a pandemic (Kim et al., 2016).

Given that the natural host of influenza A viruses are aquatic birds (with the exception of H17N10 and H18N11, which have only been found in bats), these viruses are commonly referred to as "avian influenza" (Centers for Disease Control & Prevention, 2017a). A different means of classifying influenza A viruses is based on pathogenicity; they can be "designated as highly pathogenic avian influenza (HPAI) or low pathogenicity avian influenza (LPAI) based on molecular characteristics of the virus and the ability of the virus to cause disease and mortality in chickens in a laboratory setting" (Centers for Disease Control & Prevention, 2017a, para. 4).

Influenza B viruses are not divided into subtypes, but are generally named for their lineage and by strain (Centers for Disease Control & Prevention, 2017c).

Seasonal Influenza. Seasonal influenza is an easily transmissible viral infection, resulting in respiratory illness, that has an annual epidemic cycle generally peaking during winter months (Institute of Medicine, 2011; World Health Organization, 2018). Annual outbreaks of influenza continue to occur due to slow and continued mutations in the antigens expressed by the virus (Viboud, Grais, Lafont, Miller, & Simonsen, 2005a).

Impact on population. Globally, it is estimated that there are three to five million cases of severe influenza illness annually, resulting in 250,000 to 500,000 excess deaths (World Health Organization, 2017b). In the United States, it is estimated that influenza affects up to 15% of the population annually and is the sixth leading cause of death in adults, with an annual average of 36,000 deaths (Finch, 2006; Poland, Tosh, & Jacobson, 2005; The Joint Commission, 2009; Tilburt, Mueller, Ottenberg, Poland, & Koenig, 2008; van Delden et al., 2008). More than 200,000 hospitalizations occur in the U.S. each year as a result of seasonal influenza and its complications (Institute of Medicine, 2011). While the severity of the seasonal epidemic varies each year, the 2018-2019 season (which is ongoing at the time of this writing) has resulted in an estimated 31.2-35.9 million cases in the U.S. (Centers for Disease Control & Prevention, 2019a). These cases have resulted in an estimated 419,00-508,000

hospitalizations and 28,000-46,800 deaths (Centers for Disease Control & Prevention, 2019a). This demonstrates an increase in flu-related admissions to healthcare facilities (HCFs) and if this trend continues could impact functioning and surge capacity further. In addition to the significant morbidity and mortality caused by influenza, the economic impact is also great, with an estimated direct annual cost of between three and five billion dollars in the U.S. alone (Poland et al., 2005).

King, Ajao, Lichenstein, & Magder (2014) reviewed 12 years of data from 47 hospitals in Maryland. In this study, billing data were used to identify medically attended acute respiratory illnesses (MAARI) and influenza surveillance data were used to identify the peak influenza outbreak (PIOP) periods (the four weeks, including the peak week, with the greatest number of positive influenza test results for the HHS region, for each year). The study found that, "For all ages and years combined there was a 7% increase in the rate of ventilator use during the PIOP compared to the non-ITP [non-influenza time periods] (RR = 1.07, $P<0.0001$) and a 20% increase (RR=1.2, $P<0.0001$) in MAARI-related hospitalizations during the PIOP compared to the non-ITP" (King et al., 2014, p. 138). These results demonstrate that seasonal influenza increases the burden on the health system annually.

Impact on HCWs. Several studies examined the impact of HCW influenza-like illness (ILI) on staffing levels(Chan, Shie, Lee, & Lin, 2008; Chan, 2007; Mota et al., 2011). There was a significantly lower number of ILIs experienced by HCWs who were vaccinated against influenza than by HCWs who were not vaccinated. The same study also showed a significant difference in the number of days of work that were missed between the vaccinated and unvaccinated groups (Chan, 2007). Chan (2007) also noted that in the group of HCWs who were vaccinated, no one missed work as the result of a vaccine-related side effect.

The impact of seasonal influenza is significant, yet often goes unnoticed, even by HCWs. According to a study conducted by Norton, Schiefele, Bettinger, and West (2008), "Up to one-quarter of health-care workers are infected with [seasonal] influenza each winter" (p. 2942). Despite this, many

HCWs continue to work even when they have febrile illness. Additionally, many infections of HCWs are subclinical so infected individuals may unknowingly be transmitting the virus. Together, the presence of subclinical infections and HCWs working when febrile, has led to nosocomial transmission of influenza. It is estimated that, "nearly two-thirds of influenza cases in immunocompromised patients and one-third of influenza cases admitted paediatric intensive care are nosocomial" (Norton et al., 2008, p. 2943).

HCWs who attend work while ill can transmit the virus to the patients in their care as well as to their co-workers. One study conducted in "5 European hospitals found that nurses' high degree of contact with potentially infectious persons places them at higher risk than the general population for infection during an influenza pandemic" (Santos, Bristow, & Vorenkamp, 2010, p. 48). Other studies have demonstrated that attack rates, an epidemiologic expression of risk among a defined population over a period of time, in local outbreaks of seasonal influenza have approached 59% of HCWs (Wise et al., 2011). One change that has been noted is an increasing number of HCWs receiving the annual influenza vaccination. In the 2017-2018 flu season 78.4% of all HCWs in the US were vaccinated and 90.5% of nurses (Centers for Disease Control & Prevention, 2018c).

Pandemic influenza. The occurrence of infectious diseases in the population spans a continuum from an infected individual to an outbreak or epidemic, and then to a pandemic. An outbreak is defined as a localized increase in the number of cases of disease and is synonymous with epidemic. An epidemic is defined as the occurrence of more cases of disease than expected in a given area or among a specific group of people over a particular period of time and a pandemic is defined as an epidemic spanning a large geographic area crossing territorial borders and often impacting multiple continents. The influenza virus will be the most likely cause of a pandemic. We can see, historically, that there have been three to four pandemics per century (Potter, 2001). Additionally, the virologic make-up of influenza predisposes it to human pandemics (Kim et al., 2016; McCullers, 2016).

In March 2013, a novel Avian influenza A (H7N9) was noted in China resulting in severe illness in those that were affected (World Health Organization, 2017a). During the ensuing epidemiologic investigation there was no evidence of human-to-human transmission of this new strain. Enhanced surveillance was put in to place by the country as well as many of the neighboring countries focusing on their poultry populations. In 2016, there was an increase in cases noted in China and limited human-to-human transmission cannot be ruled out during that time (World Health Organization, 2017a).

Pandemics result when this 'drift' of viral genetic make-up is replaced by a genetic 'shift' in which a new viral subtype replaces a previously circulating one and the human population has no or limited immunity to the new subtype (Viboud et al., 2005a). This creates the opportunity for severe illness in the vulnerable population, and while this may not always occur, there are several hallmarks of pandemic influenza that distinguish it from non-pandemic influenza. The first distinguishing characteristic is a "shift in the age distribution of mortality toward younger age groups" (Viboud et al., 2005a, p. 233). According to the Department of Health and Human Services (HHS), a pandemic influenza viral strain could result in 75 million to 105 million people becoming ill, with anywhere from 200,000 to 1,900,000 excess deaths (American College of Physicians, 2006) in the U.S. alone. The "predominant form of critical illness associated with all prior pandemics is pneumonia, either primary viral or secondary bacterial" (Gabriel & Webb, 2013, p. 467).

However, not all pandemics are created equal. The severity of influenza illness ranges from mild fever and malaise requiring only rest and supportive care to severe illness with secondary pneumonia that may require advanced level support such as ventilatory assistance and cardiopulmonary assistance (e.g. extra-corporeal membrane oxygenation (ECMO), vasopressors, etc.) and the need for intensive nursing care. These patients require critical care nurses (CCNs). While we cannot know for certain for the level of severity for the next influenza pandemic, our healthcare system should be prepared for all

possibilities. The Department of Health and Human Services (HHS) (2005) identified some of stressors that HCWs might face, including:

- increased risk of exposure to pandemic virus
- ethical dilemmas, such as conflicts between one's role as a healthcare provider and parent/spouse, or concern about receiving vaccines or antiviral drugs before other people
- Increased difficulty in performing crucial tasks and functions as the number of severely ill patients increases, the healthcare staff decreases, and medical and infection control resources are depleted

These risks, identified in 2005, continue to hold true today and have been demonstrated during actual outbreaks in recent years. What is critical to know, and what this study seeks to investigate, is how CCNs will behave when we don't know the severity of the event. Given the lack of predictability of influenza epidemics and pandemics we need to investigate CCNs' intentions during a time of peace so that we can adapt our planning to both (1) intervene, where indicated, to increase willingness to report to work, and (2) plan for anticipated CCN shortages accompanying increased patient volume.

Influenza summary. From its genetic makeup to the interaction between its natural reservoir and humans, the influenza virus is likely to continue to cause pandemic disease in the future as it has done in the past. The annual impact of influenza illness contributes to world-wide morbidity and mortality in spite of the current state of medical care and causes increased demand for patient care. Pandemic influenza has the potential to greatly increase the demand on HCWs and CCNs, necessitating this study.

Disaster Response

History of disaster response. Disasters by definition overwhelm normal operations at the local level. Disasters can require different types of response, from technical rescue expertise or medical care, to some combination thereof. History has shown that in times of disaster, aid and relief is frequently provided by areas that have not been affected. One example of this is the 1917 explosion in Halifax, Nova Scotia. Two ships collided in the harbor, one of which was carrying millions of pounds of explosives, and the resulting fire and explosion killed more than 1,800 and injured an estimated 9,000 individuals (Bilis, 2015). The hospitals that survived the blast and subsequent tidal wave were

overwhelmed with the increase in demand for care. In response, numerous medical professionals from Boston including nurses, physicians, and surgeons headed north with medical supplies to assist in the response (Bilis, 2015). One need only look to other disasters to find examples of individuals and groups reaching out to provide aid, including medical care. However, what is potentially unique in a pandemic is that such a large geographic area has the potential to be affected; therefore the type of response seen in other more isolated disasters will not be feasible.

Historical response to infectious diseases. Infectious diseases have a history of invoking fear in humans. During the Middle Ages entire towns barricaded themselves against outsiders for fear of pestilence and disease (Bailey, Rosychuk, Yonge, & Marrie, 2008; Brody & Avery, 2014). Records from as early as 166 A.D. report physicians abandoned their patients, and even their homes in order to avoid infectious diseases (Bailey et al., 2008). During outbreaks of plague in the Middle Ages cities and towns would hire "plague doctors," using considerable financial inducements, as the vast majority of their physicians and healers would abandon their duties. Of those who did care for plague victims, many were found to be "quacks" who worked solely for personal financial benefit and the rest often cared for victims out of a sense of Christian obligation and the need for personal salvation (Huber & Wynia, 2004). However, the populace did not tolerate this without question and in 1382 Venice, which had previously experienced the flight of physicians, passed a law forbidding physicians from leaving during times of plague (Bailey et al., 2008). Other cities across Europe soon followed.

Around the 1900s in the U.S., public opinions of the medical profession began to shift. The expectation that physicians would not abandon their patients and would provide care to those with infectious diseases grew, even during outbreaks or pandemics (Brody & Avery, 2014). As this change impacted practice, between 1920 and 1940 an estimated 10% of medical students developed active tuberculosis during their training. Given the endemic diseases of the time, risk became synonymous with

medical training (Huber & Wynia, 2004). This resulted in a shift in terms of how HCWs viewed their responsibilities to their patients, risking illness themselves in order to continue to provide care.

Beyond the response of medical providers to outbreaks of infectious disease, individually and professionally, civic governments and other institutions responded in kind. The plague epidemic of 1347-1352 ravaged Italy, and the spread from their ports further ravaged the ports of France and Spain (Tognotti, 2013). There was no treatment for the disease and many cities responded to outbreaks by closing the city off to outsiders, including ships from other ports, until the health of their crew and goods were confirmed. However, beyond ships the newly introduced concept of quarantine was often utilized to refuse admittance certain ethnic or other minority groups such as Jews (Tognotti, 2013). The association of infectious disease with minority groups has led to stigmatization in multitudes of cases. This has manifested itself in recent years with stigmatization and discrimination of healthcare workers who cared for patients with HIV/AIDs in the 1980s, SARS patients in the early 2000s, and those with EVD in 2014-2015. Reports of the concept of duty to treat, discussed in more detail below, did not appear in medical and ethical conversations until the 1800s.

Nurses' response to disasters. In this section the role of nurses in response to prior disasters and disease outbreaks, including recent pandemics, is reviewed. Response to disasters and times of war have long documented the role of nurses, and even if the profession was not explicitly named, the functions of a nurse were identified (Gebbie & Qureshi, 2006). While this study did not examine the historical responses of individual CCNs, it is important to review the historical behavior of nurses as a group as well. As previously noted in the discussion of the conceptual frameworks guiding this study, the Theory of Planned Behavior (TPB) typically focuses on individual behavior and not group behavior but it does provide an avenue for the review of past behavior as an independent predictor of intentions (Conner et al., 2008).

Since the professionalization of nursing by Florence Nightingale, nurses have been at the forefront of emergency and disaster response. In fact, Nightingale herself gained influence during the Crimean War by responding to what can only be considered a public health emergency. While soldiers were being injured in the war, they were dying of disease in the hospitals. Nightingale's work to provide a clean and healthful environment decreased mortality from 60 percent to just over 1 percent (Sitzman, 2010). While Nightingale's work occurred over 150 years ago, "Nurses will continue to be key players in local and national level emergency response as we move through the 21st century... All nurses must be prepared to report to work during a disaster" (Gebbie & Qureshi, 2006, para. 16).

Duty to care. There are those who would argue that the obligation to provide care to patients during a pandemic is an ethical issue more than a practical issue. Over the past century, the concept of duty to care among healthcare workers has gone from a maxim to an area of conversation and debate (Bensimon et al., 2012). Today, both the American Nurses Association's (ANA) and American Medical Association's (AMA) codes of ethics speak to their profession's responsibility to be present and provide appropriate care to those in need (American Medical Association, 2004; American Nurses Association, 2015). Indeed, it is from these same codes of ethics that the dilemma of responding during times of a pandemic can be highlighted; the ANA (2015) states, "2. The nurse's primary commitment is to the patient, whether an individual, family, group, or community" (p.10). However, it then follows with the fifth provision of that document: "The nurse owes the same duties to self as to others, including the responsibility to preserve integrity and safety..." (ANA, 2015, p. 21). The interpretive statements accompanying these provisions provide little guidance to the nurse on balancing personal integrity with professional commitment and responsibility. Bensimon and colleagues (2012) summarize the current state of the literature, writing:

> [F]ew challenge the view that some degree of duty, however defined, exists, and that it does, in times of broader social emergencies, trump an HCP's autonomous right to refuse provision of care. Therefore, the pertinent question regarding the duty to care

> shifts from “whether or not” to one of “when and to what extent” (Clark, 2005a, p. 2426).

The 2015 update to the ANA’s *Code of Ethics for Nurses with Interpretative Statements* addresses this issue for the first time under Provision 8, but does not provide concrete guidance to nurses. According to the interpretative statements accompanying Provision 8.4 *Collaboration for Human Rights in Complex, Extreme, or Extraordinary Practice Settings*:

> Human rights may be jeopardized in extraordinary contexts related to fields of battle, pandemics, political turmoil, regional conflicts, environmental catastrophes or disasters where nurses must necessarily practice in extreme settings... Thus, nurses must engage in discernment, carefully assessing their intentions, reflectively weighing all possible options and rationales, and formulating clear moral justifications for their actions (American Nurses Association, 2015, p. 33).

Research on public perceptions of the duty to care conducted in Canada in the aftermath of the SARS outbreak revealed that “nearly every participant, even those whose starting point was more categorical, arrived at the conclusion that the eventual solution lay somewhere between positing an absolute duty and abdicating the duty altogether” (Bensimon et al., 2012, p. 2427). The AMA (2004) explicates the responsibilities of physicians during a disaster, stating:

> Individual physicians have an obligation to provide urgent medical care during disasters. This ethical obligation holds even in the face of greater than usual risks to their own safety, health or life. The physician workforce, however, is not an unlimited resource; therefore, when participating in disaster responses, physicians should balance immediate benefits to individual patients with ability to care for patients in the future (para 1).

This position is consistent with the public perceptions that the participants in the Bensimon et al. (2012) study presented, which suggested that HCWs might be assisted in balancing the conflict between their personal and professional obligations if offered appropriate acknowledgment and concern for their safety during a pandemic. The suggestions that emerged were that in order for HCWs to meet their obligations to care for patients, they needed to be provided with the necessary resources to do their jobs, including proper personal protective equipment (PPE), and they should be given priority access to any available prophylaxis measures and treatment, if necessary.

Unwillingness to Report

Prior research has been conducted to assess the willingness of emergency responders, public health workers, and healthcare workers to report to work during various scenarios including a possible pandemic influenza. This research has demonstrated wide variations in willingness by profession and also geography. When assessing the willingness of local health department workers to report to work during an influenza pandemic, Balicer, Omer, Barnett, and Everly (2006) noted that nearly half of those surveyed indicated that they were "not likely to report." However, within the local health department workers, clinical staff were significantly more likely (multivariate OR 2.5) to report compared to other staff, and perception of their role within the organization's response was the "single most influential factor" influencing willingness to report and was statistically significant (multivariate OR 9.5) (Balicer et al., 2006, p. 99). This suggests that if individuals perceived that their role in the response to the pandemic was vital to organizational response success, they were more likely to indicate that they would be willing to report to work.

Balicer and colleagues (2010) surveyed healthcare workers at a large urban teaching hospital to determine their willingness to report to work during an influenza pandemic and found that 28% were unwilling to report if asked. Of the respondents in this study, 29.8% of nurses reported that they would not report to work if asked, which was significantly greater than the 20.7% of physicians unwilling to report (Balicer et al., 2010). When physicians and nurses were told they were *required* to report to work, 13.9% of nurses and 9.6% of physicians indicated they would still not report, and the difference between the two groups was no longer statistically significant. These findings are consistent with a 2008 survey of hospital workers in Germany, where 36.2% of HCWs indicated that they would not report to work during an influenza pandemic (Wicker, Rabenau, & Gottschalk, 2009). A startling discovery by Gershon et al. (2010) was that 12% of respondents in their sample reported that they would either retire early or quit

their job in the event of a pandemic outbreak in order to avoid placing themselves and their families at risk.

In contrast, a study of nurses in Hong Kong found that only 16% felt unprepared and were unwilling to report to work during an outbreak of avian influenza (Tzeng & Yin, 2006). Similarly, at the height of the 2009 H1N1 pandemic in Greece, a study demonstrated that only 4.3% of HCWs at a large urban referral hospital planned to take leave to avoid infection (Goulia, Mantas, Dimitroula, Mantis, & Hyphantis, 2010). And in King County, Washington, 11% of licensed/registered HCWs who responded to a survey stated that they would not be willing to report to work (Stergachis et al., 2011).

The influences on willingness to report are numerous; as reported above, employee perception of personal importance in the response can influence willingness, likewise the perception of risk or threat to oneself or one's family also influences willingness to report. Still, these barriers are not absolute in nature; for example, 58.7% of nurse participants in one study conducted in Taiwan:

> did not think that if there were an outbreak of avian flu, their working hospitals would have sufficient infection control measures and equipment to prevent nosocomial infection in their working environments. About 57% of the nurse participants indicated that they were willing to care for patients infected with avian influenza (Tzeng & Yin, 2006, p. 455).

This indicates that despite the perception of personal risk of infection, nurses were still willing to report to work. It is important to distinguish between actual risk and perception of risk. We do not know whether or not the facilities in which the nurse respondents worked had adequate infection prevention measures, but the important measure is the nurses' perception of this. The roles of geographic and cultural influences on willingness to respond are difficult to separate from one another. Nurses in Asia have been exposed to more outbreaks of infectious diseases in recent years than those living and working in other areas of the world. It is important to assess the impact of this history on their responses and note that historical bias may impact the study results.

A survey by Daugherty and associates (2009) of the willingness of critical care healthcare workers to report to work during a pandemic flu in the U.S. found 21% of their sample was unsure or unwilling to report, slightly lower than surveys including all disciplines of nurses and physicians. Their study was conducted at one urban teaching hospital and one community hospital in the same state and oversampled physicians (house staff and attendings) and medical students. Since the critical care nurse staffing has been identified as one of the limiting factors in surge capacity, a 20% decrease in staffing can have a considerable effect on facility surge capacity planning and capabilities, all of which can impact patient outcomes.

Disaster response summary

While medical providers, nurses, and informal care givers have been present in response to many types of disasters, history has demonstrated that the fear associated with infectious diseases has occasionally led them to fail to report to work. Indeed, the concept of duty to care has come to reflect the obligation that society places on physicians and nurses to perform their jobs in the face of dangers. Still, recent ethical analyses have demonstrated that the duty to care is not absolute. And, as the next section will demonstrate through a review of recent pandemics, HCWs, including CCNs, are often at an increased risk when caring for patients during epidemics and pandemics.

Research examining the factors that influence these decisions have yielded different results in different samples. Factors such as age, gender, educational background, and response role have all demonstrated significant relationships (Balicer et al., 2010, 2006; Barnett et al., 2009; Devnani, 2012; Errett et al., 2013; Rutkow et al., 2017). However, nurses and particularly CCNs have been underrepresented in these studies and so those results are not generalizable to this population. Additionally, while personal and professional characteristics were examined in these studies, employer or organizational characteristics have not been examined for potential influence. This study sought to address these gaps.

Recent Pandemics and Their Impact

While influenza pandemics have been documented throughout history, the 20th century was affected by three notable ones, the Spanish Flu of 1918, the Asian Flu of 1957, and the Hong Kong Flu in 1968 (Institute of Medicine, 2011; Rossow, 2012). Their impacts on the population and HCWs are detailed below. Additionally, other recent pandemics—while lacking the severity of these—are also presented as they might be better proxies for issues regarding increased patient volume, impact on HCWs and health systems, and challenges around surge capacity in our present medical environment. To that end, the pandemics discussed here include: 2002-2003 SARS, 2005 H5N1 (Avian flu), 2009 novel H1N1, 2012 MERS-CoV, the 2014-2015 Ebola virus disease (EVD) outbreaks, and the 2018-2019 EVD outbreak. The analysis of these disease outbreaks focuses on the impact on the population as well as their impact on healthcare workers. Healthcare workers impact is highlighted, as they have been identified by the Occupational Safety and Health Administration (OSHA) as being at increased risk (high risk) for exposure to "novel influenza viruses during a pandemic" (Wise et al., 2011, p. S198).

Spanish Influenza

Impact on population. According to firsthand accounts from medical students at the University of Pennsylvania who cared for patients during the Spanish influenza outbreak in 1918, "at the height of the epidemic about one fifth of the total patient population of the emergency hospital died *each night*" (Starr, 2006, p. 140). In Pittsburgh, at the height of the pandemic there, two weeks after influenza was first noted in the city, there was "roughly 1 new flu-related case every 90 seconds and 1 flu-related death every 10 minutes" (Tabery, Mackett III, & University of Pittsburgh Medical Center Pandemic Influenza Task Force's Triage Review Board, 2008, p. 114). If we were to experience a pandemic similar to the 1918 one today, "1) The attack rate in the United States would be 30%, causing 90 million cases; 2) of those infected about 50% would seek medical care; 3) the excess mortality would be 209,000 to

1,903,000 deaths; and 4) the outbreak in the community would last about 6 to 8 weeks" (Bartlett, 2006, p. 142).

Impact on HCWs. One of the great difficulties facing healthcare workers in the US who were attempting to care for these patients, despite already having diminished numbers due to World War I, was a lack of ability to protect themselves from infection. According to one report "... health-care providers fell ill, and some died. At one point, Minneapolis's City Hospital reported that 'nearly half of the nursing staff has been ill with influenza in the last three weeks'" (Ott, Shaw, Danila, & Lynflield, 2007, p. 804). At one point, the Secretary of the Minnesota State Board of Health attempted to recruit physicians from outside the cities to assist in caring for patients, but "'A number who we have called for have made excuses and have not come at all.' Other physicians who were recruited by Dr. Bracken simply did not show up" (Ott et al., 2007, p. 804). In this case, Minnesota attempted to use senior medical students to augment the ranks of HCWs, but was unable to secure permission from various regulatory and educational entities (Ott et al., 2007).

In contrast, at the same time in Philadelphia, the Dean of the University of Pennsylvania closed campus and sent third and fourth year medical students to staff an emergency hospital; fourth-year students were slated to work as medical interns and the third-year students as nurses (Starr, 2006). To aid and advise the medical students functioning as nurses, "one 'regular' trained nurse was available for help and consultation during the day and another during the night" (Starr, 2006, p. 138). In Minneapolis and St. Paul, the hospitals were overwhelmed and unable to care for many of the influenza patients that presented to them:

> This inadequacy was not entirely due to the lack of beds and supplies; there simply were not enough healthy nurses. At City Hospital, Superintendent Dr. Harry Britton reported that the "hospital was caring for about 150 cases, and had about 70 on the waiting list. It had beds available for that waiting number, but not nurses." (Ott et al., 2007, p. 804)

Today, registered nurses, while educated as generalists, often enter a specialty area in the workforce. While all registered nurses are able to provide a basic level of care, it is more important now than it was

during the 1918 pandemic that not just a nurse be available, but that it be a nurse whose area of expertise matches the patient's need. In the case of caring for hospitalized influenza patients, today that nurse would likely need to be a critical care nurse.

1957-1958 Asian Influenza

Impact on population. In the 1957-1958 Asian influenza outbreak of a relatively mild strain of influenza, nearly two million people died globally (Tabery et al., 2008). Unlike the 1918 influenza pandemic, the majority of the deaths occurred in individuals with pre-existing medical conditions (Kilbourne, 2006). Two conditions placing individuals at the greatest risk of mortality were rheumatic heart disease and third trimester of pregnancy (Kilbourne, 2006). Of note, "This was the first time the rapid global spread of a modern influenza virus was available for laboratory investigation. With the exception of persons >70 years of age, the public was confronted by a virus with which it had had no experience, and it was shown that the virus alone, without bacterial co-invaders, was lethal" (Kilbourne, 2006, p. 10).

Impact on HCWs. No studies were identified that examined the direct impact of this pandemic on HCWs. However, a study by Cooley, et al. (2010) modeled the transmission of influenza in current day Allegheny County, Pennsylvania, based on the epidemiology and viral behavior of the 1957-1958 Asian influenza pandemic. Startlingly, their model revealed that HCWs experienced infection (secondary attack rate) rates that were about 60% higher (54.3%) than that of other adults (34.1%). This would indicate a greatly increased risk of infection in HCWs as a result of occupational exposure.

1968 Hong Kong flu

Impact on population. Considered by experts to be a mild strain of influenza, the 1968 outbreak of the Hong Kong flu, which lasted two years, resulted in nearly one million deaths globally (Tabery et al., 2008). Despite being termed "mild" in nature, over two pandemic seasons this viral strain resulted in a 47% increase in pneumonia and influenza (P&I) mortality and a 6.6% increase in all cause (AC)

mortality in the United States. Other developed nations saw similar increases (Canada: P&I 43% increase, AC 3.6% increase; England and Wales: P&I 63% increase, AC 13% increase; France: P&I 82% increase, AC 11.9% increase; and Australia: P&I 59% increase, AC 9.1% increase) (Viboud, Grais, Lafont, Miller, & Simonsen, 2005b, p. 238).

Impact on HCWs. Media reports indicate that within one week of the abrupt emergence of the flu in Hong Kong there was an effect on "the functioning of the healthcare sector as well as civil infrastructure due to worker infection and absenteeism. Other contemporary reports of the 1968 influenza pandemic have also suggested that abrupt reporting of multisector absenteeism was a prominent early feature" (Wilson, Iannarone, & Wang, 2009, p. S149). Influenza vaccination had been possible since the mid-1940s, but had not been widely utilized by the public.

2003 SARS Outbreak

Impact on population. In 2003, there was an outbreak of a novel virus named SARS CoV that caused widespread respiratory illness in Asia and parts of North America. From the beginning of November 2002 through the end of July 2003 the WHO recorded 8,096 probable cases of Severe Acute Respiratory Syndrome (SARS) around the world (World Health Organization, 2003). Among these probable cases there were 774 deaths for a fatality rate of 9.6% (World Health Organization, 2003).

Additionally, the SARS outbreak was one of the first large-scale infectious disease outbreaks to occur in the era of modern media and increasing globalization. The media coverage contributed to the fear associated with the disease and may have enhanced the outbreak's impact on the population.

Impact on HCWs. Response to this outbreak resulted in the illness and death of HCWs who responded (Ruderman et al., 2006). Care for those who became ill was compromised by HCW absenteeism or the refusal of HCWs to provide care to those known to be infected. Indeed, up to 30% of the SARS cases around the world were HCWs (Ruderman et al., 2006). Ruderman, et al. (2006) note that, "The risk [to HCWs]... was not distributed equitably, and those HCPs who volunteered to provide

care faced the greatest exposure" (p. 2). Sokol (2006) stated "During the SARS outbreaks in Toronto the persons most at risk were nurses and infectious disease (ID) specialists" (p. 1239). The author then goes on to hypothesize that by entering into such specialties, these groups of HCWs have assumed additional risk. Yet during the SARS outbreak in Toronto, 25% of nurses did not report to work in order to avoid exposure to the virus (Stergachis et al., 2011).

During the SARS outbreak there were noted shortages of nursing staff in Taiwan from April-mid-July of 2003 (Tzeng, 2004). Many nurses who resigned from their positions during this time reported that they did not feel their employment site had provided sufficient training with regards to personal protective equipment (PPE) or had sufficient quantities of PPE to keep them safe. Tzeng (2004) also found that "some nurses' families continuously and actively prevented them from working for fear that they would bring SARS home" (p.278). In China, one hospital "ceased to function because of mass absence of its workers" (Imai et al., 2010, p. 673).

2005 H5N1 (Avian) Influenza

Avian influenza (subtype A H5N1 virus) has its natural reservoir in birds (Suwantarat & Apisarnthanarak, 2015; Tzeng & Yin, 2006). Migratory birds can spread the virus to domesticated birds (poultry), which can then transmit the infection to people. Presently, the viruses are not easily spread from birds to people, but once a person becomes infected, there is a high risk of fatality from the associated illness (Suwantarat & Apisarnthanarak, 2015; Tzeng & Yin, 2006). In the early 2000s, this viral subtype raised alarm among healthcare professionals and governments when human infections began to rise. It was realized that if viral changes allowed for human-to-human transmission the potential impact would be great. The CDC estimated that if this occurred, 1.9 million Americans would die and almost 10 million would be hospitalized (Tzeng & Yin, 2006).

Impact on population. The H5N1 Avian flu that emerged in humans in 1997 and circulated in the early 2000s spurred great concern among public health officials and HCWs and resulted in the

development of many of the pandemic influenza plans that continue to be revised and used today. From 2003 until early 2006, this virus "infected 228 people and killed 130—a mortality rate of more than 50%" (American College of Physicians, 2006, p. 135). And, "as of 3 March 2015, 784 laboratory-confirmed human cases of avian influenza A (H5N1) virus infection, including 429 deaths, have been reported from 16 countries" leaving this viral strain with a case-fatality rate of 54.7% (Suwantarat & Apisarnthanarak, 2015, p. 358).

Impact on HCWs. To date, there is no documented transmission of avian influenza to a HCW as a result of exposure to infected patients (Suwantarat & Apisarnthanarak, 2015). Yet avian influenza remains a concern as a result of its high fatality rates and pandemic potential.

2009 H1N1 Pandemic

First identified in the United States in April of 2009, this novel strain of H1N1 influenza quickly spread around the globe (Gesser-Edelsburg, Mordini, James, Greco, & Green, 2014). The impact of the virus on health systems varied, with relatively minor outbreaks in some regions and significant disease burden in others.

Impact on population. The 2009 H1N1 pandemic is estimated to have affected anywhere from 43 to 89 million individuals around the world and caused between 8,870 and 18,300 deaths (Hines, Rees, & Pavelchak, 2014). During the 2009 H1N1 outbreak in the United States, as cases surged in the early fall, the CDC "predicted that 15 states could run out of available hospital beds during the peak of the epidemic" (Balicer et al., 2010, pp. 436–437). While that scenario did not occur in our country, it was an important reminder that if an epidemic were to occur and control measures were unable to contain it, our healthcare system could quickly be overwhelmed. Still, from "May to June 2009... 1082 hospitalizations for pH1N1 infection were reported to the CDC ... [and] an estimated 1 million persons infected during that time" (Wise et al., 2011, p. 202).

Indeed, the 2009 H1N1 pandemic did result in the disruption of services in other countries. The burden of disease by this novel influenza A virus resulted in a total of 124,219 laboratory-confirmed cases in 35 countries and 2,638 deaths in 22 countries from within the Region of the Americas alone by September 11, 2009 (Pan American Health Organization [PAHO], 2009). For example, Argentina, a country with developed health and educational systems, had the "highest per capita H1N1 mortality rate in the world" with more than 500 deaths among more than 1,500 cases (Stern, Koreck, & Markel, 2011, p. 9). In order to cope with the increased demand on the healthcare system , approximately 8 weeks into the pandemic the Argentinean Ministry of Health deployed "28 mobile hospital units in Buenos Aires and hired 600 healthcare workers to run these units" (U.S. Department of Health and Human Services, 2009, p. 16).

In Australia, during the H1N1 outbreak, 15-20% of people admitted to the hospital with laboratory confirmed influenza required intensive care services (U.S. Department of Health and Human Services, 2009). New Zealand had even higher rates, with one-third of hospitalized cases admitted to ICUs, and at the peak of the epidemic, H1N1 cases occupied approximately half of the ICU beds in the country. Both of these developed countries also reported intermittent periods of hospitals operating at or above capacity, and Australia ordered additional respirators and extracorporeal membrane oxygenation (ECMO) machines as a result of the increased demand (U.S. Department of Health and Human Services, 2009, p. 16). The majority of the patients admitted to intensive care units in Australia and New Zealand during this outbreak required ventilatory support for a median duration of ventilation of eight days (Gabriel & Webb, 2013).

Impact on HCWs. Across the Pan-American Health Organization member countries, HCW absenteeism approached 30% in some countries and a scarcity of PPE was noted (Pan American Health Organization, 2009). In Argentina alone, HCW absenteeism approached 40% in certain regions and Australia noted an elevated absenteeism rate compared with the previous two influenza seasons (U.S.

Department of Health and Human Services, 2009). New Zealand reported "hospital staff absenteeism stressed hospitals temporarily during the peak of the disease" (U.S. Department of Health and Human Services, 2009, p. 16).

Staffing. Mota et al. (2011) compared the levels of staff absenteeism during the height of the 2009 H1N1 pandemic to sick leave levels for the same month in the previous year. The study revealed that at the height of the pandemic, 3% of the hospital workforce received leave for influenza-like illness. While this was a noted increase in absenteeism, it was not statistically significant when compared to the previous year. However, given the patient surge the organization was experiencing during the pandemic, the level of staff absenteeism may have significantly impacted clinical care. The 3% that required leave for ILI is lower than the models of the 1957-1958 Asian Flu, this could be for several reasons. First, we must consider that there is a decreased risk of infection of HCWs in an occupation setting as influenza vaccination is much more common and widely available and there have been significant increases in the use of PPE and the quality of PPE available. The other consideration is that many HCWs who were infected during this outbreak had subclinical infection and went to work not knowing they had the virus or went to work despite of having symptoms of ILI.

HCW illness. Santos, Bristow, and Vorenkamp (2010) found that different groups of HCWs were at increased risk of nosocomial influenza infection during the 2009 H1N1 outbreak in New York City. They reported that "about 49% of the reported cases of H1N1 in HCWs occurred in a population that constitutes less than 20% of the total HCW population. (Emergency medicine, pediatrics, ambulatory care, intensive care units, and anesthesiology made up 19.1% of the total HCW population studied.)" (Santos et al., 2010, p. 49). When laboratory-confirmed cases of influenza were analyzed by position, Santos, Bristow, and Vorenkamp (2010) documented that physicians and medical personnel had a 6.7% infection rate and nurses and clinical technicians had a 2.2% infection rate. However, when the same data were analyzed by department, the HCWs in the adult emergency department experienced an

infection rate of 28.8% and the pediatric emergency department had an infection rate of 25.0%. Yet another study investigated the source of illness among HCWs and found that "Half of reported HCP with H1N1 infection were classified as probably or possibly having acquired infection in a healthcare setting from either ill patients or coworkers" (Wise et al., 2011, pp. 200–202).

Stress. At an urban referral hospital in Greece during the peak of their 2009 H1N1 outbreak, a study of HCWs found that 56.7% were worried about the pandemic and "their degree of worry [was] moderately high;" their most common concern was the potential for infection of their family and friends, and they perceived their occupational risk of infection as "moderately high" (Goulia et al., 2010, p. 327). It was noted that while a low percentage of employees indicated that they were going to take leave to prevent occupational infection "worry and degree of worry were significantly associated with intentional absenteeism" (Goulia et al., 2010, p. 327). Nurses were more likely than other HCWs to feel that they were not receiving adequate information and that their care areas were unprepared to respond to the pandemic (Goulia et al., 2010).

Santos, Bristow, and Vorenkamp (2010) compared mean sick hours for HCWs at New York-Presbyterian Hospital during the pandemic in April-June 2009 to the same time period in 2008 and 2007. Over the three-month period in 2009, "mean sick hours increased by 9.2% (P<0.001) compared with 2008 and by 7.7% (P<0.001) compared with 2007" (p. 49). There was a significant increase in the mean number of sick hours per employee used by nurses and clinical technicians during both May and June of 2009. May saw a 17.8% increase and June a 22.5% increase. Over the entire three-month period there was a 12.4% increase (P<0.01). Over the same time span there was not a significant increase in the mean sick hours per employee for the physicians, medical personnel category of HCWs at this facility (Santos et al., 2010, p. 50).

In New Zealand and Australia a total of 856 patients were admitted to intensive care units with H1N1 between June and August of 2009 (Honey & Wang, 2013). Approximately two-thirds of these

patients required mechanical ventilation, and of those, 68 adult patients did not respond to mechanical ventilation and required extracorporeal membrane oxygenation (ECMO) therapy. Honey and Wang (2013) conducted a study of the ECMO trained nurses at a large urban hospital in New Zealand (the only hospital providing this therapy) and their perceptions of the experience. The CCNs who participated in this study identified several challenges, with 61% reporting that they "perceived a 'great or severe impact' from caring for these very sick patients" (Honey & Wang, 2013, p. 65). The participants indicated that wearing appropriate PPE and following infection control standards during 12-hour shifts was burdensome and they were often concerned about the infection control practices of their non-nurse colleagues who were treating the patients. They reported that while they received good or very good support from their ICU and ECMO colleagues, 89% felt that the support they received from hospital management was poor or very poor. The nurse participants emphasized that they often felt tired and overworked due to the burden on those who were trained to take care of ECMO patients, 89% reported working extra shifts during this time period with one nurse stating "receiving numerous/repeated text messages looking for ECMO nurses to do overtime became very invasive of one's private life and was tiresome" (Honey & Wang, 2013, p. 67).

MERS-CoV

Middle East Respiratory Syndrome Coronavirus (MERS-CoV) is a viral illness first reported in Saudi Arabia in September 2012 (Centers for Disease Control & Prevention, 2017b). The natural reservoir for the virus is camels, and overall spread among humans has been slow (Kupferschmidt, 2015).

Impact on population. MERS-CoV has caused severe acute respiratory illness in people with associated fevers, cough, and shortness of breath. Since first being identified in September 2012, the WHO has been notified of 2,374 laboratory-confirmed cases of MERS-CoV infection and 823 associated deaths in a reported 27 countries (World Health Organization, 2019b). It has an overall case-fatality rate

of 34.6% (Centers for Disease Control & Prevention, 2017b; World Health Organization, 2019b). Originally MERS-CoV was associated with travel to the Arabian Peninsula, but in 2015 an outbreak occurred in South Korea (Kupferschmidt, 2015) which highlighted the risk of nosocomial transmission in other countries when index cases are not quickly identified.

> The first South Korean patient, who had visited four Middle Eastern countries before flying home, was treated from 15 to 17 May [2015] in St. Mary's Hospital in Pyeongtaek. There, he infected the other patient in his room, the patient's son and daughter, and doctors, nurses, and patients in other rooms—more than 30 people altogether, in what researchers are calling a "superspreading event" (Kupferschmidt, 2015, p. 1183).

Unfortunately this was not the end of the Korean outbreak, which ultimately infected 186 individuals resulting in 38 deaths (Oh et al., 2018). The outbreak lasted over two months with 16 different healthcare facilities (12 hospitals and four clinics) and two ambulances having documented cases of nosocomial transmission. In the end, almost 17,000 individuals were quarantined for fourteen days (the incubation period) in order to suppress the outbreak (Oh et al., 2018).

One positive in the Korean outbreak is that the case-fatality rate was strikingly lower than what was observed in the Middle East, with less than 10% mortality. One hypothesis for this is that with its intensive case-finding investigations the South Koreans identified more mild cases of illness allowing "for a better estimate of the virus's true lethality" (Kupferschmidt, 2015, p. 1184).

Impact on HCWs. In one MERS outbreak, 27% of the cases were HCWs and across all outbreaks more than 50% of the HCWs infected were nurses (Suwantarat & Apisarnthanarak, 2015). In the four large MERS-CoV outbreaks in healthcare facilities in the Middle East there has been continued documentation of nosocomial transmission to HCWs (Suwantarat & Apisarnthanarak, 2015). Of the affected HCWs, greater than 50% were nurses, and in one outbreak, with 402 confirmed cases, 109 were in HCWs resulting in 4 HCW deaths (Suwantarat & Apisarnthanarak, 2015, p. 350). It has been documented in Saudi Arabia that some intensive care patients have "significantly higher amounts of virus in their lungs than others" but with similar symptoms (Kupferschmidt, 2015, p. 1183). Patients with

higher viral loads may contribute to increased nosocomial transmission. Furthermore, it has been postulated that nosocomial spread, both in the Middle East and in South Korea, has been in part due to poor infection control measures (Kupferschmidt, 2015).

An additional impact on HCWs during the outbreak was an increase in patients presenting to emergency departments for evaluation of flu-like symptoms due to "widespread media coverage" of the outbreak (Varughese et al., 2015, p. 1). Indeed, one emergency department in Qatar saw a 46% increase in patients presenting with ILI (Varughese et al., 2015). This led to the need for hospitals to revamp patient evaluation procedures and general workflow. HCWs need to provide appropriate care to those who are ill, and not miss cases of highly transmissible illnesses while not spending excess time and resources evaluating and treating the worried well.

Ebola Virus Disease

Ebola virus disease (EVD) was first identified in 1976 and causes hemorrhagic fever associated with high mortality in humans (Suwantarat & Apisarnthanarak, 2015).

2014-2015 West African Outbreak's Impact on population. In December 2013 an outbreak of the Zaire strain began in Guinea and spread unnoticed until March 2014 (Suwantarat & Apisarnthanarak, 2015). This outbreak included sustained human-to-human transmission as a result of contact with infected body fluids and dead bodies. The outbreak continued throughout 2014 into 2015 with significant spread, and sporadic cases continue to be identified. As of June 2016 the WHO identified 28,616 confirmed, probable, and suspected cases in Guinea, Liberia, and Sierra Leone with an associated 11,310 deaths (World Health Organization, 2016). The case-fatality rate in these three countries has ranged from 31% to 66% (Suwantarat & Apisarnthanarak, 2015). This outbreak also had a limited number of cases in other African countries—Senegal, Nigeria, Mali, and Cote d'Ivoire and reached other continents Europe (Spain, Italy, and England) and North America (U.S.) (Ngatu et al., 2017).

2018-2019 Democratic Republic of Congo's Outbreak Impact on population. On August 1, 2018 the World Health Organization recognized a new outbreak of EVD in the Democratic Republic of Congo (DRC). As of April 1, 2019, the outbreak is ongoing with a total of 1,092 cases (1,026 confirmed and 66 probable) and 683 associated deaths (617 in confirmed cases and 66 in probable cases) (World Health Organization, 2019a). The current case-fatality ratio is 62.5%. The current response efforts have been hampered by the ongoing sectarian violence in the country. Additionally, a newly released study indicates that up to 25% of the population does not believe that EVD exists (Hogan, 2014; Schnirring, 2019).

Impact on HCWs. A preliminary report by the WHO found that from January 1, 2014 to March 31, 2015 there were 815 confirmed or probable infections of HCWs in Sierra Leone, Liberia, and Guinea accounting for 3.9% of all confirmed or probable cases reported (World Health Organization, 2015). The proportion of HCW infections "as a proportion of all monthly cases peaked in July 2014" at 12% and then steadily decreased to a low of 1% of all cases in February 2015; this decrease in proportion of cases "may reflect the implementation of [infection] prevention interventions" in healthcare facilities (World Health Organization, 2015, p. 4). In these three countries, "Nurses, nurses assistants and nurses aides accounted for over 50% of all health worker infections with occupation reported (n=373/718). They were followed by medical workers (12%), laboratory workers (7%) and trade and elementary workers (7%) [janitors and facility staff]" (World Health Organization, 2015, p. 4).

Given the strides made in the 2014-2015 outbreak, it is disheartening to see that nosocomial transmission continues to be a problem several years later. In the current outbreak, there have been 78 confirmed EVD infections in HCWs comprising 8% of all cases in the DRC (World Health Organization, 2019a). The World Health Organization noted that "with higher risks of exposure in caring for others, health workers were disproportionately impacted and traumatized by Ebola" (World Health Organization, 2015, p. 2). Indeed it is estimated that "health workers are between 21 and 32 times more

likely to be infected with Ebola than people in the general adult population" (World Health Organization, 2015, p. 1).

In the United States, the index case of EVD arrived in the country from Liberia In September 2014 (Centers for Disease Control & Prevention, 2019b). Two nurses that cared for the index case were infected and became ill; there were no further cases in the country as a result of transmission within country borders. Subsequently, one case was identified in a physician who had served as a medical aid worker caring for EVD patients in Guinea. All other Ebola patients cared for in the U.S. were HCWs who developed the illness while abroad and were known to be ill prior to transport back to the country for treatment.

Surge Capacity

"Hospitals are expected to withstand considerable challenges during an influenza pandemic including surge capacity, patient triage, infection control, delaying non-emergent surgical procedures, and expanding ICU capacities" (Balicer et al., 2010, p. 441). Hospitals remain a finite resource and it has been noted that "Large hospitals, particularly those who anchor community safety nets, typically operate near capacity, so their ability to serve a large influx of critical patients is limited' (Katz, Staiti, & McKenzie, 2006, p. 953)" (Adams, 2009, p. 3). Watson, Rudge, and Coker (2013) define *surges* as "large-scale, sudden escalations in treatment needs" (p. 2).

Watson, Rudge, and Coker (2013) describe the recent shift in language in the literature with regard to the concept of surge capacity. Some authors continue to use the term surge capacity to describe any increase in patient volume within the daily fluctuations of an acute care facility as a surge; however, the general trend has been to recognize surge capacity as it relates to "exceptional events (such as natural hazard induced disasters and pandemics)" as "qualitatively distinct phenomena" (Watson et al., 2013, p. 10). The nuances of language extend to differentiating pandemics from other events that might require a surge as pandemics generally fall in to the "widespread, prolonged"

category when considering geographic boundaries and duration of event as descriptors. It is generally accepted that the definition of surge capacity includes "the ability...to respond to a sudden increase in patient care demands (Hick et al., 2008b)" (Watson et al., 2013, p. 12). However, definitions are often extended or made more specific. Watson, Rudge, & Coker (2013) report "the *American College of Emergency Physicians'* definition of surge capacity as a 'measureable representation of a healthcare system's ability to manage a sudden or rapidly progressive influx of patients *within the currently available resources* at a given point in time' (ACEP, 2006) (emphasis added)" (p. 12).

Adams (2009) acknowledges that while there is no consensus on a definition of surge capacity, there is consensus on its key components. Initially surge capacity was identified by the number of beds that a healthcare facility could add to accommodate patients; however:

> Barbisch *et* al (2006) were among the first to problematise reliance on bed numbers as a proxy for surge capacity. ... It is not simply beds or ventilators, but appropriately trained personnel (staff), comprehensive supplies and equipment (stuff), facilities (structure), and, of imperative importance, integrated policies and procedures (systems) to develop optimized sustainable surge capacity (Watson et al., 2013, p. 14).

The components are often referred to as the "4S's" and include "staff," "stuff," "structure," and "systems" (Adams, 2009). Roccaforte and Cushman (2007) state,

> The surge capacity of a facility is defined simply as the total number of patients that can be managed with only normal and surge resources. Overflow capacity is likewise defined as the absolute number of patients who can be accommodated with the addition of overflow resources (p. 169).

While staffing, stuff, structure, and systems are listed separately in this interpretation of surge capacity it is important to note that there remains an interplay among these resources. However, "each resource (ventilators, monitors, nursing staff, and so forth) has its own normal, surge, and overflow capacity" (Roccaforte & Cushman, 2007, p. 169). One recent study found that in a pandemic, U.S. hospitals "could absorb between 26,200 and 56,300 additional [patients requiring ventilation] at the peak of a national influenza pandemic with robust pre-pandemic planning (Ajao et al., 2015, p. 634).

The concept of a fifth "S" has been recently introduced, social supports. While not widely published in the literature, Partners In Health uses this new concept to support the sustainability of their programs and interventions (Farmer, 2015). It is an interesting concept to consider in the context of a pandemic. Social supports both within the nursing and healthcare community could impact intentions to report to work. Likewise, social supports outside of work, family, and public opinions may also influence CCN decision-making.

Staffing

Watson et al. wrote "Kaji et al's *(Kaji et al., 2006)* point that 'one must plan for what people will do, rather than what one wants them to do' is represented in analyses and recommendations that seek to incorporate estimates of staff absenteeism and develop means to intervene to reduce its extent" (p. 15). Nurses, as frontline healthcare workers, are vital to the "staff" component of surge capacity; Gebbie and Qureshi (2006) highlight the unique contribution of nurses in such situations, writing that "nurses are among the most flexible of staff. They often possess key clinical care, communication, and management skills that can be used to fill a wide range of roles" (para 16). Furthermore,

> As hospitals and communities plan more comprehensively for a range of disaster events, it has become clear that nurses are key for meeting surge capacity needs, whether these needs are in the field conducting surveillance, in shelters or mass medication/vaccination dispensing sites, in departments of health staffing public education/information hot lines, or in hospitals that are rapidly admitting patients in numbers far exceeding the typical census (Gebbie & Qureshi, 2006, para. 18).

Absenteeism. "Past experience shows that HCWs are at increased risk of infection in influenza pandemics" (Schwartz, Shapira, & Bar-Dayan, 2014, p. 150). Absenteeism can result from personal illness/infection, responsibility to care for an ill family member, or even an unwillingess to report to work.

Counter to absenteeism, a different ethical dilemma is HCWs who report to work while ill. In one study, respondents indicated that they would still come to work if they were experiencing influenza-like illnesses. Other studies demonstrated similar findings (Salgado, Farr, Hall, & Hayden, 2002). While

dedication to patients and colleagues is admirable, and highlights the participants 'willingness' to come to work, reporting to work while sick with an ILI may influence the workforce's ability to provide appropriate patient care and/or surge staffing capacity if needed. All HCWs with ILI should stay home until 48 hours after their fever has resolved in order to prevent them from transmitting the infection to other staff or patients (Mota et al., 2011). However, given the nature of influenza transmission, remaining absent from work while febrile is not enough to combat nosocomial spread as transmission may occur up to two days prior to the onset of symptoms.

Transmission of influenza within healthcare settings has been well documented (American College of Physicians, 2007; J. Potter et al., 1997). Healthcare workers have been shown to have serologically confirmed influenza infection rates that exceed the rates in the general population, thus putting patients and co-workers at an even greater risk of nosocomial transmission (American College of Physicians, 2007). Within acute care settings, certain patient populations are more vulnerable to severe consequences of influenza than others. One study demonstrated an overall median excess mortality rate of 16%, with rates significantly higher in intensive care units and transplant units (33-60%) (Salgado et al., 2002).

Complicating the issue of nosocomial influenza transmission is the nature of influenza and HCWs behavior. A person with influenza can transmit the virus up to two days prior to the onset of symptoms. Therefore, HCWs may not realize that they are infectious and unknowingly expose patients and co-workers. A disturbing finding is that a significant proportion of HCWs (up to 70%) report that they have or will continue to work while ill despite, one can assume, having an understanding about disease transmission (American College of Physicians, 2007). Both of these scenarios lead to healthcare environments being a prime place for the transmission of influenza to vulnerable patients and to the HCWs who are expected to care for them. One study revealed that up to 25% of healthcare workers had evidence of influenza infection during an annual epidemic; had those workers remained absent from

work during their entire period of infectiousness, there could have been drastic consequences on system capacity (Salgado et al., 2002).

Another component of absenteeism is the workplace mandated exclusion from work for HCWs known to have significant exposure to an infectious disease in order to prevent them from infecting other staff and patients should they develop the disease. HCWs who may have significant exposures are those who cared for the patient prior to identification of the need for enhanced personal protective equipment (PPE) or who have significant breaches of their PPE. Removing currently healthy workers could rapidly diminish the number of available HCWs able to report to work and the duration of exclusion is typically the known incubation period of the disease—anywhere from 7-21 days. However, if appropriate PPE is worn during patient care, many employers have decided that employees will be allowed to continue to work as scheduled.

Stuff

The "stuff" component of the 4 S's refers to the items traditionally associated with surge capacity. This includes the number of physical beds in the facility, the number of ventilators, and other requisite durable medical equipment. It also encompasses disposable supplies including personal protective equipment including gowns, gloves, masks, and face shields. Other supplies of note that may be needed during influenza pandemics include oxygen, airway suction equipment, intravenous fluids, and medications including antibiotics, vaccines, and antivirals.

Structure

The structure of the facility includes the physical spaces to accommodate patients and staff. The structure can be repurposed during surges as needed. For example, post-anesthesia care units (PACUs) can be utilized to care for medical patients. In the case of transmissible diseases, the structure of the facility can come into play with regard to infection prevention. The number of isolation rooms or negative pressure rooms may be limited. The ability to provide patients with private rooms or cohorting

of patients with the same infection in non-private rooms may be implemented. Some hospitals have developed surge plans for Influenza Specialty Care Units (ISCUS), which would allow cohorting of those with influenza in ward-like environments while limiting the risk of nosocomial transmission to non-influenza infected patients.

Systems

Epidemics of infectious disease are different than the other types of events that might result in hospitals implementing surge measures. Other events (weather-related, terrorism, etc.) occur rapidly, but epidemics evolve slowly (Roccaforte & Cushman, 2007). For example, during the SARS outbreak, "the worldwide surge in patients peaked at 56 days following initial case reports. The delay in the surge of casualties allows administrators to implement plans, adjust resources, and request and obtain outside assistance" (Roccaforte & Cushman, 2007, p. 167). However, even for slowly evolving events, the systems must be in place for this to happen. Broadly speaking, the systems component of surge capacity includes: command, control communications, coordination, continuity of operations, and community infrastructure (Watson et al., 2013).

The role of the systems component is highlighted in its ability to coordinate, plan, and secure the other components of surge capacity; supporting the importance of systems preparedness are the findings by Fisher et al., (2011) where a high incidence of "hospitals with no available ICU beds were managing severe patients in emergency rooms or general wards while in nearby hospitals ICU beds were available" (p. 878). The importance of having adequate systems in place cannot be stressed enough; one report states "Experts in the field have indicated that systems are particularly important to effectively utilize stockpiled medical countermeasures such as mechanical ventilators" (King et al., 2014, p. 141).

Surges during pandemics

The increase in patients seen during a surge event should be anticipated to include more than those who are actually infected with influenza. The phenomenon of worried well, which has been

documented in many disasters, has also been seen in pandemic situations. During the spring of the 2009 H1N1 pandemic, there was an overall 32% increase in emergency department visits in New York City with "more than a 50% surge in patient volume ... seen in many adult EDs, and many pediatric EDs reported more than twice the volume of visits" (Santos et al., 2010, p. 47). Another recent example of increased numbers of patients seeking care during an epidemic is that after "widespread media coverage" on the MERS-CoV outbreak in Qatar there was "a 46% increase in patients visiting the ED at Hamad General Hospital with flu-like symptoms" (Varughese et al., 2015, p. 1).

Summary

This chapter has provided an overview of the literature to support the proposed study. It has investigated what a pandemic influenza is, the historical context of the role of nurses in prior disasters and disease outbreaks including the concept of duty to care; it details several recent pandemics (of influenza and other infectious diseases) and their impacts on HCWs and the general population, surge capacity of healthcare facilities in the U.S., and provided further detail on the theoretical models underpinning the study.

This literature review identified several gaps in the literature, specifically, the intentions or willingness of CCNs to report to work during an influenza pandemic have not been examined. The literature demonstrates the increased demand that HCWs are likely to face and the illness burden on HCWs due to public and nosocomial exposure. Understanding CCN intentions and influencing factors will facilitate the development of actionable plans and enhance preparedness efforts.

CHAPTER THREE: METHODOLOGY

This chapter provides an overview of the study design, sample, setting, and procedures that were used in the study. Variables of interest, including those identified in the review of the literature as

having relationships with intentions to report to work in other populations and the Johns Hopkins Public Health Infrastructure Response Survey Tool (JH~PHIRST), the data collection instrument, are provided and reviewed. The protection of human subjects is discussed and the pilot study that was conducted to examine instrument accessibility and feasibility is reviewed. Lastly, the data analyses and sample size are discussed.

Design

This study employed a quantitative, cross-sectional survey methodology. Researchers utilize cross-sectional studies to collect information over a relatively short time-span and to examine associations among variables (Hulley, Cummings, Browner, Grady, & Newman, 2007). Quantitative surveys are also appropriate to provide a description of sample subject attitudes (Creswell, 2009). Specifically, survey methods provide "statistical estimates of the characteristics of a target population...by describing the sample of people who actually respond, one can describe the target population" (Fowler, 2008, p. 11). Both of these design methodologies match the goals of this study, to gather a "snapshot" of whether or not CCNs intend to report to work during a pandemic flu. Collecting this information over a short period of time minimized the risk of introducing historical bias. Additionally, the aims of this study were to describe the personal, professional, and organizational characteristics that impact CCN intentions of reporting to work.

This study utilized both the Extended Parallel Process Model (EPPM) and the Theory of Planned Behavior (TPB). The EPPM is the conceptual framework that underpins the Johns Hopkins Public Health Infrastructure Response Survey Tool designed to assess the intentions of healthcare providers to report to work during a hypothetical pandemic influenza scenario. The TPB was also used to guide the study design and modify the instrument. TPB posits that "intention" can serve as a proxy for a behavior when the researcher is not able to measure the behavior directly, or when the behavior in question might occur at a future time. Given that we cannot predict when the next influenza pandemic will occur, this

study sought to measure CCN intentions to report to work. Doing so enhanced the utility of the study as it is important to identify CCN intentions of reporting to work prior to an actual event so that, if indicated, measures can be taken to modify intentions and plans can be adapted accordingly. The unpredictable nature of disasters makes them notoriously difficult to research. The grounding of the study design and instrument in the theoretical framework provided the researcher with a mechanism to support the use of intentions, which can be measured through self-report, as a proxy for behavior. Additionally, the use of the two theories allows results of this study to be placed in a broader context and provides an avenue for interpretation of the results.

Coming from a postpositivist philosophical background rooted in pragmatism, the design for this study employed the research methodologies identified to best answer the research questions. The goal in a pragmatic approach is to find solutions to problems rather than to focus on antecedent conditions (Creswell, 2009). With regards to this study, a pragmatic viewpoint accepts that researchers and healthcare workers may not be able to stop or control an outbreak of influenza, therefore research efforts should be focused on conditions within our control.

Sample

Population

The target population for this study was critical care nurses (CCNs), specifically nurses who self-identified as having experience in "settings where patients require complex assessment, high-intensity therapies and interventions and continuous nursing vigilance" (American Association of Critical-Care Nurses, 2015a, para. 5). In order to obtain a nationally representative sample, the target population was accessed through their professional organization, the American Association of Critical-Care Nurses (AACN). AACN (2015) states that they support more than half a million critical care nurses in the United States. These nurses work in intensive care units (ICUs), step-down or transitional care units, post-operative recovery units, and emergency departments. It is estimated that CCNs account for 37% of the

total number of nurses working in hospitals (AACN, 2015). This sub-population of nurses was chosen because if a pandemic flu were to occur it is likely that most hospitalized patients would require critical care including ventilator support. Furthermore, the current nursing shortage is most pronounced in critical care and the unavailability of CCNs is a factor limiting services at many facilities.

Participants

The sample for this study was drawn from the members of the American Association of Critical Care Nurses (AACN). According to their website, as a professional organization:

> AACN is the largest specialty nursing organization in the world, representing the interests of more than 500,000 nurses who are charged with the responsibility of caring for acutely and critically ill patients. The association is dedicated to providing our members with the knowledge and resources necessary to provide optimal care to critically ill patients (American Association of Critical-Care Nurses, 2015a).

In this study the unit of analysis was the individual CCN as defined above. The study design recognized that not all of these CCNs currently work in intensive care units but identified themselves as having the requisite knowledge and skills to care for critically ill patients if needed. Exclusion from the study included: individuals who did not self-identify as matching the skills/knowledge definition provided above and those who did not identify as Registered Nurses (RNs). Additionally, those who did not indicate that they gave consent for participation were automatically exited from the survey but were still able to elect participation in the raffle.

Setting

Study recruitment began in March of 2017 and data collection ended on August 31st, 2017. The survey began at the end of the 2016-2017 flu season, an annual epidemic in the U.S. The CDC described that season as “moderate” with cases peaking in mid-February nationally (Centers for Disease Control & Prevention, 2018b). While severe, the 2017-2018 flu season did not begin to demonstrate activity until November, several months after data collection ended (Centers for Disease Control & Prevention, 2018c). Therefore, it is unlikely that exposure to a flu-related event would impact the responses of

participants who took the survey at the end of the data collection period as opposed to those who completed it at the beginning of the time period (historical bias).

Participants were recruited through the mail, in person at the AACN annual National Teaching Institute in Houston, Texas in May, and electronically via AACN chapter leadership. Participants gained access to the survey through the AACN member webpage and were able to complete it at a time and place of their choosing via any electronic device connected to the internet.

Data Collection Procedures

The electronic, web-based survey was hosted by Qualtrics©. Qualtrics© is a privately owned and operated web-based survey company founded in 2002 and is commonly used in academic settings and in research (Chapman, 2012). As demonstrated in the pilot, the survey was easy to complete on a variety of devices and did not place an onerous time burden on participants. The survey instrument can be found in Appendix A.

Participant Recruitment

Access to the target population was initially obtained through the AACN member mailing list. AACN does not allow researchers to access the e-mail addresses of their members, but it does allow access to home addresses; therefore, a mixed-mode survey design was utilized (Messer, Edwards, & Dillman, 2012). Recent research on the use of "Web + mail" survey methodologies has shown that this method can achieve as demographically representative sample as a mail-only survey (Messer & Dillman, 2010). An additional support of this methodology is that it maximizes response while producing higher quality data, as web-based surveys tend to have lower item nonresponse rates (Messer, & Edwards, 2012).

AACN generated a random sample of 3,600 members who had complete mailing addresses on file that was representative of all 50 states. Additional characteristics requested in the sample were that

the members indicate they were “currently practicing” and in one of the following roles at an acute care hospital (including non-profit, for profit, and government facilities):

- Bedside/Staff Nurse
- Charge Nurse
- Clinical Nurse Specialist
- Manager

Based on AACN list rental requirements, the list of 3,600 AACN members was sent to New England Professional Systems (NEPS), a full-service mailing house for management (New England Professional Systems, n.d.). NEPS assumed responsibility for the list through an agreement with AACN. No members of the research team had access to the list; at the end of the recruitment phase the mailing list was destroyed by NEPS in accordance with their agreement with AACN.

To incentivize participation, survey respondents had the option to enter a raffle. Two Kindle Fire tablets were raffled off as were five $10.00 gift cards to Starbucks. Participation in the raffle was optional and as the survey was constructed to be completed anonymously respondents who wanted to participate were directed to an unlinked survey to enter their names and email addresses. Once data collection ended, raffle winners were selected through a random number generator and contacted via email.

The recruitment plan originally called for a modified Dillman (2009) approach to be utilized for implementation of the survey. By generating online responses, the research design saves time and money as the information is directly entered into a format that makes it accessible for statistical analysis. Additionally, recent research has shown that web-based survey formats have lower levels of item non-response than paper formats thus decreasing missing data (Messer, Edwards, & Dillman, 2012). Given the required sample size to appropriately power the study and with the historical knowledge of response rates of nurses to surveys it was determined that NEPS would target the initial round of mailings to 1,200 of the AACN members on the list. Participants received two mailings:

1. Day 0 (March 17th, 2017): Survey opens in Qualtrics; mailing 1- welcome letter plus link to electronic version of the survey (Appendix B)
2. Survey open+ 1 week (March 24th, 2017): mailing 2- reminder postcard that contains link to electronic version of the survey (Appendix C)

By the end of April, 105 responses had been recorded with a response rate of 8.75%, which was below what was expected. After consultation with the dissertation committee chair and a cost benefit analysis of further recruitment by mail, it was decided to expand the recruitment methods to include other methods. Institutional Review Board approval was obtained for these changes.

Face-to-face recruitment of potential participants took place at AACN's National Teaching Institute, the organization's annual conference. The researcher attended the conference in Houston, Texas on May 22nd and 23rd, 2017. Participants were recruited between sessions and at networking events. The researcher briefly explained the study and provided interested individuals with the same recruitment postcard that had been mailed. People were also encouraged to share the recruitment postcard with their colleagues when they returned home. Over 250 postcards were distributed at the event.

AACN has local chapters across the country; chapter presidents (or their designees) were identified through the AACN member's website. Emails were sent to all chapter presidents asking them to share information about the study with their specific members (Appendix D). Additionally, AACN agreed to host a link to the survey, along with a brief description of the study, on their research webpage where it would be accessible to members. It was posted from early June through the end of data collection. Because of the multi-modal recruitment strategies implemented it is not possible to calculate a final response rate.

Data Management

Qualtrics© software was used to design the survey. The survey site uses TLS encryption for data protection and is capable of downloading raw data in to SPSS© (Qualtrics, 2012). The computers used for analysis of the data are password protected with network firewalls, and an external hard drive that is kept in a locked drawer houses a back-up copy of the data. Only members of the research team and the dissertation committee have access to the data files. No data or other information were collected on paper. The researcher and all committee members are CITI-trained and the researcher has taken care to prevent the loss or misuse of any of the data.

Protection of Human Subjects

There are several ethical concerns that were considered during the design of this study. The concerns addressed include informed consent, participant privacy and confidentiality, and burdens on the participants.

Consent

A statement of consent was included as the first page of the online survey tool. Participants electronically agreed to the statement of consent; those who did not were automatically redirected to the end of the survey. In order to keep their identities anonymous, participants were not required to provide a signed statement of consent and no other identifying information was obtained in the survey.

Participant Privacy and Confidentiality

All data were de-identified during collection using the processes outlined above. No names of participants or healthcare facilities were collected.

Burden(s) on Participants

It was unlikely that participants experienced any emotional distress related to the survey questions and the topic. Contact information for the investigator and the Boston College Institutional Review Board (IRB) was provided and participants were encouraged to reach out with any related questions or concerns or if they experienced any distress. Two participants reached out to the

investigator with questions about whether or not they met the inclusion criteria; both were informed that they did. The mother of one AACN member who received the mailings contacted the BC IRB to inform them that her daughter was in the military and was currently deployed. The BC IRB staff clarified that participation was voluntary.

The primary burden to the participants was the time-demand for survey completion. Qualtrics estimated that the survey would be completed in less than 20 minutes, and the participants in the pilot survey supported this timeline. During the study, participants were able to minimize this burden by choosing when and where to complete the survey. They were informed of the estimated time for survey completion in the recruitment materials. Individuals were not compensated for their time. Unknown or unanticipated risks to participants may have arisen, all participants were provided with the researchers contact information and the contact information for the Boston College Institutional Review Board (IRB) should they have concerns.

Institutional Review Board

Approval was obtained from the Boston College IRB for the conduct of this study. Given the nature of the study it was unlikely that any harm would come to the participants, but all essential steps were undertaken to protect them and their confidentiality. AACN did not require a separate IRB approval process; they approved the list rental and further recruitment support after receiving confirmation of Boston College's IRB approval (Protocol # 17.153.01e; Exempt 45 CFR 46. 101(b)).

Pilot Study

Prior to conducting the full-scale study, a pilot study was completed in January 2017 to assess feasibility and acceptability with a sample (N=17) of CCNs recruited by the researcher through personal connections. The specific aims of the pilot study were to (1) determine how long it took to complete the survey, (2) test readability and formatting of the survey on various electronic devices (PCs, Apple

computers, Android phones, and iPhones), and (3) obtain feedback on readability and acceptability of the instrument items and demographic items in the survey.

All participants in the pilot study received a URL link directly from the researcher. Due to the recruitment methodology and personal relationship with the researcher, all data collected during the pilot study were excluded from the analysis and findings of the full study. Pilot study participants were asked to complete the survey on a variety of electronic instruments, time how long it took them to complete the survey, and report this information back to the researcher. Additionally, they were asked to provide any feedback on specific items from readability, clarity, or acceptability.

Participants reported that it took them between 9 and 17 minutes to complete the entire survey with most participants completing it under 11 minutes. Pilot participants completed the electronic survey on a variety of electronic devices including iPhones, Android phones, personal computers (PCs), and Mac computers. No issues were reported with formatting, survey logic, or access on different devices. Participants were able to skip any questions except those related to consent and attestation of meeting inclusion criteria.

Participants also provided feedback on individual items. Several demographic items were identified and adapted accordingly. Comments highlighted that the item assessing Gender (which was the desired variable, not biologic sex) was binary, and as such could be exclusionary. This was addressed in the final version of the instrument by utilizing more inclusive gender options (*Collecting Sexual Orientation and Gender Identity Data in Electronic Health Records*, 2013). Additionally, it was noted in the pilot that collecting the zip codes of employers along with other organizational characteristics could be sufficient to identify the employer and even potentially employees. As such, only the first three digits of participant zip codes were obtained for both their primary employer and their home address.

Sample Size

Power Analysis

Power analysis calculations were conducted to determine the number of participants required to meet a two-tailed significance level of 0.05 with a moderate effect size (0.25) with a minimum of 85% power for a varying number of predictor variables and variance inflation factors using Piface version 1.76 (Lenth, 2011). Based on these estimated sample sizes it was determined that 220 participants needed to be recruited.

Sample size. Healthcare workers, in general, have a history of low response rates to survey research (Morton & Levy, 2011). Nurses typically have poor survey response rates, with current literature suggesting that a response rate of less than 60% is now common (VanGeest & Johnson, 2011). Previous response rates using this tool ranged from 18.4% to 83% (Balicer et al., 2010; Barnett et al., 2009). As a result of the variations in response rates this study used a conservative estimate of an anticipated response rate, 20%, given that participants were to be contacted through the mail (Damery et al., 2009). The anticipated response rate and the sample size target (N=220) were used to determine the number of AACN members to mail recruitment materials to. The formula $N^1 = \frac{N}{1-q}$ where N^1 is the number of participants to target for recruitment, N is the number of required participants to appropriately power the analysis, and q is the proportion of targeted participants expected to refuse to participate was utilized (Suresh & Chandrashekara, 2012). Using the estimated response rate and number of participants required to power the study in the equation, $N^1 = \frac{220}{1-.8}$ = 1,100. Thus, it was determined that 1,100 AACN members should be contacted for recruitment in order to successfully recruit 220 participants. The first round of mailings targeted 1,200 AACN members to create a buffer.

Unfortunately, the initial response rate (8.75%) to the mailings was well below the goal (20%), so alternative recruitment methods were employed in order to adequately power the study. These included in-person recruitment by the researcher at the AACN NTI, electronic recruitment through AACN

social media sites and member webpage, and emails to AACN chapter presidents. Between all of these recruitment methods, 274 participants accessed the electronic survey instrument with 245 participants meeting the inclusion criteria, consenting to participation, and completing the instrument.

Additionally, logistic regression analysis typically requires 10-20 "events," in this case individual participants per predictor variable (Stoltzfus, 2011). As detailed below, no more than seven potential predictor variables were included in the model-building component (based on significance and accounting for multicollinearity) for any one model. That means that there were 35 participants per potential predictor, which is well above the tolerable limit for logistic regression.

Instrument

The Johns Hopkins- Public Health Infrastructure Response Survey Tool (JH~PHIRST) was adapted for use in this study and demographic information on participants (personal and professional), as well as their primary employer, were collected. The data collection instrument for this study was adapted from the Johns Hopkins-Public Health Infrastructure Response Survey Tool, specifically the version utilized by Errett et al. (2013) and was used with permission from one of the primary authors, Dr. Daniel Barnett. The assessment tool was utilized by Errett et al. (2013) to investigate Medical Reserve Corps (MRC) volunteers' willingness to respond to four hypothetical scenarios. The four scenarios were: a weather-related disaster, a pandemic influenza emergency, a radiologic ("dirty bomb") emergency, and an inhalation anthrax bioterrorism emergency (Errett et al., 2013). As outlined in Chapter 2, the pandemic influenza emergency scenario poses unique challenges to our healthcare system and to the CCNs who will care for these patients. Therefore, the current study only utilized this single scenario.

Reliability and Validity of JH~PHIRST

This JH~PHIRST instrument has been designed to "examine the effects of perceived threat and efficacy" on "willingness to respond" utilizing the Extended Parallel Process Model (EPPM) (Errett et al., 2013, p. 30). The definitions of each of these are presented in Appendix E, Table 1A. It has been

validated in studies used to assess willingness to respond in varied populations including HCWs, emergency responders, and public health workers (Balicer et al., 2010, 2006; Barnett et al., 2009; Errett et al., 2013; McCabe et al., 2010). In a review of the literature, Devnani (2012) examined 32 studies that investigated the willingness of healthcare personnel to work during an influenza public health emergency. Only two of the 32 published reports included evidence of reliability. The lack of published reliability statistics is a known limitation of this study. In this study, a Cronbach's alpha was calculated for the modified instrument and was 0.831. This demonstrates high reliability, but as no other studies using this tool have published the metric, comparisons cannot be made. Prior studies have established content validity through repeated use of the instrument among HCWs.

Likert-scale in JH~PHIRST. Previous studies utilizing the JH~PHIRST have used a variety of Likert scales to capture responses. These have included a 5-point scale (Balicer et al., 2006), a 9-point scale plus a "don't know" option (Balicer et al., 2010; Errett et al., 2013), and a 10-point scale plus a "don't know" option (Barnett et al., 2009). The studies with the 5- and 9-point scales included a neutral midpoint in addition to the "don't know" option, and the studies that utilized the "don't know" option imputed the mean score on any item for which a participant selected "don't know." Given the wide variation in scales used, the decision was made to use a 7-point Likert scale, with a neutral midpoint, and eliminate the "don't know" option. The decision to use a 7-point scale was made based on the variance in the studies utilizing the JH~PHIRST and by returning to the conceptual framework on which the study is based. Azjen (2019) reports: "Most investigators working with the TPB [Theory of Planned Behavior] use 7-point bipolar adjective scales ... The format of these scales is based on work with the semantic differential which found 7 points to be optimal" (para. 19). The items in the instrument measure beliefs and attitudes with regards to the items, as such, the inclusion of a neutral midpoint already allows participants to indicate neutrality towards a statement.

Known problems with acquiescence response bias in Agree-Disagree items like those used in this study include a bias towards agreement. Individuals who acquiesce end up in the middle of the scale, but this is not reflective of their actual beliefs (Holbrook, 2019; Krosnick & Presser, 2010). Acquiescence has been linked to lower educational levels, but that should not be a factor in this homogenous group. Additionally, with the differentiation of a 7-point Likert scale utilized in this study, the acquiescence could be attributed to societal and ethical pressure given the nature of the profession. Krosnick and Presser (2010), report drift particularly related to the midpoint, and bias away from neutral. Furthermore, for the pragmatic aims of this study—to create recommendations for policy and pandemic preparedness planning—having a conservative estimate of intentions of reporting to work will create more robust plans. Therefore, for the outcome variables, intentions of reporting to work were dichotomized with 1= Strongly agree and 2= Agree as those individuals intending to report and 3= Somewhat agree, 4= Neither agree nor disagree, and the remaining options being categorized as not intending to report. As the current study utilized a 7-point Likert scale, with a neutral mid-point, and eliminated the "don't know" option, an adjustment was made for the dichotomization: positive responses (≤2) and negative responses (≥ 3)**.** The Theory of Planned Behavior views attitudes as evaluations of the consequences (both positive and negative) of performing the target behavior—in this case reporting to work during a pandemic flu (Ajzen, 2002; Fishbein & Ajzen, 2010).

Adaptation of the JH~PHIRST. Prior to piloting the instrument, the items were reviewed by a panel of three experts for content validity. The instrument was reviewed by two expert critical care nurses, and one expert in emergency medicine and emergency preparedness. Some of the items in this instrument were slightly modified to address the unique role of CCNs. Many of the changes were minor such as changing verbiage from "MRC" to "CCN" and from "volunteer site" to "employer." Other changes were more extensive; for example, in the original instrument one item read: "In terms of my skills, I am prepared to perform my MRC role-specific responsibilities in the event of a pandemic flu

emergency." And this was altered to target skills of CCNs that will be needed during a pandemic flu emergency and the items became "I have the knowledge and skills necessary to care for a critically ill, ventilated patient" and "I understand droplet and airborne isolation precautions."

Additionally, items were added to gain a deeper understanding of factors that may influence CCN intentions and these came from the review of the literature. The adaptation of the instrument was supported by one of its primary authors (D. Barnett, personal communication, November 13, 2014). It was recognized that current research on intentions (or willingness) of reporting to work, as well as observations of nurses and other HCW behavior during recent infectious disease outbreaks, that updates to the instrument were indicated. Given that this study only assessed one role group, CCNs, targeted adaptions were made based on factors that were noted in the literature. For example, the review of the literature had identified that nurses have an ethical obligation to care, but the influence of this ethical obligation and its external influences were not previously captured. Items added to capture this included:

- If I do not report to work for my regularly scheduled shifts during a pandemic flu emergency then patient care would be negatively impacted.
- If I do not report to work during a pandemic flu emergency I could lose my job.
- If I do not report to work during a pandemic flu emergency I could lose my nursing license.
- I have an ethical obligation to my patients to report to work during a pandemic flu emergency.
- I have an obligation to my coworkers to report to work during a pandemic flu emergency.

Several items were added based on what was noted during the 2009 H1N1 epidemic in Australia and New Zealand:

- A pandemic flu emergency is likely to result in increased volume of patients requiring critical care.
- A pandemic flu emergency is likely to result in an increased number of patients requiring complex care like advanced respiratory therapies and extracorporeal membrane oxygenation (ECMO).
- A pandemic flu emergency is likely to overwhelm existing healthcare resources and require a change in practice from normal operation conditions.

And lastly, several items were added to bring balance to the subscales. It was noted that far more of the items on the original instrument were associated with the perceived response efficacy (4) and perceived self-efficacy (6) subscales than with the perceived severity (1) and perceived susceptibility (2) subscales:

- If it occurs where I live/work, a pandemic flu emergency is likely to impact my health or the health of my family &/or friends.
- As a critical care nurse, I would be at increased risk of contracting influenza than a member of the general public.
- Due to my work as a critical care nurse, my family &/or friends would be at an increased risk of contracting influenza than a member of the general public.
- A pandemic flu emergency is likely to result in a shortage of healthcare workers capable of providing patient care.
- A pandemic flu emergency is likely to occur in the near future.

All revised and newly added instrument items were reviewed by the panel of experts for content validity and were included in the pilot study. Additionally, after data collection was complete all items were reviewed using the "Cronbach's Alpha if item is deleted" statistical test. This analysis is used to determine if the removal of any given item would improve the overall reliability of the instrument. Two items (Q4_16 and Q4_17) were flagged, as their removal from the instrument would increase the overall Cronbach's alpha. These items were reviewed and both related to perceived susceptibility to influenza (of self and family/friends). It was determined that these items were important to that subscale and the improvement in the overall Cronbach's alpha with their exclusion (to 0.833 and 0.832 respectively) was negligible, so they were not removed.

Table 1.
Cronbach's Alpha of Instrument and Subscales

Variable	Number of items	Mean (Standard Deviation)	Cronbach's Alpha	*N*
Independent Variable				
JH~PHIRST	30	65.67 (13.25)	.831	219
Perceived Self-efficacy	8	22.03 (7.24)	.837	232
Perceived Severity	6	8.99 (2.78)	.660	241
Perceived Response Efficacy	11	20.28 (5.06)	.635	239
Perceived Susceptibility	5	12.73 (3.76)	.619	237

Demographic Characteristics

In addition to requesting that participants complete the instrument, personal, professional and employer (organizational) characteristics were obtained. These variables were collected based on their potential impact on the outcome(s) of interest and supported by the review of the literature presented in Chapter Two. Personal characteristics included: gender (categorical), age (continuous), race/ethnicity (categorical), being a caregiver for child(ren) under 18 years (dichotomous), being a caregiver for an adult family member (dichotomous), having a spouse/partner (dichotomous), spouse/partner having a response role (dichotomous), and annual household income (categorical). Professional characteristics included: years as an RN (continuous), years in critical care (continuous), number of hours worked per week (continuous), highest nursing degree obtained (categorical), highest non-nursing degree obtained (categorical), and having more than one employer (dichotomous). Organizational characteristics obtained were: required annual influenza vaccination (dichotomous), provision of annual PPE training (dichotomous), academic medical center (dichotomous), designated trauma center (dichotomous), Magnet® designations (dichotomous), nurses belonging to a collective bargaining unit (dichotomous), and average number of patients cared for at one time (continuous). These variables are further detailed in Table 1A, and the full survey, as seen by participants, is located in Appendix A.

Data Analysis

As detailed above, participants completed the survey electronically using Qualtrics. The data were downloaded from Qualtrics directly into Statistical Package for Social Sciences® (SPSS), a software platform with advanced statistical analysis and machine-learning algorithms (IBM Corp., 2017). SPSS® version 25 was used for all analyses unless otherwise indicated.

Missing Data

Analysis began with an examination of missing data. The electronic survey instrument was accessed by 274 respondents. One individual selected “I do not wish to participate” on the consent page

and was directed to the "thank you" page at the end of the survey with the option to enter the raffle. An additional 13 respondents selected "No, I am not a critical care nurse" and thus did not meet the inclusion criteria. They were also exited from the survey. When data analysis began, these 14 respondents were removed from the sample. Fifteen other respondents started the electronic survey, but did not answer any questions beyond indicating their consent to participate and their CCN status; these 15 respondents were also excluded from the final sample. Thus 245 participants remained in the sample.

Among the 245 participants, the extent of missing data was assessed. All participants completed every item in the modified JH~PHIRST. When completing the personal, professional, and organizational demographics some missing data were noted. However, there was no systemic missing data so all participants were included in the analysis.

Assessment of Data

Descriptive statistics including frequencies, range of scores, means, and standard deviations were calculated for all major variables. Instrument reliability estimates were calculated and reported for the overall JH~PHIRST as well as the four individual subscales (perceived self-efficacy, perceived response efficacy, perceived susceptibility and perceived severity.

Descriptive Characteristics

Personal, professional, and organizational descriptive characteristics were summarized and are presented in a table in the results section (Chapter Four). Identification and selection for inclusion of these characteristics (and potential confounding variables) were based on the results of previous studies and identified gaps based on the literature and content expert review. Comparisons of personal and professional characteristics were made to the known AACN population characteristics using a Chi-Square Goodness of Fit analysis of what was observed in the sample compared to what is expected

based on known AACN values. This analysis was conducted using a web-based calculator by Lowry (2009).

Testing the Research Hypotheses

Research Question 1. What percent of respondents intend to report to work during a pandemic flu emergency? Research Question 1a. What percent of respondents intend to report to work during a pandemic flu emergency, regardless of severity? Research Question 1b. What percent of respondents intend to work beyond their regularly scheduled shifts if asked? This descriptive research question, and its sub-questions, were addressed with descriptive analysis. Frequencies, proportions, means, and standard deviations are reported where appropriate and used to support qualitative comparisons between groups. In Chapter Four, there is a qualitative discussion highlighting the differences between CCNs who intend to report to work and those who do not intend to report to work.

Additionally, each recorded personal, professional, and organizational characteristic was assessed to determine if it had a significant impact on the outcome variables. This was done using Pearson's Chi-squared test for independence. This non-parametric test is used to analyze difference between groups when the dependent variable is measured at a nominal level and it does not require equality of variances between the groups or homoscedasticity in the data (Mchugh, 2013). To calculate the Pearson's Chi-square statistic the following equation is used: $\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$ In this equation, O stands for the **o**bserved frequency and E stands for the **e**xpected frequency and the *i* means that this is calculated for every cell. The resultant Chi-square statistic and the degrees of freedom are used to calculate the p-value, which is interpreted at the previously established limit.

While the Pearson's chi-square test for independence is robust to most assumptions, two key concerns come in to play. First, there is an expected cell count of >5 in at least 80% of the cells in a single equation. In this study, this meant that several categorical variables needed to be collapsed into fewer categories: (1) participant reported race/ethnicity were collapsed into two categories, white and

non-white; (2) highest non-nursing degree obtained was collapsed into two categories, having a non-nursing degree and not having a degree outside of nursing; and (3) highest nursing degree obtained was collapsed into two categories, having a graduate degree in nursing and not having a graduate degree in nursing. The second concern is that chi-square is only a measure of significance, not a measure of the strength of the association (Mchugh, 2013). Other statistical analyses can be used to calculate the strength of the association and in this study, this was done with logistic regression. A test such as the Cramer's V could have been calculated for each significant variable; however, utilizing logistic regression allowed for the calculation of the strength of a variables, relationship while controlling for the contribution of the other variables. The details on logistic regression are presented under Research Question 3.

For continuous and categorical variables that could be dummied, correlation analysis was used to investigate the presence or absence of a significant relationship between the potential predictors (personal, professional, and organizational characteristics) and the outcome(s) of interest. A Pearson's product moment correlation coefficient (*r*) was calculated and the strength of that relationship was estimated (*p*). These are presented in Chapter Four as well.

Research Question 2. What are the unique and combined effects of perceived threat and perceived efficacy on critical care nurses' self-reported intention to report to work during a pandemic influenza? H2a. It was hypothesized that as perceived threat increases, CCNs' self-reported intention to report to work during a pandemic influenza will decrease. H2b. It was hypothesized that as perceived efficacy increases, CCNs' self-reported intention to report to work during a pandemic influenza will increase.

Instrument scoring. The instrument items were scored to calculate the four subscale scores, perceived self-efficacy, perceived response efficacy, perceived susceptibility, and perceived severity and then to determine the threat and efficacy profiles to which participants belonged. The items that

correspond with each of these scales were detailed in Appendix E, Table 1A. Based on the EPPM model, the subscales were used to classify participants into one of four categories: high threat/low efficacy, high threat/high efficacy, low threat/low efficacy, or low threat/high efficacy.

The details of the various scales used in the JH~PHIRST were described above, for the purposes of this study a 7-point Likert scale (1= Strongly Agree; 4= Neutral; 7= Strongly Disagree) was used to capture the variance in responses. Scoring of the instrument was done in accordance with the method used by Errett and colleagues (2013). Several items were reverse coded and this was addressed at the time of scoring. The sum of the positives were then tabulated to calculate the subscale scores. Each participant then had four scores: perceived self-efficacy, perceived response efficacy, perceived susceptibility, and perceived severity. The threat profile was calculated by the cross product of perceived severity and perceived susceptibility. The efficacy profile was calculated by the cross product of perceived self-efficacy and perceived response efficacy. "Low and high profiles of threat and efficacy were determined by the median values of these 2 cross-products" (Errett et al., 2013, p. 3). As the decision was made to examine the unique contribution of each of the subscales, the same method (median) was employed for determining high/low profiles within each subscale. As this is the first study to target only CCNs using this instrument it makes sense to determine the within-group differences in this way.

Research Question 3. What influence do personal, professional, and organizational characteristics have on CCNs' self-reported intention to report to work during a pandemic influenza? H3a. Competing personal demands (family/caregiver responsibilities; additional employers) will decrease the likelihood of intention to report to work. H3b. Perceived positive organization characteristics will increase the likelihood of intention to report to work. The significance of the relationships between the personal, professional, and organizational characteristics was first assessed

for whether or not they had a significant relationship with the outcome variable(s). Those that did were reviewed and their unique impact was examined through model building.

Model building. In order analyze which of the independent variables had the greatest impact on the outcome variable(s), logistic regression was utilized to identify those variables that explained the most variance. Logistic regression is useful for when researchers would like to be able to predict the presence or absence of a characteristic based on a set of predictor variables (Allison, 2013; IBM Knowledge Center, n.d.; Statistics Solution, n.d.). For this study, binary logistic regression was conducted and that does require that the dependent variable be dichotomous (intend to report to work, does not intend to report to work). Specifically, stepwise regression (Forward: LR) was utilized to assess for the unique variance accounted for by the variables that were identified as having a significant relationship with the outcome variables (Field, 2009). Forward regression was selected as the resultant model includes only the variables that explain the largest amount of the variance in the outcome (Errett et al., 2013; Stoltzfus, 2011).

Because there are two conditional outcomes (regardless of severity, and work in addition to scheduled shifts) in addition to the main outcome (intention to report to work), three separate models were built. Unlike linear regression, logistic regression does not require a linear relationship between the independent variables and the dependent variable(s). Additionally, logistic regression is resilient to many of the assumptions that must be met in linear regression such as the need for residuals to be normally distributed or homoscedasticity.

Critical factors that impact the creation of an accurate model, when using logistic regression, are careful selection of the independent variable(s) and the choice of model building strategy (Stoltzfus, 2011). Variable selection should be guided by theory, previous research, observations, or preliminary statistical analysis (Stoltzfus, 2011). In this study, theory and previous research guided the instrument development and what personal, professional, and organizational characteristics were collected. Then

preliminary data analysis was done using the Pearson's Chi-Square test for independence and Pearson's product-moment correlation coefficient. Based on this the decision was made to include those variables that had significant relationships with any of the three outcome variables in the model-building component to explore the unique variance, if any, contributed. The four JH~PHIRST subscales (perceived self-efficacy, perceived response efficacy, perceived severity, and perceived susceptibility) were included in all three models due to their theoretical relationship to the outcome. The other variables included in each model are detailed in the results section based on the initial analyses.

While logistic regression is a robust tool, several assumptions must be met including: independence of errors, linearity in the logit for any continuous independent variables, and the absence of multicollinearity.

Independence of errors. This assumption looks for all sample groups outcomes to be separate from one another; that there are no duplicate responses. As this study was cross-sectional in nature, with no repeated measures or longitudinal data, there was no violation of the independence of errors (Stoltzfus, 2011).

Multicollinearity. Due to the large number of predictor variables it was important to check for multicollinearity. Multicollinearity was assessed through the calculation of tolerance and the variance inflation factor (VIF). Tolerance had to be greater than 0.20 and VIF had to be less than 2.5 (Allison, 2012; Yoo et al., 2014). VIF has a lower bound of 1 and no known upper bound. The variance is the square of the standard error and the larger the VIF the more the variance is inflated due to the relationship of the variable with other variables.

Linearity in the logit for any continuous independent variables. After accounting for multicollinearity, the only continuous independent variable remaining was years of experience in critical care. There was no evidence that this variable violated this assumption.

Predictors were considered significant and retained for inclusion if the likelihood ratio test maintains a p-value in compliance with the pre-stated level of tolerance ($p \leq 0.05$). The estimates of the regression coefficients and the standardized regression coefficients (coefficient divided by the Standard Error) provided estimates of magnitude, direction, and order of the effects.

Displaying and Discussing Data

Results of the analyses described above are presented in Chapter Four in tables and figures to highlight statistically significant findings. In Chapter Five, a discussion seeks to situate the results in the context of nursing practice, research, education, and policy.

Limitations

The study design has several limitations. The study was cross-sectional and descriptive in nature, and while relationships between variables can be presented, researchers are unable to determine a causal relationship. The recruitment strategies introduce the potential for selection bias, participants who elected to participate may have had a greater interest or personal experience with the topic than those who declined to participate. Additionally, even though the responses were collected anonymously there remains the potential for social desirability bias. That is to say that given the ethical nature of the nursing profession, the CCNs participating may have answered the questions in a way that conformed to expected norms, rather than as they truly felt. The final potential limitation, based on design, is that by limiting the survey to CCNs who belong to AACN there may be a difference between nurses who belong to this professional organization and those who do not. As a result, this bias would limit the ability to generalize the findings to all CCNs.

CHAPTER FOUR: RESULTS

This chapter will address the results of the data analysis in this cross-sectional study that investigated critical care nurse intentions of reporting to work during a pandemic flu emergency and the factors that influenced their intentions. First, an overview of the sample is provided. This includes personal and professional characteristics of the participants and organizational characteristics of their primary employer. The study sample characteristics are then compared to the overall AACN membership from which participants were recruited. Finally, the findings for each of the three research questions are presented.

Demographic Characteristics of the Sample

A total of 274 participants accessed the survey instrument electronically. One participant selected "I do not wish to participate" on the consent page and an additional 13 participants selected "No, I am not a critical care nurse" after reviewing the inclusion criteria. The survey skip logic immediately directed these individuals to the final "thank you" page of the survey. This left 260 participants who consented to participate and met the inclusion criteria; however, it was determined that 15 individuals who consented to participate and indicated that they met the inclusion criteria answered no further questions so they were removed from further analysis. The final sample consisted of 245 participants. Additional missing data were minimal, with no individual items having fewer than 220 responses. The *a priori* power analysis indicated that 220 participants would be required to meet a two-tailed significance level of 0.05 with a moderate effect size (0.25) with a minimum of 85% power for a varying number of predictor variables and variance inflation factors. Thus the sample was determined to be sufficient to power the study.

Personal characteristics

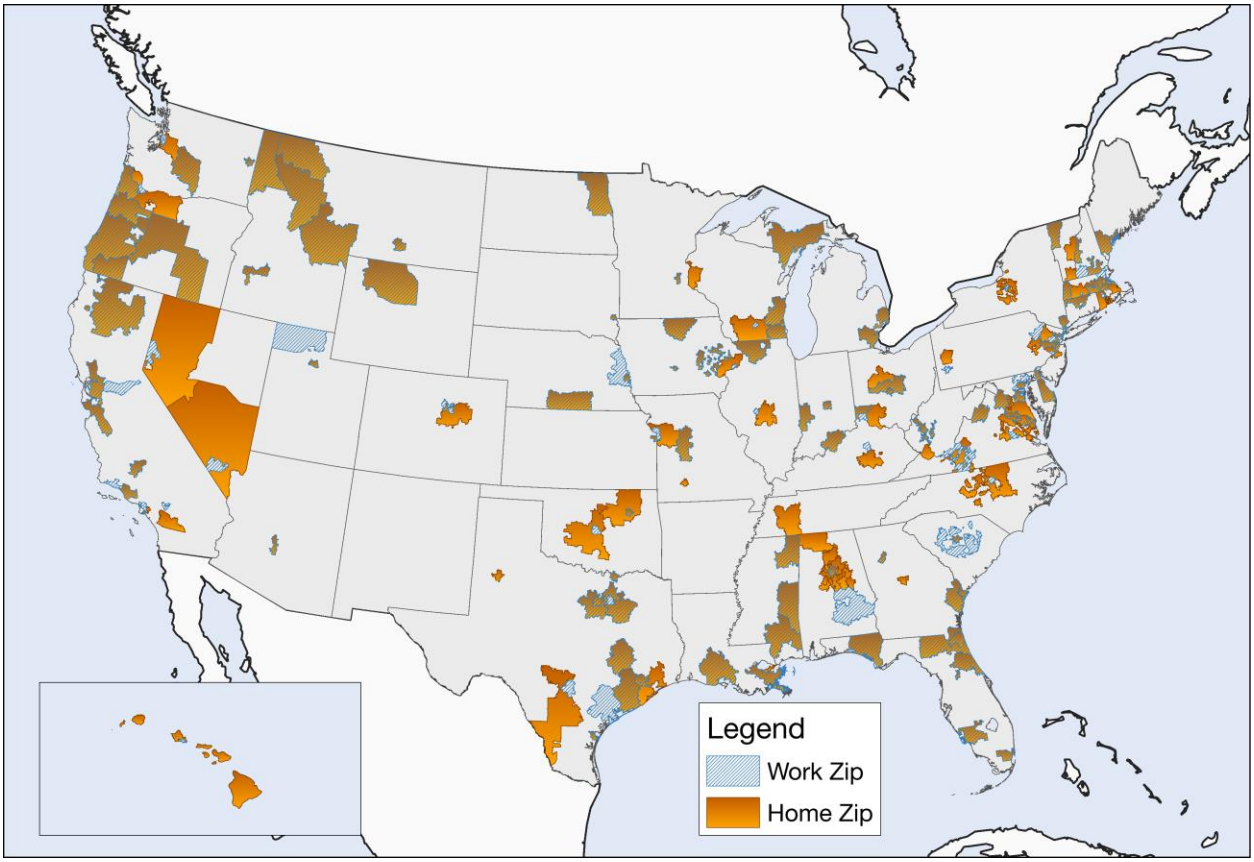
All participants were adults between 22 and 70 years old. The mean age was 41.8 years old (*SD* ± 12.2). The majority of participants were female (90.5%, *n*= 220). Only one participant identified as other

than “male” or “female” indicating that they identified as “transgender male/trans man/female-to-male (FTM).” Because gender was used for analysis and not biologic sex, this participant was grouped with those who had identified as “male” in the analysis. The participants were predominantly white (*n* = 208, 86.3%) and ten individuals (4.1%) identified as Hispanic.

Most participants indicated that they had a partner or spouse (*n* = 184, 76%), but of those only 14.2% (*n* = 26) indicated that their partner/spouse had a job that would also require them to report to work during a pandemic flu. Less than a third of participants were the parent or caregiver for a child(ren) under 18 (*n* = 72, 30%) and even fewer were the primary caregiver for an adult family member (*n*= 17, 7%). The annual household income of participants typically exceeded $50,000 (*n*= 222, 93.7%) with the most frequent response (mode) being $100,000-$150,000. DataUSA (n.d.) reports that the average CCN salary is $73,002. Participants lived in 47 states and the District of Columbia. The states without representation were Alaska, Arkansas, and Rhode Island. None of the US Territories or Protectorates including Puerto Rico or Guam were represented. All ten Health and Human Services (HHS) regions were represented; Figure 2 depicts the areas where participants both live and work. Table 2A in Appendix E presents the personal characteristics of the participants in more detail.

Figure 2.

Where participants live and work



Professional characteristics

Appendix E, Table 3A provides detailed information on the professional characteristics of participants; key findings are summarized here. Participants had an average of 15.9 (*SD*±12.0) years of experience as registered nurses with a range of 1 year to 47 years. They had an average of 12.8 (*SD*±11.3) years of experience as critical care nurses (CCNs) with a range of 6 months to 47 years. They work an average of 38.3 hours per week (*SD*±- 8.1). The majority of participants were BSN prepared (*n*= 159, 66%) and did not have a degree outside of nursing (*n*= 149, 64%). Thirty-eight (15.8%) of the respondents indicated that they had more than one nursing job, and of these the majority (*n*= 29, 76.3%) recognized that each unique employer would likely expect them to report to their facility in the event of a pandemic flu.

Organizational characteristics

Respondents reported characteristics about their employer at an organizational level. For the 15.5% of respondents who indicated that they have more than one employer they were asked to answer the questions based on what they considered to be their "primary" employer. Organizational characteristics were only captured based on participant report; there may be inaccuracies as a result.

A majority of participants indicated that their employer requires they receive an annual influenza vaccine (93.8%), and provides them with annual PPE training (86%). Approximately half of the respondents were employed in an academic health center (48%). A majority of respondents reported their employer was designated a trauma center (58%) and of those trauma centers most were level one (54.8%). A minority of respondents were covered under collective bargaining or union contracts (27%) and the majority were not employed in a Magnet designated hospital (60%). A more detailed description of the organizational characteristics is detailed in Appendix E, Table 4A.

Comparison of study respondents to AACN membership

The demographics of the study participants were compared to known demographics of the AACN's overall membership. The details provided by AACN on their members are presented in Table 2. (American Association of Critical-Care Nurses, 2015b). Chi-Square Goodness-of-Fit (GoF) tests were performed comparing the observed frequency in the sample to the expected proportion reported by AACN. The percentage of study participants that were female did not differ from the AACN membership, χ^2 (1, N = 243) = 3.78, p = 0.0519. Nor was a difference noted in age between study participants and the general AACN membership, χ^2 (4, N = 228) = 5.78, p = 0.22. It can be interpreted that the study sample is representative of the AACN membership with regards to gender and age; however, the difference approaches significance for gender, as the sample was 90.5% females while overall AACN membership is 86% female.

Table 2.
AACN Member Demographics

Average age of AACN members		**Highest nursing degree held by AACN members**	
0-29 years	17%	Diploma	3%
30-39 years	26%	Associate's	19%
40-49 years	22%	Bachelor's	58%
50-59 years	24%	Master's	19%
60+ years	11%	Doctorate	1%
Number of years in critical care		**Gender**	
Less than 2	12%	Female	86%
2-3	11%	Male	14%
4-5	10%		
6-10	19%	**Ethnicity**	
11-15	13%	White (non-Hispanic)	75%
16-20	9%	Asian	12%
21-25	9%	African American	5%
26-30	8%	Hispanic	4%
31-35	6%	Other	3%
36-40	2%	Pacific Islander	1%
41+	1%		

There is a statistically significant difference in the study respondents compared to the general AACN membership for several variables: highest nursing degree, race, and years in critical care. For highest nursing degree achieved the study participants included more BSN-prepared nurses than expected and fewer Associates Degree Nurses (ADNs) than expected, χ^2 (4, N = 245) =13.71, p = 0.008. For race there were more study participants who identified as white and fewer who identified as Asian

than expected; χ^2 (4, *N* = 245) =17.33, *p* = 0.002. There was a statistically significant difference between the study participants and the overall AACN membership with regards to years in critical care χ^2 (7, *N* = 239) =17.34, *p* = 0.015. Overall, the sample had more CCNs with fewer years of experience than the overall AACN membership. A more significant proportion of respondents reported 4-10 years of experience and a less significant proportion in the 16-30 years categories.

The Johns Hopkins ~ Public Health Infrastructure Response Survey Tool (JH~PHIRST)

The majority (89.4%) of participants (*n* = 219) completed all the items of the instrument. The Cronbach's Alpha for the 28-item adapted JH~PHIRST was 0.831. This is a high α coefficient and creates confidence that the items of the instrument are measuring the same underlying concept. A Cronbach's Alpha was calculated for each of the four subscales and was detailed in Chapter Three-- Table 1. The α coefficient for the perceived self-efficacy score also indicates a strong level of reliability at 0.837. The α coefficients for the remaining subscales also indicate reasonable reliability for perceived response efficacy (0.635), perceived severity (0.660), and perceived susceptibility (0.619).

Research Questions

What percent of respondents intend to report to work during a pandemic flu emergency? (Question 1)

To answer Research Question 1, the responses to the dependent variable item "I intend to work my regularly scheduled shifts if a pandemic flu emergency occurs" were tabulated. This item, like all items in the JH~PHIRST was measured using a 7-point Likert scale where 1= Strongly Agree, 4= Neither Agree or Disagree, and 7= Strongly Disagree. Based on the original construction and validation of the instrument, participant responses were dichotomized such that response ≤ 2 were considered positive and those ≥ 3 were considered negative. 45.7% of the CCN participants indicated that they "strongly agree" with the item and 41.2% "agree" for a combined 86.9%. As detailed in the methodology, responses were recoded such that respondents who picked these two selections were considered to

"intend to report to work" and those who did not were considered to not intend to report. Of note, no participants selected "strongly disagree" for this item.

As shown in Table 3, gender demonstrated a significant difference with whether or not a participant indicated that they intend to report to work. Analysis of variance found that females (90.5%) were significantly ($p < .001$, $\chi^2 = 12.161$) more likely to intend to report to work than males (71.1%).

Table 3.
Relationship of personal, professional, and organizational characteristics with intentions to report to work in a pandemic

Characteristic	Chi-Square	df	*p* value	*N*
Gender (Females =1; Males =0)	12.161	1	≤.001	243
Average # of patients cared for at a time	2.582	1	.108	232
Has more than 1 employer (No=0/Yes=1)	1.491	1	.474	241

When Pearson's product-moment correlation statistics were calculated for dummied and continuous variables (Table 4) the following personal characteristics had a significant association with intentions of reporting to work: Race: African American or Black ($r = .159$; $p = .013$), Race: White ($r = -.142$; $p = .026$), Annual Household Income (AHI): > $150,000 ($r = .138$; $p = .031$), and Race: Native Hawaiian or Pacific Islander ($r = .035$; $p = .035$). When interpreting these associations, it is important to remember that a lower score (1) means that the participant has a stronger intention of reporting to work. Therefore, identifying as white was associated with a stronger intention to report to work and identifying as African American/Black, or Native Hawaiian/Pacific Islander, or reporting a household income greater than $150,000 was associated with decreased intentions of reporting to work. Professional characteristics with significant correlations on overall intentions of reporting to work are: degree outside of nursing-bachelors ($r = .179$; $p = .005$), and degree outside of nursing-none ($r = -.166$; $p = .009$). This can be interpreted as those with bachelor's degrees outside of nursing are significantly less likely to agree that they intend to report to work and those without a degree outside of nursing are

significantly more likely to agree that they intend to report to work. Additionally, hours worked per week approaches significance (r = .117; p= .071) with the more hours worked per week appearing to decrease intentions to report.

Table 4.
Correlations of dummied and continuous variables for intentions of reporting to work

Characteristic	Pearson's *r*	*p* value	*N*
Race: African American or Black (Yes =1, No =0)	.159	.013	245
Race: White (Yes =1, No =0)	-.142	.026	245
Annual Household Income (AHI): >$150,000 (Yes =1, No =0)	.138	.031	245
Race: Native Hawaiian or Pacific Islander (Yes =1, No =0)	.035	.035	245
AHI: ≤ $75,000 (Yes =1, No =0)	-.103	.109	245
Partner/Spouse (Yes =1, No =0)	.098	.129	242
Race: Asian (Yes =1, No =0)	.059	.355	245
Children < 18 years (Yes =1, No =0)	.040	.535	240
Caregiver for adult family member (Yes =1, No =0)	-.037	.566	240
Partner w/response role (Yes =1, No =0)	.039	.596	183
Age (continuous)	-.035	.603	228
Race: Other (Yes =1, No =0)	-.025	.697	245
AHI: $75,001 - $100,000 (Yes =1, No =0)	-.023	.719	245
AHI: $100,001 - $150,000 (Yes =1, No =0)	-.022	.971	245
Degree Outside Nursing: Bachelors (Yes =1, No =0)	.179	.005	245
Degree Outside Nursing: None (Yes =1, No =0)	-.166	.009	245
Hours worked per week (continuous)	.117	.071	239
Years as a Registered Nurse (continuous)	-.057	.380	239
Nursing Masters Degree (Yes =1, No =0)	.050	.438	245
Degree Outside Nursing: Masters (Yes =1, No =0)	.037	.566	245
Nursing Associates Degree (Yes =1, No =0)	-.032	.616	245
Nursing Doctoral Degree (Yes =1, No =0)	-.025	.697	245
Degree Outside Nursing: Doctoral (Yes =1, No =0)	.016	.803	245
Nursing Bachelors Degree (Yes =1, No =0)	-.006	.928	245
Years in Critical Care (continuous)	.004	.950	239
Trauma Center (Yes =1, No =0)	-.068	.298	233
Magnet® Hospital (Yes =1, No =0)	.066	.314	233
Nurses in CBU/Union (Yes =1, No =0)	.320	.320	233
Required annual flu vaccine (Yes =1, No =0)	.063	.326	244
Academic Medical Center (Yes =1, No =0)	-.006	.926	231
Employer provides annual PPE training (Yes =1, No =0)	.001	.991	244

What percent of respondents intend to report to work during a pandemic flu emergency, regardless of severity? (Question 1a)

For research question 1a, the responses to the outcome variable "I would be willing to report to work in a pandemic flu emergency regardless of severity," 78% of participants "strongly agreed" or "agreed" that they intend report to work regardless of severity. When the qualifier of "regardless of severity" is added more personal, professional, and organizational characteristics show significant differences between those who are likely to report and those who are not. Age (by quartile), gender, race, years of experience as an RN (by quartile), years of experience in critical care (by quartile), holding a graduate degree in nursing, and nurses belonging to a collective bargaining union (CBU) all achieve significance.

Analysis of variance (Table 5) indicated that gender again plays a role with female participants having significantly greater intentions of reporting regardless of the severity (82.5%) than males (57.8%) ($p < .001$, $\chi^2 = 13.006$). When correlation analyses were conducted on the personal and professional characteristics of respondents compared to their intentions of reporting to work regardless of severity (Table 6), the following factors had a significant association: race: African American/Black ($r = .213$; $p \leq .001$), age ($r = -.152$; $p = .022$), degree outside of nursing-bachelors ($r = .160$; $p = .012$), nursing bachelors' degree ($r = .150$; $p = .019$), and years as a registered nurse ($r = -.138$; $p = .033$). As age and years of experience increased, CCN respondents were more likely to agree that they intend to report to work. Respondents who identified as African American/Black were less likely to agree that they intend to report, as were those with a non-nursing bachelor's degree or a bachelor's degree in nursing. Furthermore, having a master's degree in nursing neared significance ($r = -.114$; $p = .074$), suggesting a trend that those CCNs holding MSNs were more likely to intend to report to work regardless of severity than those who do not have this degree.

Table 5.
Relationship between personal, professional, and organizational characteristics with reporting to work regardless of pandemic severity

Characteristic	Chi-Square	df	*p* value	*N*
Gender (Females = 1/Males=0)	13.066	1	≤.001	243
Has more than 1 employer (No =0/ Yes =1)	3.267	1	.194	241
Average # patients cared for at a time	1.758	1	.185	232

Table 6.
Correlations of dummied and continuous variables for intentions of reporting to work regardless of severity

Characteristic	Pearson's *r*	*p* value	*N*
Race: African American or Black (Yes =1, No =0)	.213	≤.001	245
Age (continuous)	-.152	.022	228
Race: White (Yes =1, No =0)	-.106	.097	245
Race: Other (Yes =1, No =0)	.096	.133	245
Child(ren) <18 years (Yes =1, No =0)	.094	.147	240
AHI: > $150,000 (Yes =1, No =0)	.070	.273	245
Partner/Spouse (Yes =1, No =0)	-.064	.321	242
Caregiver for adult family member (Yes =1, No =0)	-.063	.332	240
Race: Asian (Yes =1, No =0)	-.058	.362	245
AHI: $100,001 - $150,000 (Yes =1, No =0)	-.047	.467	245
Race: Native Hawaiian or Pacific Islander (Yes =1, No =0)	-.026	.689	245
AHI: $75,001 - $100,000 (Yes =1, No =0)	-.020	.755	245
Partner w/emergency response role (Yes =1, No =0)	-.009	.900	183
AHI: ≤ $75,000 (Yes =1, No =0)	.004	.951	245
Degree Outside of Nursing: Bachelors (Yes =1, No =0)	.160	.012	245
Nursing Bachelors Degree (Yes =1, No =0)	.150	.019	245
Years as a Registered Nurse (continuous)	-.138	.033	239
Nursing Masters Degree (Yes =1, No =0)	-.114	.074	245
Degree Outside of Nursing: None (Yes =1, No =0)	-.109	.089	245
Years in Critical Care (continuous)	-.105	.106	239
Degree Outside of Nursing: Doctoral (Yes =1, No =0)	-.052	.414	245
Nursing Associates Degree (Yes =1, No =0)	-.050	.431	245
Nursing Doctoral Degree (Yes =1, No =0)	-.047	.467	245
Hours worked per week (continuous)	.030	.644	239
Degree Outside of Nursing: Masters (Yes =1, No =0)	-.014	.827	245
Nurses in a CBU/Union (Yes =1, No =0)	.106	.106	233
Employer provides annual PPE training (Yes =1, No =0)	.067	.298	244
Magnet® hospital (Yes =1, No =0)	.065	.325	233
Required annual flu vaccine (Yes =1, No =0)	.055	.389	244
Academic Medical Center (Yes =1, No =0)	-.011	.864	231
Trauma Center (Yes =1, No =0)	.006	.922	233

What percent of respondents intend to report to work if requested to work more than their regularly scheduled hours (longer shifts, extra shifts)? (Research Question 1.b)

For research question 1b, "If I were asked to work more than my regularly scheduled shifts (longer shifts, extra shifts) during a pandemic flu emergency, I would do so" there was a noted decrease in agreeable responses. With the condition of working extra attached to the scenario, only 62.8% of participants selected "strongly agree" or "agree" and in fact 2% of participants chose "strongly disagree." When participants were asked if they would be willing to work extra (additional shifts or longer shifts) during a pandemic flu emergency, significant differences were noted relating to gender, whether or not their spouse/partner also had a job with a response role, whether or not they had a graduate degree and nursing, and how many hours per week they typically work. Full details are provided in Tables 7 and 8.

Analysis of variance indicated that female participants were significantly more likely to strongly agree or agree (67.5%) that they would work extra than male participants (42.2%) (p = .002, χ^2= 10.054). When correlation analyses were conducted between the personal or professional characteristics and respondents' intentions of reporting to work if asked to work extra no personal characteristics were significantly associated with intentions (Table 8). However, several professional characteristics continued to have significant associations with the outcome variable, those were: having a bachelor's degree in nursing (BSN) (r = .191; p= .003), the number of hours worked per week (r = -.152; p= .019), and having a master's degree in nursing (MSN) (r = -.148; p= .021). Again, we see that those nurses prepared at the BSN level are less likely to agree that they intend to report to work, while MSN prepared nurses are more likely to agree with the statement. Interestingly, the more hours worked per week by the respondent the more likely they are to agree that they intend to report to work if asked to work extra.

Table 7.
Relationship between personal, professional, and organizational characteristics with intentions to report to work if asked to work in addition to regular shifts

Characteristic	Chi-Square	df	*p* value	*N*
Gender (Females =1/Males =0)	10.054	1	.002	243
Has more than 1 employer (No=0/Yes=1)	2.460	1	.292	241
Average # of patients cared for at a time	0.838	1	.360	232

Table 8.
Correlations of dummied and continuous variables for intentions of reporting to work if asked to work extra

Characteristic	Pearson's *r*	*p* value	*N*
Race: Asian (Yes =1, No =0)	-.098	.127	245
Race: White (Yes =1, No =0)	.074	.253	245
Partner w/a response role (Yes =1, No =0)	-.076	.309	181
Has a Partner/Spouse (Yes =1, No =0)	.057	.379	240
AHI: $100,001 to $150,000 (Yes =1, No =0)	-.056	.384	245
AHI: > $150,000 (Yes =1, No =0)	.042	.520	245
Race: African American or Black (Yes =1, No =0)	.029	.647	245
Race: Native Hawaiian or Pacific Islander (Yes =1, No =0)	.028	.665	228
Age (continuous)	-.026	.693	245
Race: Other (Yes =1, No =0)	-.025	.698	245
Child(ren) < 18 years (Yes =1, No =0)	.021	.753	238
AHI: $75,001 to $100,000 (Yes =1, No =0)	.011	.859	245
AHI: ≤ $75,000 (Yes =1, No =0)	.010	.881	245
Caregiver for adult family member (Yes =1, No =0)	.007	.913	238
Nursing Bachelors Degree (Yes =1, No =0)	.191	.003	243
Hours worked per week (continuous)	-.152	.019	237
Nursing Masters Degree (Yes =1, No =0)	-.148	.021	243
Nursing Associates Degree (Yes =1, No =0)	-.092	.151	243
Degree Outside of Nursing: Doctorate (Yes =1, No =0)	-.066	.309	243
Nursing Doctoral Degree (Yes =1, No =0)	.057	.378	243
Years in Critical Care (continuous)	.046	.481	237
Degree Outside of Nursing: None (Yes =1, No =0)	.037	.566	243
Degree Outside of Nursing: Masters (Yes =1, No =0)	-.013	.628	243
Years as a Registered Nurse (continuous)	.025	.693	237
Degree Outside of Nursing: Bachelors (Yes =1, No =0)	.017	.774	243
Academic Medical Center (Yes =1, No =0)	.086	.193	230
Magnet® hospital (Yes =1, No =0)	.046	.485	231
Trauma Center (Yes =1, No =0)	-.026	.699	231
Employer requires annual flu vaccine (Yes =1, No =0)	.021	.742	242
Nurses in a CBU/union (Yes =1, No =0)	-.018	.786	231
Employer provides annual PPE training (Yes =1, No =0)	.007	.910	242

Overall Intentions of Reporting to Work

As reported above, 86% of participants indicated their intentions of reporting to work during a pandemic flu emergency, that number decreased to 78% when the condition "regardless of severity" was added, and that number further decreased to 62.8% when individuals were asked if they would be willing to work extra (visually represented in Figure 3). All of these differences are statistically significant and are detailed in Table 9.

Figure 3.
Percentage of respondents intending to report to work during a pandemic flu emergency

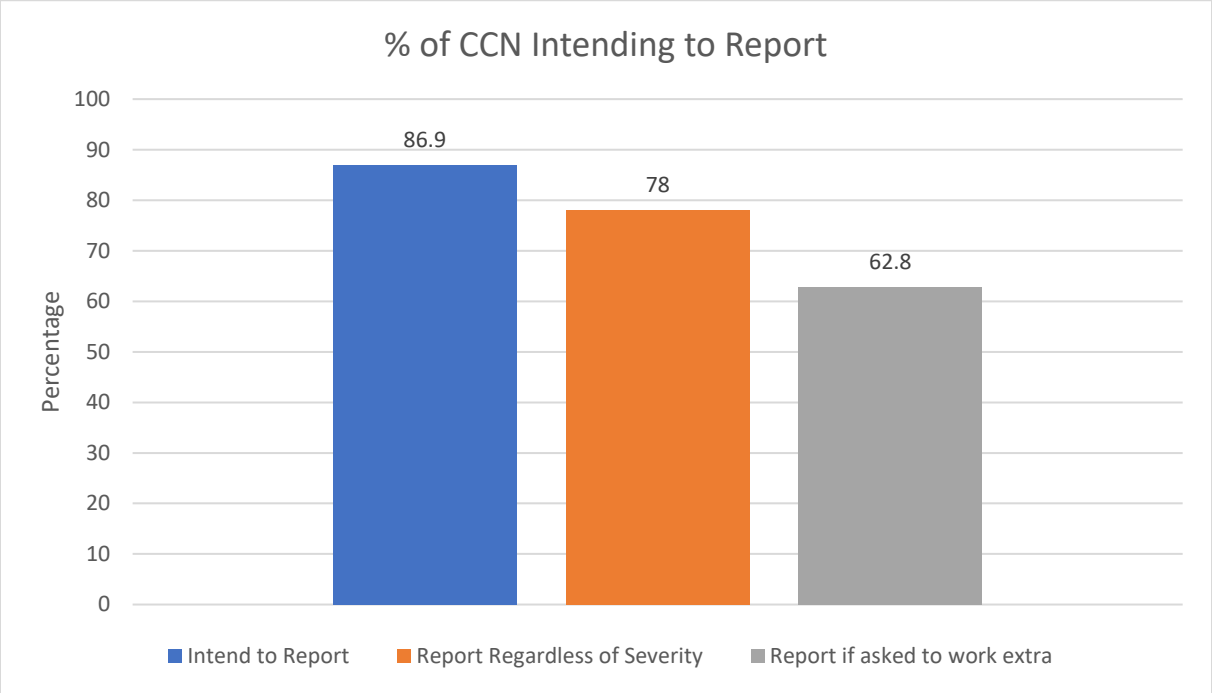


Table 9.
Intentions of Reporting to Work

Variable	Pearson Chi-Square	df	*p* value	*N*
Intend to report v. Intend to report regardless of severity	40.691	1	≤.001	245
Intend to report if asked to work extra v. Intend to report regardless of severity	22.718	1	≤.001	245
Intend to report v. Intend to report if asked to work extra regardless of severity	22.594	1	≤.001	245

What are the unique and combined effects of perceived threat and perceived efficacy on critical care nurses' self-reported intention to report to work during a pandemic flu emergency? (Question 2)

The JH~PHIRST is designed to measure the threat that an individual attributes to the scenario as well as the perception of response efficacy. The participants completed the JH~PHIRST and relationship between threat and efficacy and intentions of reporting to work are explored here.

Perceived threat

The threat of a pandemic flu emergency was broken down into two subscales, perceived severity and perceived susceptibility. For both subscales participants were divided into those who identified as having a high level of threat and a low level of threat. There was no significant difference, in either of the three outcome variables between those with high perceived severity and low perceived severity, and no significant differences were noted between those with high perceived susceptibility and low perceived susceptibility. This is detailed below in Table 10.

Table 10.
Relationship between perceived threat (susceptibility & severity) and outcome variables

Perceived Susceptibility				
Outcome variable	Chi-Square	df	*p* value	*N*
Intend to report regardless of severity	2.510	1	.113	245
Intend to report	0.744	1	.388	245
Intend to report if asked to work extra	0.169	1	.681	245
Perceived Severity				
Intend to report regardless of severity	1.298	1	.255	245
Intend to report	0.062	1	.803	245
Intend to report if asked to work extra	0.020	1	.888	245

Perceived efficacy

Participants with high perceived self-efficacy were significantly more likely to indicate that they intend to report to work, regardless of the conditional statements applied ("regardless of severity" and

"if asked to work extra") compared to those who had low perceived self-efficacy (Intend to report: 93% vs 73%; Intend to report regardless of severity: 83.6% vs 64.9%; Intend to report if asked to work extra: 70.2% v. 45.9%). Response efficacy became significant when severity of the pandemic flu emergency was a factor (81.2% of respondents who thought a response would be impactful intend to report compared with 60.5% of those who do not think a response will be efficacious). The statistical relationships are presented in Table 11.

Table 11.
Relationship between perceived efficacy (self-efficacy & response efficacy) and outcome variables

Perceived Self-efficacy				
Outcome variable	Chi-Square	df	*p* value	*N*
Intend to report	18.211	1	≤.001	245
Intend to report if asked to work extra	12.987	1	≤.001	245
Intend to report regardless of severity	10.580	1	≤.001	245
Perceived Response Efficacy				
Intend to report regardless of severity	7.955	1	.005	245
Intend to report	2.529	1	.112	245
Intend to report if asked to work extra	2.014	1	.156	245

Combined impact of perceived threat and efficacy

The combined threat and efficacy scores were used to categorize participants into four categories, (1) high threat/high efficacy; (2) high threat/low efficacy; (3) low threat/high efficacy; and (4) low threat/low efficacy. Each group was compared to all other categories and the results are presented in Table 12. It was noted that participants in the (1) high threat/high efficacy group indicated they were more likely to report to work (92.3%) compared to those in other categories (83%) and this result was statistically significant (p = .005, χ^2= 7.741). This was also true when severity was factored in (86.5% compared to 71.6% in other categories) and when the condition of being asked to work extra was imposed (71.2% in this group and 56.7% in the other categories).

A shift in intentions to report to work was noted in the group of participants who were categorized in the (2) high threat/low efficacy compared to the other groups, with only 75.8% reporting that they intend to report to work compared to 91.1% of others. That further declines to a nadir 51.5% of these individuals being willing to report if asked to work extra versus 67% in the other categories and 60.6% intending to report regardless of severity compared to 84.4% in the other categories.

The participants who fell into the low threat/low efficacy group had no significant difference in intentions to report to work than those in other groups (81.8% compared to 87.7%), there were also no significant differences between the participants in this category and the others when severity was factored in. However, there was a significant gap between participants in the low threat/low efficacy group (45.5%) and other participants (65.6%) when the condition of being asked to work extra was factored in.

The participants in the low threat/high efficacy group were more likely to indicate that they intend to report to work than their counterparts in general (95.2% compared to 85.2%), but the differences are not significant when severity is factored in or if they are asked to work extra.

Table 12.
Combined effects of threat and efficacy

Outcome variable	Chi-Square	df	*p* value	*N*
High Threat/High Efficacy				
Intend to report regardless of severity	7.741	1	.005	245
Intend to report if asked to work extra	5.328	1	.021	245
Intend to report	4.587	1	.032	245
High Threat/Low Efficacy				
Intend to report regardless of severity	15.831	1	≤.001	245
Intend to report	9.946	1	.002	245
Intend to report if asked to work extra	4.977	1	.026	245
		1		
Low Threat/Low Efficacy				
Intend to report if asked to work extra	4.947	1	.026	245
Intend to report	0.881	1	.348	245
Intend to report regardless of severity	0.108	1	.743	245
		1		
Low Threat/High Efficacy				
Intend to report	3.075	1	.080	245
Intend to report if asked to work extra	2.604	1	.107	245
Intend to report regardless of severity	1.774	1	.183	245

What influence do personal, professional, and organizational characteristics have on CCNs' self-reported intention to report to work during a pandemic influenza? (Question 3)

Logistic regression was employed to create predictive models for CCN intentions of reporting to work and to examine the unique variance of the factors that demonstrated significant differences between groups in the bivariate analysis (Chi-square and Pearson's product-moment correlations). Regression was used to isolate the effect of each variable. The decision was made to include all of the variables that were significant (at $p \leq 0.05$) in the models, along with several variables that were trending towards significance. Given that perceived self-efficacy and perceived response efficacy appear to be driving the significance of the effect between the groups (e.g. high threat/high efficacy) it was decided to utilize the subscale groupings in the analysis instead of the overall efficacy and threat categories.

Multicollinearity. When assessed, only three of the variables had elevated (>2.5) variance inflation factors (VIFs), those were age (3.889), years of experience as an RN (10.138), and years of experience in critical care (7.321). These also had tolerance values that needed to be addressed as well with age being borderline at 0.277, and years of experience as an RN (0.099) and years of experience in critical care (0.137) violating the established cutoff. It is understandable that these three variables would be collinear. The decision was made to remove years of critical care experience and years of RN experience and continue to include age as this had a significant Pearson's product-moment correlation statistic as well. When multicollinearity was reassessed the VIF for age was 1.244 and the tolerance was 0.804, well within the tolerable limits.

Variables included in model building. The variables that demonstrated significant relationships with the outcome variables were examined for use and included in the regression analysis. The decision was also made to include all four subscales from the instrument in each of the three models, even though perceived severity and perceived susceptibility did not demonstrate significance in any of the preliminary analyses, as these aligned with the theoretical underpinnings of the study. When assessing for multicollinearity, it was determined that years of experience in critical care and years of experience as a registered nurse needed to be removed from consideration with age remaining in where significant. The remaining independent variables were used in the logistic regression analysis of all three outcome variables. Table 13 details the significant variables for each independent variable.

Table 13.
Significant variables included in logistic regression model-building

Model for overall intention to report to work	Model for intention to report to work regardless of severity	Model for intention to report to work if asked to work extra
• Race: White • Race: African American or Black • Race: Native Hawaiian or Pacific Islander • Degree outside of nursing: none • Degree outside of nursing: bachelors • Gender • AHI: Greater than $150,000 • Hours worked per week	• Age • Race: African American or Black • Nursing Bachelors Degree • Degree outside of nursing: bachelors • Nurses belong to CBU • Gender • Nursing Masters Degree	• Hours worked per week • Nursing Bachelors Degree • Nursing Masters Degree • Gender • Spouse has a response role

Logistic regression is useful for when researchers would like to be able to predict the presence or absence of a characteristic based on a set of predictor variables (Allison, 2013; IBM Knowledge Center, n.d.; Statistics Solution, n.d.). For this study, binary logistic regression was conducted and that does require that the dependent variable be dichotomous (intend to report to work, does not intend to report to work). Unlike linear regression, logistic regression does not require a linear relationship between the independent variables and the dependent variable(s).

Forward logistic regression was used to evaluate each of three outcomes (intention of reporting to work, intention of reporting to work regardless of severity, and intention of reporting if asked to work extra). Odds ratios (Exp(B)) explain the strength of the impact that each variable has on the outcome of interest. Not all variables achieved significance in the model in the context of the other variables.

Intentions of Reporting to Work. When examining the variables related to the primary outcome, overall intentions of reporting to work (Column 1 in Table 13), the model was statistically significant, χ^2 = (31.532), df (2), $p \leq .001$. The model, presented below and fully detailed in Table 14,

explains 12.4% of the variance (Cox and Snell R^2= 0.124; Nagelkerke R^2= 0.227) in the intentions to report to work. The equation for the model is:

$$log\ \frac{(probability\ of\ intending\ to\ report\ to\ work)}{(1-probabilty\ of\ intending\ to\ report\ to\ work)} = 0.232 + 1.828(\text{perceived self-efficacy}) + 1.309(\text{white race}) - 1.133(\text{non-nursing bachelors degree})$$

When assessing the overall fit of the model one statistic frequently used the Hosmer-Lemeshow goodness-of-fit test (Stoltzfus, 2011). For this model the Hosmer-Lemeshow goodness-of-fit test demonstrated that the model more accurately predicted the outcome than chance alone would (χ^2= 0.298, df (2), *p*= .861). Additionally, deviance, or the -2 log-likelihood (-2LL) statistic can also be used to assess model fit. Smaller values are more desirable, indicating better model fit. The model correctly predicts membership in the outcome category 87% of the time.

Because more than one independent variable is included in the final model, the odds ratios presented are considered adjusted. When reviewing the three significant variables in this equation it is important to note the odds ratio for perceived self-efficacy is 6.221 (95% CI: 2.638-14.673). Respondents with high self-efficacy were 6.221 times more likely to intend to report to work than those who did not have high self-efficacy. Respondents who identified their race as white were 3.703 (95% CI: 1.362-10.065) times more likely to indicate that they intend to report than their colleagues who did not identify as white. And, having a non-nursing bachelor's degree was noted to have a significant negative impact on intentions to report with those holding a degree outside of nursing being 0.322 times as likely as their colleagues with only nursing degrees to report (95% CI: 0.142; 0.730).

Table 14.
Model for Intentions to Report to Work

Variables in the Equation	B	*SE*	Wald	df	Sig	Exp(B)	95% Confidence Interval Lower	95% Confidence Interval Upper
Perceived Self-Efficacy (High=1; Low=0)	1.828	.438	17.435	1	≤.001	6.221	2.638	14.673
Degree Outside of Nursing: Bachelors	-1.133	.417	7.372	1	.007	.322	.142	.730
Race: white	1.309	.510	6.581	1	.010	3.703	1.362	10.065
Constant	.232	.562	.171	1	.679	1.263		

Cox & Snell R^2= 0.124; Nagelkerke R^2= 0.227, χ^2=31.532, $p \leq .001$, -2LL = 156.665, N= 239

Intentions of Reporting to Work Regardless of Severity. When the conditional statement "regardless of severity" is added to the outcome of interest, intentions of reporting to work during a pandemic flu emergency, it was demonstrated above that overall intentions decreased. This model (Table 15) was created to determine the amount of variance in CCN intentions that can be explained by the variables noted and was found to be statistically significant, X^2= 32.857, $p \leq .001$. The resultant model explains 13.8% (Cox and Snell R^2 = 0.138) of the variance in the outcome and the model equation is:

$$log \frac{(probability\ of\ intending\ to\ report\ to\ work\ regardless\ of\ severity)}{(1-probabilty\ of\ intending\ to\ report\ to\ work\ regardless\ of\ severity)} = .624 + 1.090\ (perceived\ self\ efficacy) + 1.890(Nursing\ masters\ degree) - 3.863(Race:\ Black/African\ American)$$

For this model the Hosmer-Lemeshow goodness-of-fit test demonstrated that the model more accurately predicted the outcome than chance alone would (χ^2= 0.136, df (3), p= .712). The model correctly classifies respondents to the correct outcome group 82.4% of the time.

In the initial bivariate evaluation of the relationships between the independent variables and the dependent variables, this dependent variable had the greatest number of predictor variables. They have been included here. When the contribution of the other variables in the model is controlled, perceived self-efficacy, have a nursing masters degree, and identifying as Black or African American remain significant. Individuals who identified their race as Black/African American were 0.021 (95% CI:

0.003-0.156) times less likely to indicate that they would report to work regardless of severity. When severity comes into play the impact of self-efficacy is diminished compared to the general scenario--individuals with high self-efficacy were 2.974 (95% CI: 1.425- 6.209) times more likely to intend to report than those with low self-efficacy. Furthermore, those respondents holding a master's degree in nursing (BSN) were 6.620 times more likely to intend to report regardless of severity (95% CI: 1.453; 30.167).

Table 15.
Model Building for Reporting to Work Regardless of Severity

							95% Confidence Interval	
Variables in the Equation	B	*SE*	Wald	df	Sig	Exp(B)	Lower	Upper
Nursing Masters Degree (Has =1; Does not have =0)	1.890	.774	5.966	1	.015	6.620	1.453	30.167
Perceived Self Efficacy (High=1; Low =0)	1.090	.375	8.426	1	.004	2.974	1.425	6.209
Race: African American/Black	-3.863	1.021	14.303	1	≤.001	.021	.003	.156
Constant	.624	.554	1.269	1	.260	1.867		

Cox & Snell R^2= 0.138; Nagelkerke R^2= 0.219, χ^2=32.857, $p \leq .001$, -2LL = 187.765, N = 221

Intentions of Reporting to Work if Asked to Work Extra. When the conditional statement "if asked to work extra (longer shifts, additional shifts)" is added to the outcome of interest, intentions of reporting to work during a pandemic flu emergency decreased even further. This model (Table 16) was created to determine the amount of variance in CCN intentions; in this setting they can be explained by the variables noted and the model was statistically significant, X^2= 35.028, df (3), p≤.001. The resultant model explains 13.6% (Cox and Snell R^2 = 0.136) of the variance in the outcome and the model equation is:

$$log \frac{(probability\ of\ intending\ to\ report\ to\ work\ if\ asked\ to\ work\ extra)}{(1-probabilty\ of\ intending\ to\ report\ to\ work\ if\ asked\ to\ work\ extra)} = -1.688 + 0.964(\text{perceived self-efficacy}) + 0.063(\text{hours worked per week}) - 1.147(\text{nursing bachelors degree})$$

For this model, predicting intentions to report to work if asked to work extra, the Hosmer-Lemeshow goodness-of-fit test demonstrated that the model more accurately predicted the outcome than chance

alone would (χ^2= .124, df (2), *p*= .940). The model correctly predicts intentions to work 69.5% of the time.

Perceived self-efficacy continues to demonstrate a significant influence on intentions, and those with high perceived self-efficacy are 2.574 (95% CI: 1.411-4.697) times more likely to intend to report than those with low perceived self-efficacy. Hours worked per week was also associated with intentions to work if asked to work extra, with those working more hours per week being 1.065 (95% CI: 1.026-1.105) times more likely to indicate that they intended to report to work if asked to work additional days/hours than those who work fewer hours. Individuals with a nursing bachelor's degree were .317 (95% CI: .165-.612) times less likely to indicate that they intend to report to work extra than those without.

Table 16.
Model Building for Reporting to Work Extra

							95% Confidence Interval	
Variables in the Equation	B	*SE*	Wald	df	Sig	Exp(B)	Lower	Upper
Perceived Self Efficacy (High=1; Low=0)	0.946	.307	9.493	1	.002	2.574	1.411	4.697
Hours worked per week	0.063	.019	10.986	1	≤.001	1.065	1.026	1.105
Nursing bachelors degree (BSN)	-1.147	.335	11.748	1	≤.001	.317	.165	.612
Constant	-1.688	.771	4.798	1	.028	.185		

Cox & Snell R^2= 0.136; Nagelkerke R^2= 0.186, χ^2=35.028, df (3), *p* ≤, -2LL = 280.553, *N* = 239;

Summary

This study sought to answer three research questions. The first research question included two associated sub-questions, "What percent of respondents intend to report to work during a pandemic flu emergency? (1a) What percent of respondents intend to report to work during a pandemic flu emergency, regardless of severity? (1b) What percent of respondents intend to report to work if requested to work more than their regularly scheduled hours (longer shifts, extra shifts)?" In the analysis, it was noted that intentions to report to work significantly decreased when the conditional

statements were applied, with the fewest percentage of nurses reporting an intention to report if asked to work extra. The second research question was “What are the unique and combined effects of perceived threat and perceived efficacy on critical care nurses’ self-reported intention to report to work during a pandemic flu emergency?” Data analysis of this question demonstrated that perceived self-efficacy appears to be a primary driver of intentions to report to work. It was also noted that when the combined threat & efficacy profiles were generated, those with high threat were also more likely to report to work.

For the final research question, “What influence do personal, professional, and organizational characteristics have on CCNs’ self-reported intention to report to work during a pandemic influenza?” logistic regression was used to create models to predict the outcome. Models were created for each of the conditional statements and statistically significant results were generated. For overall intentions of reporting to work perceived self-efficacy, race, and holding a non-nursing degree all significantly explained 11% to the variance in intentions. For intentions to report to work regardless of severity race, perceived self-efficacy, perceived response efficacy, and having a nursing graduate degree all significantly explained 13% of the variance. And lastly, for intentions to report to work if asked to work extra—working fulltime (≥32 hours), having a nursing graduate degree, and perceived self-efficacy significantly loaded on the final model which explained 13% of the variance in the outcome. Overall, only a small amount of the variance in CCNs intention to report were explained by the factors measured in this study. The limitations of the study and the practical significance of these models will be explored further in the discussion. Importantly, the results suggest that perceived self-efficacy is associated with intentions to report to work during a pandemic flu emergency regardless of the conditions applied. The importance of this will be explored further in the discussion.

CHAPTER FIVE: DISCUSSION

Disasters, by definition, overwhelm capacity at the local level (Adams, 2009; Devereaux et al., 2008; Wilkinson & Matzo, 2015). Recent research has demonstrated that disasters are increasing around the world. Depending on the cause or type of event, a disaster may generate a surge of patients that could overwhelm local healthcare facilities (HCFs) and healthcare workers (HCWs). While complete recovery from a disaster may take time, the surge of patients is often time limited. However, pandemics have unique characteristics that make them different from other types of disasters for several reasons. Pandemics are not geographically isolated and they affect multiple countries. Additionally, pandemics continue to create patients over an extended period of time, lasting weeks to months depending on the disease and available medical countermeasures (Antonova et al., 2014; Centers for Disease Control & Prevention, 2018c; Fedson, 2018; Taylor, 2018). The 2018-2019 seasonal influenza epidemic lasted over 20 weeks and the average was 16 weeks in the prior five years (Centers for Disease Control & Prevention, 2019a; Ducharme, 2019).

This study was conducted to examine the intentions of critical care nurses (CCNs) around reporting to work during a pandemic influenza. Historical data on influenza have demonstrated its ability to infect large numbers of individuals (Barry, 2009; Nelson & Williams, 2007; Nelson & Worobey, 2018; Potter, 2001). Indeed, estimates of the 2018-2019 flu season indicate that between 524,000-637,000 individuals were hospitalized in the United States (US) and between 37.2 million and 42.7 million individuals were infected (Centers for Disease Control & Prevention, 2019a). Additionally, research and observations have identified that influenza illness is associated with an increased use of critical care beds, specifically for patients requiring mechanical ventilatory support (King et al., 2014). In planning for surge events of any kind, hospitals have noted that CCNs are frequently one of the limiting resources in critical care capacity (Roccaforte & Cushman, 2007). While other studies have examined intentions of various groups of HCWs, including nurses, this study specifically assessed the intentions of critical care

nurses. To the best of the author's knowledge, this is the first study to examine CCN intentions of reporting to work during an influenza pandemic in the U.S.

Results of this study indicated that factoring the severity of a pandemic influenza outbreak and being asked to work additional or longer shifts significantly decreased critical care nurses' (CCNs) intentions of reporting to work. Results also revealed that perceived self-efficacy was a significant predictor of intentions of reporting to work regardless of the conditional statements. This chapter will address findings and discuss implications to nursing practice, research, education, and policy.

Demographics

Most of the respondents were female, middle-aged, lived with a partner and had an annual income of over $100,000. Less than a third had primary caretaking responsibility for a child or dependent older adult. Two-thirds had a baccalaureate degree and most had been practicing as an RN for almost 16 years with slightly fewer years as a CCN. There was an even divide among participants who were employed at an academic medical center (48%) and those who did not, and the majority (58%) worked in a designated trauma center. A sizable number of respondents worked in a Magnet hospital (40%) and a minority were represented for collected bargaining. Almost all participants indicated that they were required by their employer to have annual vaccination against influenza and received annual training in personal protective equipment (PPE). And finally, the sample represented the ten administrative regions identified by the US Department of Health and Human Services (HHS) and participants lived in the same HHS region where they worked which included 47 states-- Rhode Island, Arizona, and Alaska were not represented in the sample.

AACN Membership

Demographics of participants were compared to the overall American Association of Critical Care Nurses (AACN) membership from which the sample was drawn. No significant differences were noted for gender and age. Regarding race, nurses who identified as Asian were underrepresented in the

sample compared to the overall AACN population (5.4% to 12% respectively). Differences were also noted in education levels and experience in critical care in that the study sample had fewer Associate Degree Nurses (ADNs, 11.7%, vs 19% in AACN) and more individuals who reported having 4-10 years of experience in critical care (40.2%, vs. 29% in AACN). It is possible that such differences correspond to patterns of nursing education and hiring practices shifting away from ADN prepared nurses practicing in critical care environments (Robert Wood Johnson Foundation, 2014).

Magnet® Designation. Forty percent of CCNs who participated in the study were employed by facilities that had received Magnet® designation, but only about 8% of hospitals in the U.S. currently hold that status (Tai & Bame, 2017). While this variable did not have a significant impact on intentions to report to work, future studies may want to further examine Magnet® designation because such hospitals are known for supporting nursing education and career development leading to improved patient outcomes (American Nurses Credentialing Center, n.d.). Indeed, the over-representation of nurses from Magnet® hospitals in the study likely impacted the differences noted between the sample and the overall AACN membership. For example, Magnet® hospitals tend to have higher proportions of BSN-prepared nurses in critical care units compared to other facilities (Hickey, Gauvreau, Connor, Sporing, & Jenkins, 2010; Robert Wood Johnson Foundation, 2014) and, in fact the study sample had a higher proportion of nurses who were BSN-prepared and fewer ADN-prepared nurses.

Magnet® designation is a factor that may have impacted participation in this study in several ways. First, given the emphasis on continuous professional development, nurses employed at Magnet® hospitals may be more likely to become members of professional organizations such as AACN. Unfortunately, AACN has not published data or statistics about membership and Magnet® designation of members' employers; and, thus this study was not able to compare Magnet® designation between study participants and the overall AACN membership. Secondly, Magnet® hospitals are known for supporting nursing education and career development (American Nurses Credentialing Center, n.d.); and thus,

Magnet® hospitals may be overrepresented among nurses who attend professional conferences, including the AACN National Teaching Institute where recruitment for this study occurred. Finally, it is possible that nurses employed by Magnet® hospitals are more likely to participate in research studies compared to other nurses.

What percent of respondents intend to report to work during a pandemic flu emergency? (Question 1)

This study represents one of the first attempts to assess the intentions of CCNs to report to work during a pandemic flu emergency at a national level (Figure 3, located on page 84). Almost eighty-seven percent (86.9%) of participants indicated that they "strongly agreed or agreed" with the statement that they would report to work during a pandemic flu emergency. However, when asked if they would report to work regardless of the severity, fewer participants (78%) indicated that they "strongly agreed or agreed" with the statement that they would report to work. Furthermore, even fewer participants (62.8%) "strongly agreed or agreed" to the statement they would report to work if they were asked to work longer shifts and/or extra shifts during a pandemic flu emergency. These results suggest that the unique circumstances of an emergency have the potential to significantly impact the decision-making process for CCNs. The differences in intentions noted between these three scenarios are statistically significant ($p \leq .001$).

Results from this study are similar to previous studies that examined willingness to report to work during a pandemic (Aoyagi, Beck, Dingwall, & Nguyen-Van-Tam, 2015; Ben Natan, Zilberstein, & Alaev, 2015; Daugherty et al., 2009; McMullan, Brown, & O'Sullivan, 2016; Rossow, 2012; Stergachis et al., 2011; Tzeng & Yin, 2006; Wicker et al., 2009). For example, in a literature review by Rossow (2012), on average 73% of physicians and 59% of nurses indicated willingness to report to work across studies. However, there was greater variability in responses for studies conducted during the H1N1 outbreak in 2009, with intentions of reporting to work ranging from 23.1% to 90.1%. After removal of the two outlier endpoints from Rossow's meta-analysis, the average percentage of nurses indicating their

willingness to report to work across studies increased from 59% to 63.7%. Seale and colleagues (2012) conducted a study in 2009 during the H1N1 pandemic and found that 86% of HCWs in Beijing were willing to report to work. This is very similar to the findings in the current study, but resulted after several years of efforts by the Chinese government to provide annual education and training on infectious disease identification and management following the 2003 SARS outbreak in the country.

While nurses overall have been underrepresented in the existing literature on intentions to report to work, CCNs specifically have been identified as a resource that often limits facilities' ability to surge critical care capacity, and so this study was designed to focus on this sub-population instead of nurses overall (Balicer et al., 2006; Devnani, 2012; Roccaforte & Cushman, 2007). Since CCNs are central to the healthcare system and the provision of critical care, it is imperative to consider first and foremost their intentions to report to work. This study was a critical first step in evaluating CCNs willingness to report. This study is unique in specifically examining CCNs intentions, which may be used to assess surge capacity. Having a CCN specific assessment on which to base pandemic preparedness is crucial in developing realistic nurse staffing models.

The current study supports the existing literature that examined nurses overall, that some CCNs will elect to remain out of work; however, it appears that CCNs have greater intentions of reporting (86.9% overall and 78% when severity of the pandemic is considered) than the overall nurse population (63.7%) (Rossow, 2012). In this study, high perceived self-efficacy was significantly associated with an increased likelihood of intending to report, even after adjusting for other factors. The differences in RNs' and CCNs' intentions to report may be associated with higher perceived self-efficacy among CCNs than other RNs. The implications of this difference will be discussed further in this chapter under education and policy. However, the wide variability in intention to report noted in previous studies makes it difficult to interpret these differences; indeed, Aoyagi and colleagues summarized their review of willingness to report to work saying that intentions were "moderately high, albeit highly variable"

(Aoyagi et al., 2015, p. 120). In three hypothetical scenarios in this study, there was also high variability in intentions to report to work. In each case, except for perceived self-efficacy, demographic and professional factors were associated with the variance.

What are the unique and combined effects of perceived threat and perceived efficacy on critical care nurses' self-reported intention to report to work during a pandemic flu emergency? (Question 2)

The current study used the JH~PHIRST to assess the impact of perceived threat and perceived efficacy on CCNs' self-reported intention to report to work during flu pandemic. Similar to prior research, the current study found that perceived threat and perceived efficacy did influence CCNs' intentions to report to work (Balicer et al., 2010; Barnett et al., 2009; Errett et al., 2013). In this study, individuals in the high threat/low efficacy group were less likely to report to work compared to other groups. This intuitively makes sense, as those in the high threat/low efficacy group could perceive a pandemic flu emergency as severe, could perceive themselves and/or their families as more susceptible, and may not perceive themselves and/or their responses as effective.

Results from this study may be different from other published literature, including those studies that used the same instrument, because CCNs were specifically evaluated. For example, Barnett, et al. (2009) examined public health workers' (PHWs), including public health nurses', willingness to report to work during a pandemic and found that perceived threat and efficacy impacted intentions to report to work but efficacy had a larger effect. Specifically, PHWs who were in the low threat/high efficacy group were 10.87 (OR: 10.87, 95% CI: 5.65-20.92) times more likely and PHWs in the high threat/high efficacy group were 11.22 (95% CI: 6.71-18.74) times more likely to be willing to report to work than PHWs who were in the low threat/low efficacy group. In another study (Balicer et al., 2010), researchers examined HCWs, including nurses, in an academic medical center and found that HCWs with high efficacy were more likely to be willing to report to work than those with low efficacy (88.9% compared to 58.6%, OR: 5.86) (Balicer et al., 2010). While these studies included nurses, efficacy results were not reported by

role group. All of these studies utilized the JH~PHIRST to assess perceived self-efficacy so these differences are notable. However, these findings are tempered by the fact that the instrument underwent multiple revisions, including revisions prior to use in this study. The significant findings from this study support the existing literature indicating that perceived efficacy impacts intentions to report to work.

Unlike previous studies, the current study also evaluated the impact of subscales of the JH~PHIRST individually (i.e., perceived self-efficacy, perceived response efficacy, perceived severity, and perceived susceptibility), and found that perceived self-efficacy was the only subscale to have a significant relationship with intentions when adjusting for other personal, professional, and organizational characteristics. Perceived self-efficacy was a significant factor across all three scenarios presented to participants ($p \leq .002$). However, the impact of perceived self-efficacy was mediated by other factors as well as the conditions in the scenarios. Table 17 summarizes the impact (odds ratios) of perceived self-efficacy, a variable of importance since it is the only predictor included in the final model for all three outcomes. Even when adjusted for the other contributing variables, perceived self-efficacy increases the odds of intending to report to work by at least 2.574 and as much as 6.221, depending on the scenario presented.

Table 17.
Impact of Perceived Self-Efficacy

Outcome	Odds Ratio	95% CI: Lower	95% CI: Upper	*P*
Intend to report to work	6.221	2.638	14.673	≤.001
Intend to report to work regardless of severity	2.974	1.425	6.209	≤.001
Intend to report to work if asked to work extra	2.574	1.411	4.697	.002

Perceived self-efficacy could explain some of the differences noted between overall intentions to respond among the study population, which exclusively included CCNs, and other studies which have included nurses in a variety of roles and specialties. The knowledge, skill, and training that CCNs have to

be able to function in their specialty may contribute to increased perceived self-efficacy. However, it is important to note that all the CCNs that participated in this study agreed with the inclusion criteria:

> I am a critical care nurse. As such, I have experience working in "settings where patients require complex assessment, high-intensity therapies and interventions and continuous nursing vigilance." Examples of this include caring for patients requiring mechanical ventilation, titration of vasoactive medications, etc.

Even within this group of CCNs, the difference between those with high perceived self-efficacy and low perceived self-efficacy had a large impact on intentions. It also appears that perceived self-efficacy has an impact on intentions before nurses enter the workforce. In a study of Israeli nursing students, perceived self-efficacy was associated with increased willingness to report to work during a hypothetical future influenza pandemic (Ben Natan et al., 2015). While their study did not look directly at perceived self-efficacy, Aoyagi and colleagues (2015) found that increased training and confidence were associated with increased willingness to report to work.

Interestingly, a study by Martin, Brown, and Reid (2013) that examined the willingness of nurses in Maine to report to work during a pandemic flu found that threat had a significant impact on intentions. While 90% of the respondents in their study indicated that they were willing to report to work, further differentiation revealed that those who perceived a pandemic flu to be of moderate to no threat ranged from 89% to 97% willing to report respectively. However, in the subgroup of nurse respondents that perceived the pandemic flu to be “high threat” only 58% of respondents were willing to report. While their study did not examine perceived self-efficacy or response efficacy, it is important, both from practical and theoretical viewpoints, to remember the interplay of threat and efficacy in the EPPM and how that impacts behavioral intentions.

In this study, and other studies using the JH~PHIRST, it should be noted that “regardless of severity” is not defined for the participant. Some participants may read that question and interpret that to mean the pandemic is more severe, while others may believe it to be the opposite. However, it

remains noteworthy that regardless of interpretation the overall severity of the pandemic does have a significant impact on intentions in study participants.

What influence do personal, professional, and organizational characteristics have on CCNs' self-reported intention to report to work during a pandemic influenza? (Question 3)

Personal (i.e., race, gender, age, having a spouse with a response role, annual household income), professional (i.e., hours worked per week, years as RN, years in critical care, having a non-nursing degree, having a nursing graduate degree), and organizational (i.e., belonging to a Collective Bargaining Unit (CBU)) factors were significantly related to CCNs' intentions to report to work. In this section, these factors and their relationship to CCNs' willingness to report to work will be discussed. This study utilized aggregated national responses and did not examine regional differences.

Personal factors

Personal factors included in the study were: (1) age, (2) gender, (3) race, (4) caregiver for child(ren) < 18 years, (5) caregiver for an adult family member, (6) relationship status including whether spouse/partner had an emergency response role, and (7) annual household income. There were significant differences noted in bivariate analyses with regards to outcomes related to age, gender, race (White, African American/Black, Native Hawaiian/Pacific Islander), whether their spouse/partner had an emergency response role, and annual household income greater than $150,000.

Relationship and caregiver status. Unlike previous research (Adams & Berry, 2012; Aoyagi et al., 2015; Damery et al., 2009; Daugherty et al., 2009; Devnani, 2012; Martin et al., 2013; Qureshi et al., 2005; Rutkow et al., 2017; Von Gottberg, Krumm, Porzsolt, & Kilian, 2016) being a caregiver for children under 18 years or an adult family member was not associated with intentions to report to work in the current study. It is possible that CCNs differ in their perception of potential risk to family members compared to nurses in general and other HCWs. Also unlike prior research (Balicer et al., 2010; Errett et al., 2013), in this study marital status did not have a significant relationship with CCNs' intentions or

willingness to report to work. However, one other prior study did not demonstrate a difference with regards to marital status (Devnani, 2012). The bivariate analyses in the scenario where they were asked to work extra indicated participants with a spouse/partner who had an emergency response role were more likely to report to work compared to those with a spouse/partner who did not have an emergency response role. However, this finding did not remain significant when adjusting for hours worked per week, perceived self-efficacy, and holding a bachelors' degree in nursing in the regression analysis. Finally, annual household income was not significantly associated with CCNs' intentions to report to work (overall) when adjusting for race and educational status (Devnani, 2012; Martin et al., 2013).

Age. Older age was positively associated with CCNs' intentions to report to work regardless of severity in the bivariate analysis ($p = .022$). But, when the final model for overall intentions was constructed, age did not have a significant impact when adjusting for perceived self-efficacy, having a non-nursing bachelors' degree, and identifying as white. Previous studies had conflicting findings with regards to the impact of age on intentions to report during a pandemic flu. Seale, Leask, Po, & MacIntyre (2009) study of HCWs found those less than 40 years of age had greater intentions of reporting during a pandemic flu. Conversely, Shabanowitz & Reardon (2009) found that those in the 20-34 year age group were less willing to report to work during an Avian influenza outbreak.

Gender. CCNs who identified as female were significantly more likely to report to work than to CCNs who identified as male in all three scenarios ($p < .001$). However, gender did not predict CCNs' intentions to report to work and did not load significantly after adjusting for other variables in each of the final models. This finding is in contrast to previous research. Multiple other studies found that females were less likely to intend to report to work during a pandemic than their male counterparts (Aoyagi et al., 2015; Ben Natan et al., 2015; Butsashvili, Triner, Kamkamidze, Kajaia, & Mcnutt, 2006; Damery et al., 2009; Qureshi et al., 2005). One explanation for this difference is that most of these other studies looked at healthcare workers in general and nurses comprised only part of the sample. The

differences noted with regards to gender may have been more representative of the difference in role group (clinician vs. non-clinician or nurse vs. physician) than of gender. However, in a study of Israeli nursing students, Ben Natan and colleagues (2015) did find that male students were more likely to be willing to report to work than female students. This is interesting when taken in the context of cultural difference, mainly that in Israel all citizens are required to serve in the military regardless of sex/gender. However, even with that background differences were noted with regards to gender. In the current study, while gender does demonstrate a significant relationship in bivariate analysis, adjusting for other variables decreases its significance across all three outcomes. It would be interesting to repeat this study in Israel across a broader pool of nurses and not just nursing students given that the significant factors discovered in this study included years of experience as a RN, household income, holding a graduate degree—it may be that nursing students were too homogenous of a group and hence the only factor that remained significant was gender.

Race. Initial analyses showed that race was significantly correlated to overall intentions to report to work (Question 1). Individuals who identified as white were more likely to agree that they intended to report to work, while those who identified as African American/Black or Native Hawaiian/Pacific Islander were less likely to agree that they intended to report. When adjusting for the other significant variables through logistic regression regarding overall intentions to report to work, CCNs who identified as white were 3.548 times more likely to intend to report (95% CI: 1.312- 9.592; p= .013). Having identified as African American/Black or Native Hawaiian/Pacific Islander did not have a significant impact when adjusting for identifying as white, perceived self-efficacy, and having a non-nursing bachelors' degree.

Participants who identified as African American/Black were identified as being significantly less likely to intend to report to work when asked their intentions "regardless of severity" (Question 1.a) $p \leq$ .001). When adjusting for the other variables in the logistic regression model this factor remained

significant; African American/Black CCNs were .021 (odds ratio) times less likely to intend to report to work (95% CI: .003-.156; $p \leq .001$) regardless of severity.

Race had no impact on the intention to report if asked to work extra (Question 1.b) in the early bivariate analyses and was not included in the logistic regression analysis for this question. In a review of the literature, Devnani (2012) found that only Daugherty et al. (2009) had identified race as a significant contributor to intentions. That study reported that individuals identifying as African American were less likely to report to work than those who were white or Asian. It is important to note that the unique contribution of race in this study has been adjusted for the other variables in the model (adjusted odds ratios are presented). This means that controlling for perceived self-efficacy, educational degrees, income level, and the other variables placed into each of the models, race remained significant and requires further exploration.

Professional Factors

Professional factors included in the study were: (1) years of experience as a registered nurse, (2) years of experience in critical care, (3) highest nursing degree held, (4) highest non-nursing degree held, (5) hours worked per week, and (6) whether or not the participant had more than one employer. Initial analyses indicated that each variable had a significant relationship with the outcome variable(s) except whether participants had more than one employer. However, three variables (years of experience as a registered nurse, years of experience in critical care, age) had high levels of multicollinearity and the decision was made to only include the variable age in the logistic regression model-building, as age had a significant Pearson's product-moment correlation statistic in addition to significant Pearsons Chi-square.

Highest nursing degree obtained. Differences were found in education regarding willingness to report regardless of severity and if asked to work extra. A bachelor's degree in nursing significantly decreased CCNs' intentions to report regardless of severity (p= .019) and significantly decreased

intention if asked to work extra (p = .003). Conversely, a nursing master's degree significantly increased intention to report if asked to work extra (p = .021). There was a trend suggesting an increased intention to work regardless of severity for those CCNs who have a master's degree in nursing (p = .074).

In the regression model, nursing education was predictive of intention to report "regardless of severity." CCNs with a master's degree in nursing are 6.620 times more likely to intend report to work regardless of severity than their colleagues holding other degrees (95% CI: 1.453-30.167; p = .015). In contrast, CCNs with a bachelor's degree in nursing were 0.322 times less likely (95% CI: 0.142-0.730; p= .007) to intend to report if asked to work extra.

Holding a non-nursing degree. CCNs with a non-nursing degree were significantly less likely to report to work (p= .005) compared to CCNs with only a nursing degree (p= .009). Participants holding a non-nursing bachelors' degree were also significantly less likely to report to work regardless of severity (p= .012). In the regression model of intentions to reporting in the event of a pandemic flu (Table 12) holding a bachelors' degree outside of nursing (OR = 0.322; 95% CI: 0.142-0.730; p= .007) decreased the odds of CCNs intention to report to work.

Impact of education on intentions. Other studies have indicated that education and training may influence willingness to report to work (Balicer et al., 2010, 2006; Rutkow et al., 2017). Balicer and colleagues (2010) reported that HCWs with a bachelor's degree (OR: 0.63; 95% CI: 0.49-0.81) or high school diploma (OR: 0.51; 95% CI: 0.38-0.67) were significantly less likely to report than those holding professional degrees (reference group). Differences in intention to report by educational attainments (bachelors' degree versus professional degree) were confounded in these earlier studies by the differences in professional versus supportive health care worker roles. In this study that sampled only CCNs, the impact of education highlighted the unique impact educational attainment had on nurses' intentions to report.

Although this study did not capture participants' primary role (staff nurse, clinical nurse specialist, nurse manager), it is possible that nurses holding graduate degrees are more likely to be in management positions and not in direct-care positions. This could influence intentions and should be examined in future studies. While there may be a relationship between education and perceived self-efficacy, those educational variables that remained significant in the logistic regression models did so after adjusting for perceived self-efficacy in this study. All odds ratios reported are adjusted odds ratios, meaning that when perceived self-efficacy is controlled for, participants with a bachelor's degree outside of nursing were a third as likely as their other colleagues to intend to report to work. Those with master's degrees in nursing were 6.620 times more likely to report when the severity of the pandemic was factored in. Therefore, it will be important to examine what other potential factors could be associated with this difference, and role/position within the institution should be examined. This could be significant, as role, more than degree, may influence risk perception. Those individuals in direct care roles (bedside nurse, nurse practitioner) may have a different perception of susceptibility and severity than those individuals in roles that do not have direct care responsibilities (clinical nurse specialist, nurse manager, nurse supervisor). Capturing these differences will be an important next step in further studies.

Hours worked per week. There was a trend suggesting that CCNs who worked more hours were more likely to report in the event of a pandemic flu (p= .071), However, hours worked per week did not uniquely and significantly impact intentions to report overall (Table 12). When participants were asked their intention to report to work during a pandemic flu if asked to work extra, those CCNs who worked more hours were more likely to agree to work extra (p =.019). This remained significant when adjusting for other the contribution of other variables. Specifically, participants who work more hours were 1.065 times more likely to intend to report to work (95% CI: 1.026-1.105; $p \leq .001$) when asked to work extra. Devnani's (2012) review of the literature supports this finding. She identified two other studies that

reported participants who were employed part-time were less likely to work during a pandemic influenza. Additionally, Aoyagi and colleagues (2015) demonstrated that employees who worked full-time were more willing to report than those who worked less than full-time.

This is a critical finding in pandemic planning and preparedness. Many organizations would likely assume that their per diem and part-time employees would form an existing pool of labor from which to build surge capacity. However, the findings in this study and previous work have indicated that in fact employees who work fewer hours per week are less likely to be willing to work in addition to their regularly scheduled shifts. This is a significant finding that suggests that disaster planning should not assume additional critical care nursing resources can be mobilized from part-time or per-diem nurses.

Having more than one employer. Having multiple employers had no effect on CCNs intention to report in any of the three scenarios. Nonetheless, for disaster planning purposes, it is important to note how many CCNs in this study reported that they work for more than one employer, as this has practical implications on efforts to increase nurse staffing in the event of a pandemic. While only 15.8% of respondents reported that they had more than one employer, 76% of those believed that each unique employer would expect them to report to work during a pandemic flu emergency. Employers should assess how many of their employees have other jobs and factor this in to their staffing plans.

Organizational Characteristics

Prior research on nurses' intentions to report in the event of a pandemic sampled one hospital or hospital system and did not analyze the impact of unique organizational characteristics. The current study is the first to examine how organizational characteristics from acute-care settings across the United States may influence CCN intentions to report in the event of a pandemic. Organizational characteristics examined in this study included whether the primary employer was (1) an academic medical center, (2) a designated trauma center, (3) whether nurses were members of a CBU, (4) average number of patients cared for during shift, (5) whether the facility had Magnet® designation, (6) whether

employer required staff to receive annual influenza vaccine, and (7) whether employer provided annual training on personal protective equipment (PPE). Results from this study found that all but one of the organizational characteristics measured in this study had no impact on CCNs' intention to report in any of the three scenarios. Only being employed by an organization where nurses were members of a CBU was found to be significantly associated (p = .030) with intentions to report to work regardless of severity. While a majority of CCNs represented in a CBU would report to work regardless of severity (69.8%), this was less than the 82.4% of CCNs who are not in a CBU but intend to report. However, after adjusting for the other variables, membership in a CBU did not remain significant.

The overrepresentation of CCNs employed by Magnet® hospitals was addressed earlier in this chapter. Namely, nurses employed by Magnet® hospitals comprised 40% of the nurses in the sample, while Magnet®-designated hospitals only comprise about 8% of all hospitals in the United States. Magnet® hospitals have similar organizational characteristics and as such, the impact of organizational characteristics may have been diluted by this overrepresentation. Nonetheless, given that this is the first study on CCNs willingness to respond in the event of a pandemic, it is noteworthy that organizational features of the employer did not have an influence on their intention; rather, factors associated with personal and professional characteristics impacted CCNs' decision to report.

Limitations

While efforts were made in design and implementation to reduce limitations and bias in the study, it is crucial to discuss limitations to determine the generalizability and applicability of the findings. First, the current study used a cross-sectional design and thus causality cannot be established. Second, data was self-reported and individuals may have over or under-reported to present a socially desirable outcome. Furthermore, respondents may have made inadvertent errors about their primary employer. Third, historical bias may have influenced participants' responses. However, to limit historical bias, data collection occurred over several months and outside of the historical influenza season (October-April).

Fourth, recruitment was a convenience sample. Although the initial design called for a random sample of AACN members, response rates were low, and thus the recruitment strategy was changed to a convenience sample of AACN members. The resultant sample was reflective of AACN membership with regards to gender and age, but was not reflective of AACN membership with regards to highest nursing degree obtained, race, and years in critical care. Thus, generalizability of the results to all CCNs is not possible and interpretation of findings needs to consider the convenience sample. Due to the adaptations made to the overall survey instrument, retesting of the instrument should be done to confirm validity.

The current study utilized the Johns Hopkins ~ Public Health Infrastructure Response Survey Tool (JH~PHIRST) to examine the impact of threat and efficacy on CCNs' intentions. Limitations of the JH~PHIRST were briefly discussed in Chapter Three. To expand on those limitations, in this study the JH~PHIRST was modified, and while there was a strong Cronbach's alpha for the instrument, there are no prior published values to compare it to (Balicer et al., 2010; Devnani, 2012; Errett et al., 2013). With the modifications made, the instrument would need to be retested in other populations prior to generalizing the findings. Grounding the instrument design and modifications and study design in the Expanded Parallel Process Model (EPPM) and the Theory of Planned Behavior (TPB) supports the construct validity of the results. It is also difficult to generalize the findings on intention to report to work to the overall critical care nurse population in the United States. First, the sample was recruited only from AACN membership, and additionally, while sufficiently powered for the study design, the sample size (*N*=245) is quite small compared to the estimated 503,000 critical care nurses in the country (Society of Critical Care Medicine, n.d.).

Implications for Nursing Practice

The study findings revealed several implications for future nursing practice. Perceived self-efficacy was the only factor measured in this study that was significantly associated with intentions to

report to work in all three scenarios. This finding highlights the critical importance of fostering and improving perceived self-efficacy among CCNs. It suggests that enhancing perceived self-efficacy would result in increased intentions of reporting to work during a pandemic influenza. Recent research on the Extended Parallel Process Model (EPPM) also indicates that enhancing efficacy is a more effective way of increasing willingness to report than providing interventions aimed at modifying risk communications to employees or targeting threat perception (Barnett et al., 2014). In the EPPM, overall efficacy is comprised of perceived self-efficacy and perceived response efficacy. Cipriano (2018) recently commented on our obligation to protect nurses and all other HCWs through the provision of appropriate PPE, including the training to safely don and doff without self-contamination, and the creation of other systematic supports for frontline workers. The response efficacy depends on adequate preparation and resources to protect the CCNs. While perceived response efficacy did not remain significant when adjusting for other factors in the model on severity (Question 1.b), it is likely that this would change in an actual situation if CCNs did not believe that the response plan would both keep them safe and improve patient outcomes.

A recent study of non-clinician municipal workers in Germany demonstrated that increased self-efficacy was associated with an increase in willingness to report to work (Von Gottberg et al., 2016). Using path analysis, the researchers demonstrated that increased self-efficacy also decreased feelings of susceptibility and increased employees' sense of duty to their positions. Given the discussion of duty to report for nurses and HCWs in general in Chapter Two, being able to relate sense of duty and increased self-efficacy could greatly contribute to intentions to report to work. The EPPM purports that to get an adequate response, in this case to have CCNs report to work, there needs to be "the right balance between threat appraisal and self-efficacy expectations" (Von Gottberg et al., 2016, p. 3). If interventions that increase self-efficacy lead to the secondary benefit of decreasing perceived susceptibility (a component of threat) then the results are duplicative.

Another practical implication identified in this study is that nurses who work less than 32 hours per week are not likely to work extra shifts or additional hours; indeed, those who work more hours per week are significantly (1.065 times) more likely to intend to report if asked to work extra (OR: 1.065; 95% CI: 1.026-1.105; $p \leq .001$). Models estimating CCNs or RNs surge capacity in the event of a pandemic should account for the modest ability or willingness of nurses to work extra. Indeed, during the 2009 H1N1 pandemic New Zealand saw a 15-fold increase in hospital admissions for Acute Respiratory Distress Syndrome (ARDS) requiring critical care (Honey & Wang, 2013). Such an increase would require increasing staffing over an extended period of time and the results of this study suggest that it would be difficult to achieve and maintain CCN staffing for a similar scenario here in the US.

The results highlight that different scenarios (regardless of severity, if asked to work extra) significantly impacted the proportion of respondents who indicated their willingness to report to work. This is important at a practical level because information sharing and communication could be crucial in shaping decision-making around critical care nurse staffing and planning. Intentions of reporting to work continue to serve as a proxy for measuring the actual behavior. In this it is important to remember that an intention or planned behavior "refers generally to people's expectations regarding the degree to which they are capable of performing a given behavior" (Ajzen, 2002, pp. 676–677). There will be factors in a pandemic that are external to the individual's control such as personal illness or the illness of close family/friends that may impact their intentions. Other external forces may include the closure of daycares or schools and other forms of social distancing. It is possible that these considerations were not made when responding to the survey instrument.

Implications for Research

Ongoing research should further explore factors (internal and external) that may impact perceived self-efficacy among CCNs given the consistent association with intentions to report in the event of a pandemic. Secondly, the adaptations of the JH~PHIRST should be tested in a larger population

that includes RNs to evaluate if there are differences in perceived self-efficacy between RNs and CCNs and if that difference impacts intention to report. Third, future research should replicate this study with a larger sample size and more diverse sample (race/ethnicity, non-AACN membership, CCN role) to increase generalizability. Finally, future research should examine CCNs who are trained to care for patients requiring advanced respiratory therapies and/or ECMO and who work within ECMO programs.

Perceived self-efficacy significantly impacted intentions across all three outcome variables even when adjusting for other variables. Investigating and understanding what factors influence self-efficacy in CCNs is a logical next step. Perceived self-efficacy "is said to refer to 'beliefs in one's capabilities to organize and execute the courses of action required to produce given levels of attainment'" that is, it is focused on control over the behavior, and not necessarily the outcomes (Ajzen, 2002, p. 667). Specifically investigating what factors contribute to CCN perceived self-efficacy around pandemic preparedness and other events may result in altered standards of care or a change in the normal operation conditions. Understanding what contributes to perceived self-efficacy in CCNs is important, as this factor remained significant when adjusting for other characteristics such as education level, age, and race.

The JH~PHIRST was adapted for use in this study, and based on publications utilizing it, it continues to be adapted by the primary authors. This tool has demonstrated construct validity, but frequent adaptation may compromise instrument validity. Therefore, ongoing instrument development and testing should be a priority. Given the active body of research and the shift in focus to create interventions to improve intentions, collaboration among researchers would be beneficial in moving work forward and strengthening plans and overall pandemic preparedness.

Another benefit of this study is the demonstrated reliability of the tool, JH~PHIRST, with the calculated and reported Cronbach's alpha. As previously mentioned, the lack of reporting on the validity and reliability of the tools used in studies of intentions or willingness to report to work has been a

limitation of this field of research. Cronbach's alpha is a measure of internal consistency and reliability and cannot be conflated to indicate the validity of the instrument. However, the combination of review of the adapted instrument by a panel of experts and the high Cronbach's alpha calculated in this study shows that the adapted version of the JH~PHIRST used in this study was successful in consistently measuring the constructs in this population. Future studies wishing to use the reported value of Cronbach's alpha would then need to use the adapted version of the instrument.

Limitations of this study included a lack of representation with regards to race and ethnicity, restriction to AACN members, overrepresentation of participants from Magnet® hospitals, and not collecting specific CCN roles within their organizations. Replication of this study could be designed in such a way as to address these limitations. Replication would support the findings in this study and increase the generalizability of the findings (Cresswell, 2009).

The importance of examining CCNs who have the knowledge, skill, and ability to care for patients requiring advanced therapies like ECMO is multifold. Gathering such knowledge will inform ECMO capacity at both regional and national levels, illustrating how they may be impacted during a pandemic. The current study did not capture data on whether participants were trained to care for patients requiring ECMO and whether primary employers had an ECMO program. However, most participants (82.78%; *n* =202) responded that they "strongly agree or agree" that a pandemic flu emergency would create an increased number of patients requiring ECMO. Since CCNs work in a wide variety of settings and specialties, not all CCNs have been trained to care for ECMO patients or even work in facilities that provide such care.

During the H1N1 pandemic in 2009, subgroups of CCNs in New Zealand were disproportionately affected. In particular, nurses who were trained to care for patients requiring extra-corporeal membrane oxygenation (ECMO) were frequently asked to work in addition to their normal shifts (Harrigan et al., 2010; Honey & Wang, 2013; The ANZIC Influenza Investigators, 2009). Honey and Wang

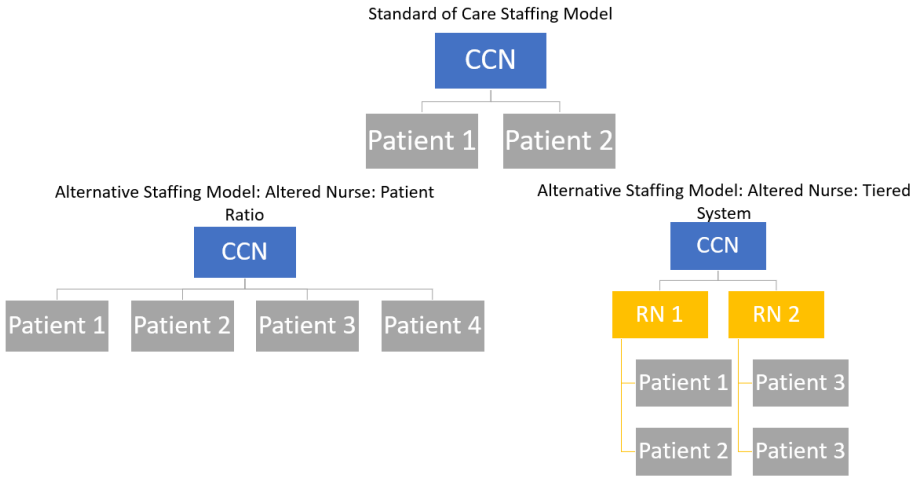
(2013) stated “the majority of ECMO nurses (89%) reported having worked between 1 and 10 extra shifts” (p. 66).

Another important point is that this study only measured CCN intentions of reporting to work during a hypothetical situation, a strategy often employed when actual behaviors are difficult to measure (Ajzen, 2002; Conner & Armitage, 1998; Hutchinson & Wood, 2007). However, this study demonstrated that conditions external to the CCN significantly impacted intentions; therefore, research that captures intentions prior to an event and then measures behavior during an event would be ideal. The practicality of this is limited due to the unpredictable nature of a pandemic flu emergency, or even the other scenarios that the JH~PHIRST has included in previous studies (weather, dirty bomb, and inhalation anthrax bioterrorism events) (Balicer et al., 2006; Errett et al., 2013). Further research is needed to examine the relationships between intentions and behaviors in CCNs and the impact that external conditions may play on influencing a change between intention and action.

Tying in with the implications for policy is the need to conduct research on alternative staffing models and crisis standards of care. If a pandemic flu emergency results in an increase in patients requiring critical care that exceeds existing capacity at any level, there will be the need to deviate from the standard of care, at least for a time. Alternative staffing models have been proposed for the provision of nursing care under these circumstances. The two most common proposals are (1) increasing the number of patients that a CCN cares for at one time, and (2) creating a tiered system by which CCN nurses supervise nurses and clinicians from other specialties in the provision of critical nursing care. Figure 4 provides a brief visual depiction of the various models (Cassidy, Munari, Forbes, Remick, & Martin, 2019; Daugherty & Rubinson, 2011).

Figure 4.

CCN Staffing Models: Standard of Care and Proposed Alternatives



Knowing that the need for alternative staffing is likely, it would be beneficial to test these models to determine feasibility and acceptability prior to implementation. These could be studied utilizing simulation or in the clinical setting through the creation of a shadow staff of nurses (to avoid negatively impacting patient care).

Implications for Theory

Two theoretical frameworks underpinned this study, from the design of the instrument, to the interpretation of the results. Constructs of the Extended Parallel Process Model were supported by this study, specifically that perceived efficacy impacts how individuals process information and arrive at a decision, in this case their intentions to report to work. We see that those individuals with high perceived efficacy are more likely to indicate that they intend to report to work than those with low perceived efficacy. However, the expected influence of perceived threat did not achieve statistical significance in the results of this study. There were no significant differences in intentions to report to work between the high and low perceived threat groups. One reason for this may be the homogeneity within the sample; critical care nurses may have similar threat perceptions as a result of their

experiences and understanding of disease transmission, thus limiting variation in responses and lack of significance.

Additionally, the Theory of Planned Behavior/Theory of Reasoned Action (TPB/TRA) was used to frame this study's design and subsequent evaluation of data collected. Using this framework, only perceived self-efficacy was significantly associated with intentions. Both frameworks used were beneficial in guiding the development of the instrument, study design, and interpretation of results; however, neither framework appears to have captured the full breadth of factors that impact CCN intentions of reporting to work during a pandemic flu emergency. It could be that the lack of significance of other key components of both theories (perceived threat, perceived response efficacy, organizational or personal characteristics) was the result of underlying homogeneity within the group. That is, given that only CCNs were surveyed, is there some other trait/factor that is similar to all individuals who would enter this position, that accounts for this.

An ideal next study would examine this using two methods. First, use of qualitative interviews and/or focus groups with critical care nurses to explore the concepts of the study and add depth that may not have been captured in the initial study. Next, it would be important to compare CCNs with the broader nursing population. For example, are there differences in intentions between nurses who care for critically ill patients requiring specialty skills and advanced support mechanisms and nurses caring for other patient populations?

More broadly, both frameworks were useful in addressing the issue at hand, which was to measure intentions as an antecedent of/proxy for the desired outcome, which is reporting to work during a pandemic flu. Kagee and Freeman (2008) reported, "the likelihood of an individual engaging in a health behavior… is correlated with the strength of his or her intention to engage in the behavior" (p. 362). Given the unpredictable nature of influenza pandemics it may be some time before the results of this study can be compared to actual CCN behavior in such a circumstance, but doing so would further

add to the body of knowledge supporting both the Theory of Planned Behavior and the Extended Parallel Process Model.

Implications for Education

The results of this study could be used to create educational materials for policy makers and healthcare leaders around CCN intentions and the impact that has on pandemic preparedness. Understanding intentions and having data on CCNs to inform staffing and resource models is important in pandemic preparedness. Key stakeholders in pandemic response need to have an appreciation and awareness of how perceived self-efficacy among CCNs has a profound impact on nurses' willingness to report in the event of a pandemic.

Perceived self-efficacy was significantly associated with intentions to report to work across all three scenarios (intend to report, intend to report regardless of severity, and intend to report to work if asked to work extra) and higher perceived self-efficacy meant a greater intention to report to work. Research has demonstrated that enhancing efficacy is more important than altering threat perception when it comes to increasing willingness to report to work (Barnett et al., 2014). Tailored educational interventions have demonstrated a significant impact on intentions and could be beneficial for facilities wishing to influence intentions among their CCNs. Additionally, the Theory of Planned Behavior (TPB) recommends that regression analysis be utilized to test relationships between the constructs, as was done in this study, and that the relative weights of these relationships be used to determine which constructs are "most important to target for behavior change efforts" (Montano & Kasprzyk, 2008, p. 75). Based on this recommendation and the results of this study, emphasis should be placed on educational efforts to enhance perceived self-efficacy.

This study also has implications for both pre-licensure and graduate nursing education. Ben Natan (2015) and colleagues demonstrated that only half of the nursing students in their study were willing to report to work during a hypothetical future pandemic. They also demonstrated that perceived

self-efficacy was already a significant influencer on willingness, even prior to beginning to work as a nurse. Wilkinson and Matzo (2015) argue strongly for the inclusion of all-hazards disaster training in undergraduate nursing education. They identify that surveys of nurses over the past 15 years have consistently identified the need for education and training on these topics, and that multiple organizations advocate for increasing nurse and other HCW preparation on these topics, including the World Health Organization, the International Council of Nurses, and International Nursing Coalition for Mass Casualty Education. The National League of Nursing and the National Organization of Associate Degree Nursing have developed core educational competencies for associate degree nurses, but stop short of identifying their roles and responsibilities during mass casualty events. However, despite the recommendations of these organizations and others, specific preparation and training remain absent in most nursing school curriculums (Wilkinson & Matzo, 2015).

As demonstrated, the nature of a pandemic influenza may decrease the number of critical care nurses reporting to work coupled with an increased demand for critical care capacity due to the nature of influenza illness. Critical care nurses have a specialized skill set requiring post-graduate education and training. It is estimated that the cost of replacing an experienced CCN ranges from $64,000 to $85,197 (American Federation of State, County, and Municipal Employees, 2019). More than the cost, orientation to the critical care environment typically ranges from three months to six months in length depending on the institution and prior experience of the nurse (Morris et al., 2009).

Opportunities to provide education and training on critical care therapies like ventilator management and hemodynamic monitoring are rarely offered to nurses outside of critical care environments or certain specialties. The cost associated with providing nurses with this training in anticipation of a pandemic would likely be considered excessive. However, the use of web-based learning management systems could be considered for just-in-time training during a pandemic. AACN has developed the Essentials of Critical Care Orientation (ECCO) program that is widely used as part of

critical care nurse orientation, at a cost of $230-$305 per student plus institutional licensing fees. Individual modules of the course are also available for purchase. Consideration of tools like these or the creation of a feasible plan for just-in-time training of nurses would be beneficial to supporting the tiered staffing models proposed in the section on implications for research above.

Implications for Policy

The researcher was unable to identify another study that assessed, at the national level, the intentions of CCNs to report to work. By definition, pandemics are not confined by a narrow region. Further research should be national in scope to elicit information that will be crucial in shaping pandemic preparedness planning and the development of crisis standards of care across the United States. As detailed in Chapter Two, during a pandemic flu emergency there will be two types of absenteeism among HCWs, those who are ill and unable to work, and those who choose to stay home for other reasons. Realistic plans should factor both of these populations into consideration when creating staffing models.

As discussed above, overall 86.9% of respondents indicated that they intend to report to work during a pandemic flu emergency, 78% of respondents intend to report regardless of severity of the pandemic, and 62.8% of respondents intend to report if asked to work extra. These results were calculated and interpreted to yield conservative estimates. Still this means that 13.1% of CCNs do not intend to report to work during a pandemic flu emergency and 22% do not intend to report when severity is factored in to the decision-making process. The literature has identified that CCNs are frequently the rate-limiting resource when it comes to increasing critical care capacity (Harrigan et al., 2010; Roccaforte & Cushman, 2007). Current estimates are that there are 503,000 CCNs in the United States and almost 78,000 licensed critical care beds; moreover, approximately 55,000 critically ill patients are cared for each day in hospitals across the country (Society of Critical Care Medicine, n.d.).

If we look at the impact of the CCNs not reporting to work we quickly see the magnitude of their absence. If we assume that hospitals are currently adequately staffed with CCNs to care for the 78,000 licensed critical care beds, a 13% decrease in nurses reporting to work drops capacity to 67,860 beds and a 22% decrease results in a capacity of 60,840 beds. Of course, staffing adequacy is impacted by region and is different at the level of the facility, but this is a cursory overview of the impact on critical care capacity. Furthermore, if 13.1% of all CCNs did not intend to report to work this would result in a viable workforce of 437,107 CCNs, and if 22% do not intend to report to work when severity is factored in it drops to 392,340—a loss of over 100,000 CCNs from the workforce. This scenario does not factor in an increased demand for critical care beds, or CCN absence from work due to illness, both of which would be likely.

Summary

To the best of this researcher's knowledge, this study is the first to examine CCNs' intentions to report to work during a pandemic flu emergency at a national level in the United States. CCNs were selected because this subpopulation of nurses is often a limiting factor in a hospital's ability to increase critical care capacity. Moreover, this dissertation study investigated personal, professional and organizational factors that may influence CCNs' intentions of reporting to work during a pandemic flu emergency. Results found a significant relationship between perceived self-efficacy and CCNs' intentions to report to work, and this relationship remained significant after accounting for other variables. In fact, perceived self-efficacy influenced CCNs' intentions to report to work regardless of the severity and even if CCNs were asked to work longer/more shifts. Interventions designed to target perceived self-efficacy as a means of increasing intentions to report to work are supported both from a practical perspective as well as the theoretical underpinnings of this study (Barnett et al., 2014; Montano & Kasprzyk, 2008). Some examples could include training on role-specific responsibilities during a pandemic or other interventions targeted to increase self-efficacy in the management of critically ill patients. Findings from

this study provide a baseline on which to conduct additional research on CCNs' intentions to report to work during a pandemic flu emergency and have the potential to contribute to improvements in pandemic planning and preparedness.

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Appendix A.
Survey Instrument

Dissertation Survey_Jan_13_2017

Q1 You are being asked to participate in a research study titled "Critical care nurse intentions to report to work during an influenza pandemic". You were invited to participate in this project because you are a member of the American Association of Critical Care Nurses (AACN).

The purpose of this study is to investigate the factors that influence critical care nurses' intentions of reporting to work during influenza pandemics.

If you agree to participate, you will complete this survey online. It is anonymous and no identifying data will be collected. The survey should take approximately 10 minutes to complete. We anticipate that there will be minimal risks or discomforts from participation in this survey; however there may be unknown risks. The results of this survey could inform planning and practice for response to influenza pandemics, but there are no direct personal benefits for participants. You will not be compensated for the time spent completing this survey. There are no costs to you associated with your participation.

Your participation is voluntary. If you choose not to participate, it will not affect your relations with AACN or Boston College. You are free to withdraw from participation or skip questions for any reason. There are no penalties for withdrawing or skipping questions. You may also choose to enter a raffle for one of two Amazon Fire tablets or one of five $10.00 Starbucks gift cards. Participation in the raffle is also voluntary, the information collected there will not be linked to your survey responses.

If you have any questions or concerns regarding this research you may contact the Principal Investigator: Eileen F. Searle, PhD (c), RN, CCRN at 617-643-9321 or at eileen.searle@bc.edu. This research is being supervised by Dr. Judith Shindul-Rothschild, PhD, RN; she can be reached at judith.shindul-rothschild@bc.edu or by phone at 617-552-4270.

If you have questions about your rights as a research participant, you may contact the Office for Research Protections, Boston College at 617-552-4778 or at irb@bc.edu.

This study was reviewed by the Boston College Institutional Review Board and its approval was granted on _____.

If you agree to participate in this study, please press the "Consent Given" button below.

Q2 I agree to participate in the study.
- ❍ Consent Given (1)
- ❍ I do not wish to participate (2)

Q3 I am a critical care nurse. As such, I have experience working in "settings where patients require complex assessment, high-intensity therapies and interventions and continuous nursing vigilance." Examples of this including caring for patients requiring mechanical ventilation, titration of vasoactive medications, etc.

- ❍ Yes, I am a critical care nurse. (1)
- ❍ No, I am not a critical care nurse. (2)

Survey Instrument

As discussed in Chapter Three of this work, this study utilized an adapted version of the Johns Hopkins Public Health Infrastructure Survey Response Tool (JH~PHIRST) with permission of the authors. Chapter Three details the adaptations made and items added, for access to the primary instrument, please contact the primary authors.

Q33 My employer requires employees be vaccinated against influenza each year.
- ❍ Yes (1)
- ❍ No (2)

Q34 My employer provides annual training in personal protective equipment (PPE) for nosocomial infection prevention.
- ❍ Yes (1)
- ❍ No (2)

Q8 What is your current gender identity?
- ❍ Male (1)
- ❍ Female (2)
- ❍ Transgender Male/Trans Man/Female-to-Male (FTM) (3)
- ❍ Transgender Female/Trans Woman/ Male-to-Female (MTF) (4)
- ❍ Genderqueer, neither exclusively male or female (5)
- ❍ Additional gender category (or other), please specify (6)
- ❍ Choose not to disclose (7)

Q36 Please enter your current identified gender

Q9 Please enter your age in years.

Q21 Are you of Hispanic, Latino, or Spanish origin?
- ❍ Yes (1)
- ❍ No (2)

Q22 What is your race?
- ❍ White (1)
- ❍ Black or African American (2)
- ❍ American Indian or Alaska Native (3)
- ❍ Asian (4)
- ❍ Native Hawaiian or Pacific Islander (5)
- ❍ Other (6)

Q10 Please enter how many years of experience you have as an RN.

Q11 Please enter how many years of experience you have as a critical care nurse.

Q12 Indicate the highest nursing degree that you have.
- ❍ ADN (1)
- ❍ BSN (2)
- ❍ MSN (3)
- ❍ Nursing doctorate (DNP, PhD, DNS, etc) (4)

Q13 Indicate the highest non-nursing degree that you have.
- ❍ none (1)
- ❍ Bachelor's (2)
- ❍ Master's (3)
- ❍ Doctorate (4)

Q14 On average, how many hours per week do you work?

Q15 Do you work for more than one employer?
- ❍ No, I only have one employer (1)
- ❍ Yes, I have more than one employer (2)

Q16 Do you think that more than one of your employers would expect you to work during a pandemic flu emergency?
- ❍ Yes (1)
- ❍ No (2)

Q17 Do you have a partner/spouse?
- ❍ Yes (1)
- ❍ No (2)

Q18 Does your partner/spouse have a job that would require them to respond during a pandemic flu emergency?
- ❍ Yes (1)
- ❍ No (2)

Q19 Are you the primary caregiver of a child/children under 18 years of age?
- ❍ Yes (1)
- ❍ No (2)

Q20 Are you the primary caregiver of an adult family member?
- ❍ Yes (1)
- ❍ No (2)

Q23 Please enter the first three numbers of the zip code for your primary home address.

Q35 Please select the range that best defines your total household annual income.
- ❍ Less than $15,000 (1)
- ❍ $15,000 to $30,000 (2)
- ❍ $30,001 to $50,000 (3)
- ❍ $50,001 to $75,000 (4)
- ❍ $75,001 to $100,000 (5)
- ❍ $100,001 to $150,000 (6)
- ❍ Greater than $150,000 (7)

Q24 Please answer the following questions about your primary clinical employment site.

Q25 Please enter the first three numbers of the zip code for your primary employment site.

Q26 Is your employment site an Academic Medical Center?
- ❍ Yes (1)
- ❍ No (2)

Q27 Is your employment site a designated Trauma Center?
- ❍ Yes (1)
- ❍ No (2)

Q28 What level Trauma Center is it?
- ❍ I (1)
- ❍ II (2)
- ❍ III (3)

Q29 Are the nurses part of a collective bargaining unit/union?
- ❍ Yes (1)
- ❍ No (2)

Q30 Does your facility have Magnet Status?
- ❍ Yes (1)
- ❍ No (2)

Q31 How many patients do you typically care for at one time during an average shift in a critical care setting?

Q32 Thank you very much for completing this survey. Your responses have been recorded. If you would like to participate in the raffle for one of two Amazon Fire tablets or one of five $10 Starbucks gift cards please click on the following link. The information provided at that link will to be connected to the survey answers you just provided. https://bostoncollege.co1.qualtrics.com/jfe/form/SV_0rLIFRq21EfMCy1

Appendix B.
Recruitment Letter

Greetings,

You are being asked to participate in a study examining critical care nurses' intentions to work during a pandemic flu emergency. You were selected to be in the study because you are a member of the American Association of Critical Care Nurses. Only critical care nurses who are in active practice are invited to participate. The purpose of the study is to more fully understand the factors that can facilitate the response of critical care nurses to a pandemic flu emergency, as well as barriers that critical care nurses may face when reporting to work during a pandemic flu emergency.

This study will be conducted through an online survey. The survey will take you approximately 10 minutes to complete. You will be able to exit the survey and return to it at a later time through the survey link should you need to. There are no costs to you associated with your participation. Your participation is voluntary.

You can complete the survey on a smart phone, tablet, or computer. The link to the electronic survey is: **http://tinyurl.com/CCNFluSurvey** You can also access the survey with the QR code at the bottom of this letter using your smart phone. A reminder post card will be automatically sent during the survey collection period. This postcard will also contain the link to the survey.

There are no direct benefits to you, but it is through the help of critical care nurses like you that we can understand how to best prepare for a pandemic flu emergency and develop comprehensive plans that support nurses. As a gesture of appreciation, once you have completed the survey, you will have the option to be enrolled in a raffle to win one of two Amazon Fire tablets or one of five $10.00 gift cards to Starbucks.

No identifying information will be linked to your responses. The Boston College Institutional Review Board and Boston College internal auditors may review research records of this study.

This study was reviewed and approved by The Boston College Institutional Review Board (insert date). If you have any questions or comments, please feel free to contact the Principle Investigator, Eileen Searle, PhD(c), MSN, RN at eileen.searle@bc.edu or 617-643-9321. If you have any questions about your rights as a person in this research study, you may contact Stephen Erickson, Director, Office for Research Protections, Boston College at (617) 552-4778 or irb@bc.edu.

Thank you for your time,

Eileen F. Searle, PhD(c), RN

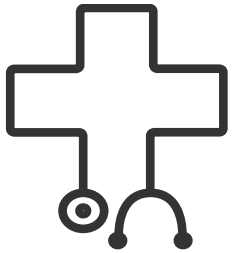
Use the QR Code reader on your smart phone or tablet to access the survey, or use the link provided above.

Will we be ready when a pandemic occurs? Will you be?

Please participate in a 10-minute survey on Pandemic Flu preparedness

Critical Care Nurse Pandemic Flu Study

http://tinyurl.com/CCNFluSurvey



Critical Care Nurse Pandemic Flu Study

http://tinyurl.com/CCNFluSurvey
Will our health care system be prepared to respond?
Will you be?

This is an invitation to participate in a study on the facilitators and barriers critical care nurses face in reporting to work during a potential influenza pandemic.

This survey will take approximately 10 minutes to complete and you can access it using the URL provided or the QR code on the front.

After completing the survey you will have the option of entering a raffle to win one of two Amazon Fire tablets or one of five $10 Starbucks gift cards as a token of appreciation.
Thank you for your participation and please do not hesitate to contact me with any questions (eileen.searle@bc.edu or 617-643-9321). *Also, please feel free to share this with your critical care nurse colleagues.*

All the best, Eileen F. Searle, RN, CCRN

http://tinyurl.com/CCNFluSurvey

Appendix D.

AACN Chapter President Email

Dear {Chapter President}.

My name is Eileen Searle and I am a doctoral student at the William F. Connell School of Nursing at Boston College. I am currently conducting my dissertation research on *Critical Care Nurse Intentions to Report to Work During an Influenza Pandemic*. I am hoping that you will share the attached information with your chapter members in the hopes that they will participate in my study. This study was approved by the Boston College Institutional Review Board (details in attachment).

This study will provide valuable information to inform emergency preparedness and response plans and seeks to improve the resilience of our nursing workforce in the event of an influenza pandemic. The survey takes about ten minutes to complete online and no identifying information is collected; however, should participants wish to, they can enter a raffle for one of two Amazon Kindle Fires, or one of five $10 Starbucks gift cards. The sharing of information to enter the raffle is not linked to their survey responses.

Thank you for your time and assistance. Please do not hesitate to contact me with any questions or concerns, I can be reached at eileen.searle@bc.edu or by phone at 617-643-9321.

Eileen F. Searle, PhD(c), MPH, RN, CCRN

Appendix E. *Tables 1A-4A*

Table 1A.

Variables, Operational Definitions, & Associated Items

Variable	Operational Definitions	Item(s) to measure that variable
Dependent variable 1. *Intention to report to work during a pandemic influenza* Measured as part of the JH~PHIRST	CCN would plan to present to their place of employment to work for their regularly scheduled shifts during an outbreak of pandemic influenza.	• I intend to work my regularly scheduled shifts if a pandemic flu emergency occurs. (Q4_3)
Dependent variable 1a. *Intention to report to work regardless of severity* Measured as part of the JH~PHIRST	Allows the participant to indicate if the severity of a pandemic flu emergency would impact their intentions.	• I would be willing to report to work in a pandemic flu emergency regardless of severity. (Q4_19)
Dependent variable 1b. *Intention to work in excess of regularly scheduled shifts if asked to do so* Measured as part of the JH~PHIRST	Allows the participant to indicate if the expectation that they work in addition to their regular hours would impact their intentions.	• If I were asked to work more than my regularly scheduled shifts (longer shifts, extra shifts) during a pandemic flu emergency, I would do so. (Q4_4)
Independent Variable 1. *Perceived self-efficacy* Measured as part of the JH~PHIRST	CCN self-reported belief that they would be able to report to work and that they have the knowledge, ability, skills to make a positive impact on patient outcomes.	• I am confident that I could safely get to my employment site to work during a pandemic flu emergency. (Q4_8) • I am psychologically prepared to perform my critical care nurse role-specific responsibilities in the event of a pandemic flu emergency. (Q4_7)

Appendix E. *Tables 1A-4A*

		• I am knowledgeable about the potential public health impacts of a pandemic flu emergency. (Q4_5) • I know what my critical care nurse role-specific responsibilities are in the event of a pandemic flu emergency. (Q4_6) • I would be able to perform my critical care nurse duties successfully in the event of a pandemic flu emergency. (Q4_10) • My family is prepared to function in my absence if I am called to work outside of my regularly scheduled shifts during a pandemic flu emergency. (Q4_11) • *I have the knowledge and skills necessary to care for a critically ill, ventilated patient. (Q4_20)* • *I understand droplet and airborne isolation precautions. (Q4_21 & 23)*
Independent Variable 2. *Perceived response efficacy* Measured as part of the JH~PHIRST	CCN self-reported belief that the response to the pandemic flu emergency would be efficacious and they could contribute to that.	• My role, as a critical care nurse, is important in my employer's response to a pandemic flu emergency. (Q4_14) • If I perform my critical care nurse role it will be beneficial to the response to the pandemic flu emergency. (Q4_18) • *If I do not report to work for my regularly scheduled shifts during a pandemic flu emergency then patient care would be negatively impacted. (Q4_24)** • *I have to balance my professional responsibilities with responsibilities to my family. (Q4_25)* • *If I do not report to work during a pandemic flu emergency I could lose my job. (Q4_26)*

Appendix E. *Tables 1A-4A*

		• *My employer would provide the support and equipment necessary to keep me, my colleagues, and my family safe from influenza during a pandemic flu emergency. (Q4_22)* • My employer should provide pre-event preparation and training for pandemic flu emergencies. (Q4_15) • My employer will be able to provide timely updates about the developing situation during a pandemic flu emergency. (Q4_12) • *If I do not report to work during a pandemic flu emergency I could lose my nursing license. (Q4_27)* • *I have an ethical obligation to my patients to report to work during a pandemic flu emergency. (Q4_28)* • *I have an obligation to my coworkers to report to work during a pandemic flu emergency. (Q4_29)*
Independent Variable 3. *Perceived severity of influenza* Measured as part of the JH~PHIRST	CCN self-reported beliefs regarding the significance or magnitude of a pandemic flu emergency.	• If it occurs where I live/work, a pandemic flu emergency is likely to have severe public health consequences. (Q4_2) • *A pandemic flu emergency is likely to result in increased volume of patients requiring critical care. (Q4_13)* • *A pandemic flu emergency is likely to result in an increased number of patients requiring complex care like advanced respiratory therapies and extracorporeal membrane oxygenation (ECMO). (Q4_30)* • *If it occurs where I live/work, a pandemic flu emergency is likely to impact my health or*

Appendix E. *Tables 1A-4A*

		the health of my family &/or friends. (Q4_31) • *A pandemic flu emergency is likely to overwhelm existing healthcare resources and require a change in practice from normal operating conditions. (Q4_32)*
Independent Variable 4. *Perceived susceptibility to influenza* Measured as part of the JH~PHIRST	CCN self-reported beliefs about the risk to themselves and their family/friends during a pandemic flu emergency and if that risk is heightened due to their work.	• A pandemic flu emergency is likely to occur in the area where I live/work. (Q4_1) • *As a critical care nurse, I would be at increased risk of contracting influenza than a member of the general public. (Q4_16)* • *Due to my work as a critical care nurse, my family &/or friends would be at an increased risk of contracting influenza than a member of the general public. (Q4_17)* • *A pandemic flu emergency is likely to result in a shortage of healthcare workers capable of providing patient care. (Q4_33)* • *A pandemic flu emergency is likely to occur in the near future. (Q4_34)* • I am confident I would be safe at work during my employer's response to a pandemic flu emergency. (Q4_9)*
Independent Variable 5. *Organizational Characteristics*	Organizational characteristics were assessed of the primary employer, where participants had more than one employer. These were reported by the participant and there was no external corroboration of the self-report.	• Location (zip code of primary employer): Q25 • Academic Medical Center: Q26 • Trauma Center Designation: Q27, Q28 • RN union/collective bargaining unit status: Q29 • Magnet Status: Q30 • Staffing (average # of patients cared for at one time): Q31

Appendix E. *Tables 1A-4A*

		• Required annual influenza vaccination: Q33 • Employer provided annual PPE training: Q34
Independent Variable 6. *Personal Characteristics*	Personal characteristics were assessed by self-report.	• Gender: Q8 • Age: Q9 • Ethnicity/Race: Q21, Q22 • Annual Household income: Q35 • Has a Spouse/Partner: Q17 • Spouse/Partner has a response role: Q18 • Caregiver for child(ren) <18 years: Q19 • Caregiver for adult family member: Q20 • Location (Zip code of primary residence): Q23
Independent Variable 7. *Professional Characteristics*	Professional characteristics were assessed by self-report.	• Years as an RN: Q10 • Years as a CCN: Q11 • Highest Nursing Degree Obtained: Q12 • Highest Non-Nursing Degree Obtained: Q13 • Multiple employers: Q15, Q16 • Hours worked per week: Q14

*Reverse coded for scoring; *Italicized* items in the JH~PHIRST are new items or underwent heavy revision for this study.

Appendix E. *Tables 1A-4A*

Table 2A.

Personal Characteristics of Participants

Characteristic	*M* (*SD*)	Range
Age (in years) (*n= 228)*	41.8 (12.2)	22-70
	n	%
Gender	243	
Female = 0	220	90.5
Male = 1	23	9.5
Hispanic Ethnicity	242	
Yes = 1	10	4.1
No = 0	232	94.7
Race	241	
White = 0	208	86.3
Black or African American = 1	11	4.6
Asian = 1	13	5.4
Native Hawaiian or Pacific Islander = 1	4	1.7
Other = 1	5	2.1
Partner/Spouse	242	
Yes = 1	184	76.0
No = 0	58	24.0
Partner/Spouse has response role	183	
Yes = 1	26	14.2
No = 0	157	85.8
Parent/Caregiver for child(ren) under 18	240	
Yes = 1	72	30.0
No = 0	168	70.0
Primary Caregiver for adult family member	240	
Yes = 1	17	7.0
No = 0	223	93.0
Annual Household Income	237	
≤ $75,000	54	22.8
$75,001 to $100,000	58	24.5
$100,001 to $150,000	75	31.6

Appendix E. *Tables 1A-4A*

Greater than $150,000	50	21.1
HHS Region	239	
Region 1 (CT, ME, MA, NH, *RI*, VT)	36	15.1
Region 2 (NJ, NY, *PR, USVI*)	12	5.0
Region 3 (DE, DC, MD, PA, VA, WV)	27	11.3
Region 4 (AL, FL, GA, KY, MS, NC, SC, TN)	46	19.2
Region 5 (IL, IN, MI, MN, OH, WI)	25	10.5
Region 6 (*AR*, LA, NM, OK, TX)	31	13.0
Region 7 (IA, KS, MO, NE)	13	5.4
Region 8 (CO, MT, ND, SD, UT, WY)	15	6.3
Region 9 (AZ, CA, HI, NV, *Guam, American Samoa, Northern Mariana Islands, Micronesia, Marshall Islands, Palau*)	15	6.3
Region 10 (*AK*, ID, OR, WA)	19	7.9

Note: In HHS regions, italicized areas had no respondents within that location.

Appendix E. *Tables 1A-4A*

Table 3A.

Professional Characteristics of Participants

Characteristic	*M* (*SD*)	Range
Years as a RN *(n*=239*)*	15.9 (12.0)	1-47
Years as a CCN *(n*=239*)*	12.8 (11.3)	0.5-47
Hours worked per week *(n*=239*)*	38.3 (8.1)	
	n	%
Do you have more than one employer	241	
No, only one employer	203	84.2
Yes, more than one employer	38	15.8
Would all your employers expect you to come to work?	38	
Yes = 1	29	76.3
No = 0	9	23.7
Educational Characteristics		
Highest Nursing Degree	241	
AND	28	11.7
BSN	159	66.0
MSN	49	20.3
Nursing Doctorate (PhD, DNP, DNS, etc)	5	2.0
Highest Non-Nursing Degree	233	
None	149	64.0
Bachelors	71	30.6
Masters	12	5.0
Doctorate	1	0.4

Note:

Appendix E. *Tables 1A-4A*

Table 4A.

Organizational Characteristics of Primary Employer

Characteristic	*M* (*SD*)	Range
Average # patients cared for at a time *(n=232)*	2.2 (0.7)	1-7
	n	%
Employer requires annual influenza vaccination	244	
Yes = 1	229	93.8
No = 0	15	6.2
Employer provides annual PPE training	244	
Yes = 1	210	86.0
No = 0	34	14.0
Employer is an academic medical center	231	
Yes = 1	111	48.0
No = 0	120	52.0
Employer is a trauma center	233	
Yes = 1	135	58.0
No = 0	98	42.0
Trauma Center Level	135	
1*	74	54.8
2**	39	28.9
3***	22	16.3
Nurses in Collective Bargaining Unit (CBU)/Union	233	
Yes = 1	63	27.0
No = 0	170	73.0
Hospital has Magnet designation	233	
Yes = 1	93	40.0
No = 0	140	60.0

Note: Data analysis revealed that while some of the participants live in different states than where their primary employer is located, none of the participants had a home address and a primary employer that were in different HHS regions. Therefore, information on HHS region for employers is identical to that presented in the personal characteristics section.
Trauma Center Levels determined by the American College of Surgeons: *Level 1: 24/7 coverage by general surgeons with prompt availability of specialists; referral resource for region; organized teaching and research effort in trauma care. **Level 2: immediate coverage by general surgeons with prompt availability of specialists; provides trauma prevention and continuing education programs for staff. ***Level 3: 24/7 coverage by emergency medicine physicians with prompt availability of general surgeons and anesthesia providers.