Toward an alternate model of uncertainty management : managing cancer prevention information

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**TOWARD AN ALTERNATE MODEL OF UNCERTAINTY MANAGEMENT:
MANAGING CANCER PREVENTION INFORMATION**

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MANAGING CANCER PREVENTION INFORMATION

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in partial fulfillment of the requirements for the degree of
Master of Communication Studies (by Research)

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Statement of Originality

I hereby certify that the work embodied in this thesis is the result of original research, is free of plagiarised materials, and has not been submitted for a higher degree to any other University or Institution.

17 October 2019

Date

Jocelin Y. Lam

Supervisor Declaration Statement

I have reviewed the content and presentation style of this thesis and declare it is free of plagiarism and of sufficient grammatical clarity to be examined. To the best of my knowledge, the research and writing are those of the candidate except as acknowledged in the Author Attribution Statement. I confirm that the investigations were conducted in accord with the ethics policies and integrity standards of Nanyang Technological University and that the research data are presented honestly and without prejudice.

17 October 2019

Date

Professor May O. Lwin

Authorship Attribution Statement

This thesis does not contain any materials from papers published in peer-reviewed journals or from papers accepted at conferences in which I am listed as an author.

17 October 2019

Date

Jocelin Y. Lam

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Abstract

With rising cancer incidence and cancer mortality rates, cancer preventive screening is the recommended health prevention measure. However, global adoption rates remained sluggish. Past evidence showed that cancer screening avoidance is attributed to demographics, psychosocial barriers, and physical environmental factors, and lacked an adequate theoretical framework. The uncertainty management theory (UMT) provides the needed conceptual framework to explaining the avoidance phenomenon. UMT, however, has not been fully developed as there uncertainty constructs that are not quantitatively measured. The objective of this thesis is to (1) identify the sources of uncertainty, (2) establish a scale that operationally defines the sources of uncertainty, and (3) determine the predictive power of HUS on information avoidance and cancer screening intentions. The HUS consists of 19 items that addresses uncertainty with five dimensions. The scale was developed and validated through three phases of study, starting with interviews, items development, validation through EFA ($n=81$), CFA ($n=371$) and predictive validation. Five typologies, medical, financial, self-efficacy uncertainty, interpersonal relationship ramification, and social support availability emerged from the qualitative analysis and were quantitatively validated. Medical, financial, and self-efficacy uncertainties measure informational ambiguity on medical recommendations, risk, financial, and doubt in self ability to cope with the possibility of cancer occurrence. Interpersonal relationship ramification and social support availability measures perceived threat cancer occurrence has on treasured relationships and evaluation of the availability of social support. Survey results showed that medical uncertainty and interpersonal relationship ramification positively predicted information avoidance. Self-efficacy uncertainty negatively and social support availability positively predicted cancer screening intentions. Theoretical and practical implications are discussed.

Keywords: uncertainty management, cancer screening, avoidance, scale development

Toward an alternate model of uncertainty management:**Managing Cancer Prevention Information****Chapter 1. Introduction**

Cancer is the second leading cause of death globally. In 2018, 18.1 million new cancer cases. This figure has increased by approximately 40% since 2008, where there were 12.7 million new cases (Jemal, Bray, Center, Ferlay, & Forman, 2011; WHO, 2018). Cancer incidence and cancer mortality rates are continuing to climb. The International Agency for Research on Cancer (IARC) estimates that 27.5 million new cancer cases and 16.3 million cancer deaths would occur by 2040 (Bray et al., 2018). To fight against the global burden of cancer and manage the cancer epidemic, major cancer centers, international and local health authorities adopted comprehensive efforts that promote prevention, early detection, and treatment. Specifically, preventive screening is recommended as it is a form of medical test to detect signs of cancer or abnormal tissue growth before symptoms appear. According to health experts, abnormal tissue or cancer when detected early is more treatable, which increases survival rates and ease needless suffering (American Cancer Society, 2019; National Cancer Institute, 2017). Despite the constant publicity of the benefits of preventive screening, the uptake screening is still low for many forms of cancers (von Wagner, Semmler, Good, & Wardle, 2009; Waller, Whitaker, Winstanley, Power, & Wardle, 2014).

Research studies have associated low screening uptake rates with demographics (e.g., age, SES, education), psychosocial barriers (e.g., emotions, self-evaluation, communication with physicians), and physical environment (e.g., distance to screening facilities) (Bukowska-Durawa & Luszczynska, 2014; Carter-Harris, Brandzel, Wernli, Roth, & Buist, 2017; Lyons & Chamberlain, 2012). These studies, however, are descriptive and lack a theoretical framework. There are several existing theoretical models, for example, *protection motivation theory (PMT)* and *extended parallel process model (EPPM)*, that attempt to explain the

avoidance of health behaviors. However, these conceptual models have focused on the impact of fear on health behaviors and information adoption and avoidance (Hong, 2011; Miles, Voorwinden, Chapman, & Wardle, 2008). Brashers' (2001, 2007) uncertainty management theory (UMT) is another such conceptual model that offers a theoretical lens to the phenomenon of health behaviours or health informational avoidance. Specifically, the study of uncertainty is pertinent as scientific and medical uncertainty permeates cancer and cancer preventive screening.

The UMT adopts the notion that uncertainty occurs due to informational ambiguity, complexity, and when the probabilistic judgment of an event or situation is unclear or unpredictable (Babrow, 2001; Babrow, Kasch, & Ford, 1998; Brashers & Babrow, 1996). UMT is an evaluative process in which people appraise the situation (e.g., cancer occurrence) to determine (1) whether the situation is a threat or an opportunity, (2) the availability of resources to cope and manage the situation and (3) ways to manage uncertainty. Brashers devises three strategies to managing uncertainty; avoiding information to *maintain* uncertainty and acquiring information to *reduce* or *increase uncertainty*. Like the PMT and EPPM, the UMT is an explicit theory and a parsimonious model in its prediction, but there are insufficient studies that verify this theory. For example, Brashers contends that uncertainty is multidimensional and that these sources of uncertainty predict avoidance or seeking behaviors. Current empirical studies (see Carcioppolo, Yang, & Yang, 2016; Rains & Tukachinsky, 2015b) on UMT focuses on the probabilistic judgment of the occurrence of an illness (e.g., "am I at risk of developing cancer?") but negates the cognitive appraisal of resource availability (e.g., "do I have sufficient resources, finances or social support, to cope with cancer?"). Second, identified sources of uncertainty describe the experience of patients with illness, and there is no empirical evidence from healthy individuals' perspectives. Intuitively, the premise of UMT is based on both patients and healthy individuals.

The development of UMT provides theoretical lens to explain avoidance behaviour, which allows health policymakers to improve screening uptake (or other health behaviours adoption). Using a mixed-methods design, this present study aims to develop and validate a multidimensional scale of uncertainty and determine the influence of the uncertainty measures on information avoidance and cancer screening intentions.

1.1 Summary of Chapters

This dissertation consists of six chapters. Section 1.2 elaborates on the uncertainty of cancer prevention screening to provide the context for the study. Chapter 2 surveys the literature that informs the direction of the study. Chapter 3 introduces the proposed, revised conceptual framework. Chapters 4 and 5 detail the data collection methods, procedures, and analysis. Chapter 6 discusses the research findings, implications, limitations and directions for future research.

1.2 Context: The Uncertainty of Cancer and Cancer Preventive Screening

Cancer is a debilitating disease that has devastating and pervasive impact on society. The increasing global burden of cancer and the physical, psychological, and social effects of the disease has garnered a great deal of scholarly attention. Uncertainty pervades at all stages of cancer, from prevention, detection, treatment, and end-of-life care and affects clinicians, healthy individuals, patients, and caregivers (Babrow & Kline, 2000; Han, Klein, & Arora, 2011). Cancer is a complex disease that is inherently filled with scientific and medical uncertainties and the determinant of cancer could arise from an extensive number of factors that directly contribute to the disease (Babrow et al., 1998; Brashers, 2007; Han, Moser, & Klein, 2006; Hurley, Kosenko, & Brashers, 2011). Often, an individual's absolute risk of cancer occurrence is unpredictable (Babrow et al., 1998), which increases uncertainty for people because one can never accurately determine their risk of cancer occurrence.

Furthermore, the ambiguity of cancer and cancer preventive screening communication add to the uncertainty of the disease.

Research indicates that the uncertainty of cancer is attributed to informational ambiguity and complexity caused by data deluge (Han et al., 2006; Viswanath et al., 2006). The data deluge is afforded by the proliferation of information delivered by the internet and mass media. Media is often the named source from which people receive health information and from which they learn about health and cancer (Cline & Haynes, 2001; Nelissen, Beullens, Lemal, & Van den Bulck, 2015b). However, much of the cancer information available publicly is ambiguous or overtly complex (Hurley et al., 2011; Ridd, Moeykens, & Colton, 2000; Viswanath et al., 2012). Ambiguity and complexity are posited to be a cause of uncertainty; uncertainty occurs when information of a situation is “ambiguous, unpredictable, complex, lacking in clarity, insufficient or conflicting”, or when contest exist in expert opinions” (Brashers, 2007, p. 478). In perhaps no other contemporary setting more conspicuous to cancer and cancer preventive screening communication.

The ambiguity of cancer communication stems from the ambiguous style in which writers adopt to disseminate health information to the public. Evidence show that uncertainty-provoking health context tends to exaggerate and sensationalize health claims that are often not supported by data or research and disregard the uncertainty of clinical trials. Furthermore, Campion, Martins, and Wilhelm (2009) found that uncertainty-provoking content in text is associated with increased cognitive interest, which motivates individuals’ to acquire information — the uncertainty in meaning of texts stimulates cognitive and emotional state of unrest or aversion. Hurley et al. (2011) found that 65% of cancer coverage news over the internet is filled with uncertainty-themed writing leading to ambiguous and complex messaging. They contend that news writers strategically develop content in an ambiguous manner to increase cognitive interest to improve readership. Creators of such content are

inclined to draw from single-source stories, and this trend is persistent in multiple medium (Holton, Lee, & Coleman, 2014; Schwitzer et al., 2005). For instance, ambiguous cancer information and content is ubiquitous in television programs (Schwitzer et al., 2005), printed news or magazine materials (Clarke & Everest, 2006), and the internet (Hurley et al., 2011). Additionally, it is reported that many health reporters lack specialized health training in health reporting and that they did not score well in health literacy. This is common among journalist covering health news, and their lack of health literacy is reflected in their writing, which further adds to the ambiguity (Keshvari, Yamani, Adibi, & Shahnazi, 2018; E. Smith, 2008).

Uncertainty is further heightened by media coverage of contention in expert opinions of cancer screening, which affects individuals' evaluation and perception of the effectiveness or efficacy of cancer screening and the preventability of cancer with the adoption of cancer screening (Han et al., 2006). The effectiveness and necessity of cancer preventive screening have been hotly contested among clinicians and health experts. There are medical controversies on most types of cancer screening tests (e.g., low-dose computer tomography lung screening, prostate-specific antigen PSA screening, mammography) (Berry, 2013; Chetlen, Mack, & Chan, 2016; Miller & Reuland, 2014; Ruano-Ravina, Pérez-Ríos, Casàn-Clarà, & Provencio-Pulla, 2018). Many social scientists lament that the reporting of medical controversies has increased medical uncertainty, public confusion, and scepticism of health recommendation (Dobias, Moyer, McAchran, Katz, & Sonnad, 2001; Fox, 1980; Schwartz & Woloshin, 2002). Consequently, uncertainty in cancer and cancer screening communication engenders message rejection or avoidance (Brashers, Goldsmith, & Hsieh, 2002; Han et al., 2006), health anxieties (Sugimoto et al., 2013), and fear (Nelissen et al., 2015b). The unpredictability of cancer coupled with the spike in cancer incidence in the last two decades

and the ambiguity of cancer prevention warrant a conceptual and empirical examination of the management of uncertainty concept and its influence on avoidance behaviour.

Chapter 2. Literature Review

2.1 The Nature and Characteristics of Uncertainty

At its fundamental, uncertainty has been conceptualised as a state of mind or an individual's cognition; "cognition is the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses" (The Oxford Dictionary and Thesaurus, 1995). Much of the definition are in unison that uncertainty is associated with individuals' cognizant of their lack of knowledge of some aspect of reality (Brashers, 2001; Folkman, Schaefer, & Lazarus, 1979; Han et al., 2006; Mishel, 1988; Mushtaq, Bland, & Schaefer, 2011). For instance, Mishel (1988, p. 225) defines uncertainty as the "inability to form a cognitive schema or determine the meaning of illness-related events." Brashers (2001, p. 278) asserts that "uncertainty is primarily a self-perception of one's own cognitive and ability to derive meaning of a given situation." The emphasis in uncertainty is the cognition, self-assessment that occurs as people are cognizant of their lack of knowledge of some aspect of reality. Hence, information is intricately linked to the state of uncertainty.

Another characteristic of uncertainty is the probabilistic assessment of an event, and that uncertainty is an evaluative or appraisal process in which individuals assess the probabilistic of occurrence. Uncertainty occurs when information or an event or a situation "is ambiguous, complex, unpredictable, unavailable or inconsistent, and when people are insecure of their state of knowledge or state of knowledge in general and that a curvilinear relationship is present between probability judgement and uncertainty, such that uncertainty is highest when the probability of occurrence is closest to 50% and lowest when closest to 0% or 100%" (Brashers, 2001, p. 478). Similarly, decision analysts (see Kahneman & Tversky, 2013) contend that regardless of the degree of vagueness of uncertainty, it is reducible to

“probability judgement,” where individuals are capable of estimating the probability of an event occurrence (Babrow, 2001; Babrow et al., 1998). In another vein contrasting the abovementioned uncertainty characteristics, several researchers argue for instances in which the likelihood of an event occurrence cannot be known (Dequech, 2000; Ellsberg, 1961). This notion of uncertainty defines uncertainty as “uncertain about uncertainty” and that it occurs, in part, due to the insufficiency of information or that the “reliability, credibility, or adequacy of information is questionable” (Han et al., 2006, p. 54). There is a subtle, nuanced difference between the definitions, and this form of uncertainty is also known as ambiguity. The latter definition fits closely with the uncertainty definition discussed previously. Under the theoretical ambiguity model, individuals still appraise the likelihood of occurrence, but they do not possess a clear calculated numerical probability or an accurate degree of knowledge and understanding of that probability. Instead, the assessment of likelihood is independent of one’s knowledge and relates with personal beliefs, therefore, “a person who believes that he or she is uncertain is uncertain” (Brashers, 2001).

The third characteristic of uncertainty is the relationship between the appraisal of uncertainty and emotions. Uncertainty, especially in the health threat context, is typically seen as a stressor that amplifies negative affective feelings (e.g., worry, fear, stress, anxiety) (Bar-Anan, Wilson, & Gilbert, 2009). Empirical literature highlighting individual differences in response to uncertainty and emotional reactions has lent support to the hypothesis. For instance, physiological experimental studies, under controlled conditions, found higher heart rate for high uncertainty stressors and lower heart rates for low uncertainty stressors (Averill, Olbrich, & Lazarus, 1972) and that the anticipation of a threatening situation give rise to significant increases in serum cortisol¹ and systolic blood pressure (Voigt, Ziegler, Grünert-

¹ Cortisol is a steroid hormone released by the adrenal glands. Whenever someone experience something the body perceives as a threat, a chemical known as adrenocorticotrophic hormone (ACTH) is released in the brain, which triggers adrenal glands to release cortisol and adrenaline. A higher cortisol level signifies higher perceived threat and be at a state of anxiety or fear.

Fuchs, Bickel, & Fehm-Wolfsdorf, 1990; Zakowski, 1995). These studies demonstrate that uncertainty creates a powerful stressor that impacts emotional reactions. In the health context, the uncertainty of incidence rate for any form of illness would constitute as a stressor, which would drive negative affect.

Further, Brashers (2001) identifies three uncertainty characteristics. These three characteristics of uncertainty present important insights and provide the rationale for developing the proposed theoretical framework. The three characteristics are (1) multi-layered, (2) interrelated, and (3) time-based (Brashers, 2001, p. 480). First, uncertainty is complex and multi-layered. Individuals generally surround themselves with layers of context. According to Brashers, these contexts could be about self (e.g., ability, values, attitudes, behaviour), relationships with others (e.g., durability and quality of these relationships), and social norms and rules. When evaluating the probability of an event's occurrence, individuals would simultaneously evaluate their self-concepts and abilities and whether the event contradicts with their beliefs or attitudes and affect their behaviour. Additionally, individuals are likely to evaluate more than one source of uncertainty (i.e., the occurrence of an illness). For instance, people may consider the impact on the event or their reaction to the event on their loved ones, how it would harm or benefit their loved ones, or how society would judge them or their actions and decisions. Hence, uncertainty is multi-layered.

The multi-layer or multidimensional characteristic of uncertainty gives rise to the interconnectedness of the different sources of uncertainty. According to Babrow (1995), this is where one source of uncertainty would cause dilemmas in another source. For instance, the uncertainty of required breast cancer treatment, e.g., mastectomy, could affect one's self-perception of one's own body and would consider whether their close family and friends would accept them after treatment.

Uncertainty is also temporal, in that uncertainty will cease to be a problem for individuals. Two situations have been suggested as cause where uncertainty would dissipate as time passes; (1) when a solution or information is found (managing uncertainty through information acquisition), uncertainty is resolved or (2) when nothing can be done to change the outcome or when there is no information, individuals are more willing to deal with dissonant information and tolerate ambiguity (Bar-Anan et al., 2009; Brashers, 2001; Case, Andrews, Johnson, & Allard, 2005; Folkman et al., 1979; Mishel et al., 2009).

The realization in the inadequacy of one's knowledge, the probabilistic self-assessment of the occurrence of an event, response to uncertainty leading to emotional reactions, multiple sources of uncertainty, the interconnectedness of multiple uncertainty sources, and the temporal nature of uncertainty constitutes to the nature and characteristics of uncertainty. The purpose of specifically defining and outlining these characteristics is to identify the distinct constructs of uncertainty, which provides direction and impetus to the research inquiry. These uncertainty constructs also lend support to the development of the health-related uncertainty management model (*HUMM*) proposed in this study (developed in a later section).

2.2 The Uncertainty Concept

To better understand the impact of uncertainty on healthy individuals' health and information behaviors, an examination of the uncertainty concept is needed. Uncertainty is a concept that has been widely and extensively examined for decades and across many disciplines, including health, nursing, psychology, and health communication. The resultant is the many conceptualisations of the concept to fit the different fields of study. A review of extant literature would aid in developing uncertainty measures.

Some of the most influential work illustrating the current uncertainty concept in the illness experience is contributed by Mishel, Babrow, and Lazarus and Folkman. They each

developed an integrative uncertainty concept of illness. However, current concepts of uncertainty focus either narrowly on specific groups of people or too broadly that failed to distinguish the target audience or the context. For instance, Babrow's (1998) meanings of uncertainty and Mishel's uncertainty of illness (1988, 1990) theory narrowly reflect the experiences of patients with existing illnesses; whereas Lazarus and Folkman's theory of stress and coping offers broad strokes appraisal and coping of stressors that applies on multiple aspects.

From the nursing literature, the term uncertainty of illness, coined by Mishel, was established and it was originally conceptualised to describe the experience of patients with acute illnesses (Mishel, 1988), and later included the experience of patients with chronic illnesses, such as HIV/AIDS (Brashers, 2001; Mishel et al., 2009). Mishel's notion of uncertainty is rooted in stress caused by an illness (Mishel, 1981). The uncertainty of illness theory centres on the experiences of patients and uncertainty occurs due to their "inability to determine the meaning of illness-related events." Mishel develops four distinct causes, i.e., ambiguity, complexity, deficiency, and unpredictability, of uncertainty. First, patients experience a stage of ambiguity or vagueness as they self-evaluate the state of illness. Second, the variety of cues about treatment and the system of care causes patients to experience *complexity*. Next, *deficient information* caused by unclear or insufficient information pertaining to diagnosis. Last, the lack of stability in the course of patients' illness and treatment outcomes leading to *unpredictability*.

In the communication literature, Babrow et al. (2001; 1998) integrates the many conceptualization of uncertainty to derive at his meanings of uncertainty. Babrow's meanings of uncertainty taxonomy, much similar but expansive to Mishel's uncertainty of illness, is essentially a conceptual taxonomy in healthcare that describes the sources of patients' uncertainty experience. The five meanings of uncertainty taxonomy are *complexity* which

arises due to the multicausality, contingency, reciprocity, and unpredictability in healthcare. Second, the *qualities of information* in which the degree of information is clear, accurate, complete, the volume of, ambiguous, consistent, applicable, and trustworthy. The third is the *probability* that is dependent on one's belief in a specific or range of probabilities. Next, the *structure of information* involving the logical or illogical order in which information is obtained and integrated with one's belief. Last, people's belief in a health situation known as "*lay epistemology*".

In psychology literature, Lazarus and Folkman (1984) develop the influential stress and coping concept that embodies the premise that people, faced with stressful situation, often "want to know what is happening and how it will impact their well-being, but they want to know it in a positive manner" (p. 46). Lazarus and Folkman (1986) found that people seek knowledge that supports their beliefs and that they evaluate the significance of the stressor about theirs and their loved ones' well-being. During the appraisal, information is the essence of knowledge. In their consideration of information during people's appraisal stage, Lazarus and Folkman offer a distinct but conceptually similar analysis of uncertainty.

The scholarly work of Babrow, Mishel, and Lazarus and Folkman provides the foundational definitions and concept of uncertainty in the health context. Their conceptualization of uncertainty also brought to light the characteristics and the defining features of uncertainty. The nature of uncertainty is vital as it informs the development of uncertainty constructs.

2.3 Tripartite Model of Uncertainty

Research on uncertainty in the illness context has shed light on specific sources of uncertainty. Brashers and colleagues (2004; 2003) first develop the medical, social, and personal causes of uncertainty, which are typologies used to describe the uncertain experiences of patients living with HIV/AIDS. The medical, social, and personal sources of

uncertainty are typically applied to patients with existing illness, and these sources have been further reinforced in other health contexts, including Alzheimer's disease (Stone & Jones, 2009), type 2 diabetes (Middleton, LaVoie, & Brown, 2012), organ transplant (Martin, Stone, Scott, & Brashers, 2010), and cancer survivors (Donovan, Brown, LeFebvre, Tardif, & Love, 2015). These typologies were later collectively coined as the *tripartite model of uncertainty* (Donovan et al., 2015). As patients navigate between life and living with an illness, *medical uncertainty* is caused by insufficient information in diagnosis, ambiguous symptom patterns, complex treatment and care, and unpredictable disease progression or prognosis (Brashers et al., 2003; Donovan et al., 2015). *Social uncertainty* is the appraisal of interpersonal interactions with others where patients may question potential social stigmatization and rejection, which may impact their relations with their loved one, inability to commit to long terms relationships, and social isolation. *Personal uncertainty* is characterized by two factors, unclear financial consequences and stability, and their valued identity and career options (Brashers et al., 2003; Donovan et al., 2015).

Chapter 3. Conceptual Framework: Toward an Alternate Model of Uncertainty Management

3.1 Brashers' Uncertainty Management Model

Brashers develops the UMT to predict the management of uncertainty as individuals appraise the probabilistic occurrence of an illness. Adopting Lazarus and Folkman, Babrow, and Mishel's work, Brashers proposes that individuals evaluate the relevancy and congruency of the situation (e.g., the likelihood of cancer diagnosis in their lifetime) to self and others and determine the availability of resources and capacity to cope. He suggests three uncertainty management factors concerning information management. The specific coping strategies are (1) seeking information to reduce uncertainty, (2) seeking more information to increase uncertainty, and (3) avoiding information to maintain uncertainty (Brashers, 2001;

Hogan & Brashers, 2009) (Figure 1). Uncertainty can be evaluated as positive or negative. When evaluated positively, individuals may see it as an opportunity and likely seek information to reduce uncertainty. When evaluated negatively negative emotions such as fear, worry, or stress amplify, and individuals would likely avoid or delay seeking knowledge on their condition.

A plethora of literature in communication and psychology have posited that individuals seek information to reduce uncertainty and that the information-seeking process is beneficial in reducing uncertainty and negative emotions (Bar-Anan et al., 2009; Barbour, Rintamaki, Ramsey, & Brashers, 2012; Berger & Calabrese, 1975; Brashers et al., 2002; Rains & Tukachinsky, 2015a; Van den Bos, 2009; Walker et al., 2003). The basic principle is that humans are driven to reduce uncertainty to make their worldview and assessment of a situation more predictable or certain (Berger & Calabrese, 1975; Kuhlthau, 1993; Wilson, Ford, Ellis, Foster, & Spink, 2002). Information acquisition, including online search, consultation from family and friends, or consulting healthcare professionals, allows individuals to develop knowledge structures that enable them to organize, interpret information, make sense of a situation, and increase certainty (Brashers, 2007). Recent empirical studies have also shown that information acquisition reducing uncertainty. For instance, Rains and Tukachinsky (2015a, 2015b), through a series of experimental studies, found that information search on the internet about skin cancer does reduce uncertainty of the disease.

However, uncertainty reduction achieved through information acquisition is based on the premise that information is available, accessible, and easy to comprehend and that individuals acquiring the information have high health literacy. As noted previously, cancer information (also other health information such as vaccination, coronary heart diseases, etc.) available on mass media is ambiguous, complex, incomplete, and conflicting. Instead of

reducing uncertainty, information search on mass media could increase uncertainty and drive avoidance of health behaviors (i.e., cancer preventive screening). Furthermore, uncertainty is tied to feelings of anxieties, worry, and stress. Individuals seeking information from family and friends may be able to relieve some emotional burdens, but self-assessment of one's medical knowledge may not be able to reduce uncertainty. Brashers et al. (2002) posit that people with an illness or who believe themselves to be at risk of illness may avoid information when it is distressing or when it conflicts with their beliefs. Therefore, avoidance is an alternative coping mechanism to manage uncertainty (Babrow, 2001; Leydon et al., 2000).

Figure 1 Brashers' uncertainty management theory (UMT)

Adopted from: Brashers, 2001

3.2 Limitations of Uncertainty Management Theory

The explication of the uncertainty concept elucidates several issues with the existing UMT. First, several sources of uncertainties in addition to medical uncertainty were identified, i.e., social and personal uncertainty factors, but these factors were never added into the empirical, conceptual model tested in various studies (Carcioppolo et al., 2016; Rains, 2014; Rains & Tukachinsky, 2015b). Carcioppolo et al. (2016) creatively develop the cancer

uncertainty preferences scale that measures the seek-to-reduce-uncertainty purported by Brashers' UMT. They found that participants who scored high on seeking information to reduce uncertainty would score low on avoiding information. However, the scale suffers from several weaknesses. One, the scale measures only medical uncertainty. According to Brashers, there is more than one form of uncertainty, i.e., social and personal uncertainty, but none of the abovementioned studies developed operational definitions for uncertainties that were identified in Brashers and colleagues' study (Brashers et al., 2003).

Second, Brashers (2001, p. 482) suggests that "information can be used to manipulate uncertainty in the desired direction." The management of information to manipulate uncertainty is supported by the *theory of motivated information management* (Afifi & Morse, 2009; Afifi & Weiner, 2006). The theory of motivated information management suggests that individuals wish to attain the desired level of uncertainty (likely to reduce uncertainty) from their actual state of uncertainty. Rains (2014) empirically showed that information does allow individuals to derive at their desired uncertainty levels. The premise, however, is still focused on individuals' wish to manipulate uncertainty through the acquisition of information.

Clearly, Brashers identifies avoidance as an uncertainty management strategy and more studies are needed to identify this relationship. As uncertainty can be perceived as a threat due to insufficient or incomplete information, some have argued that because of people's aversion to uncertainty, it is likely that people use avoidance as a shield to maintain hope (Case et al., 2005). Furthermore, there are contrasting conceptual and empirical literature supporting avoidance as a coping mechanism due to a greater chance of being exposed to ambiguous, complex, and incomplete information.

The limitations of the current UMT model have provided an opportunity to revise the model and develop a set of uncertainty constructs and model that retains its parsimony and

prediction of avoidance of cancer screening. From the literature gap, these two research questions are deduced:

RQ1: What are the sources of uncertainty?

RQ2: How would the sources of uncertainty drive the avoidance behaviour and cancer preventive screening?

3.3 Avoidance as Strategy to Uncertainty Management

By definition, avoidance refers to the deliberate attempt to pay little or no attention to information or situation that is overwhelming and threatening (Brashers, 2001; Krohne, 1989). Avoidance as a management strategy has been suggested since the late 1940s, and its theoretical roots are drawn from psychology. Mowrer (1947) introduced the two-factor theory of avoidance learning to explain the rationale for people developing and maintaining phobias. The theory postulates that individuals are conditioned to fear through past experiences. Emotional arousal, particularly fear, triggered by previous experiences or cues prior to a threatening situation, is perceived as danger. To cope, people choose to negate these unpleasant cues so that negative emotions are reduced. Eventually, avoidance becomes a reward that increasingly reinforces the behaviour of avoidance (Jacofsky, Santos, Khemlani-Patel, & Neziroglu, 2013). This theory was subsequently developed into the current cognitive avoidance. Cognitive avoidance as a coping strategy takes on several forms; it includes “intentional attempts at thought/memory suppression, efforts to dissociate or detach oneself from the affective qualities of negative experiences” (Ehlers & Clark, 2000; Williams & Moulds, 2007).

Uncertainty, caused by incomplete or ambiguous information, can represent a threat because of one’s inability to predict future events, thereby increasing individuals’ stress and anxiety, and worry (Buhr & Dugas, 2006; Floyd, Schrodts, Erbert, & Angela, 2017; Sibrava & Borkovec, 2006; Van den Bos, 2009). Individuals use these negative emotions to cope and

manage perceived threat or danger. Because the perceived danger does not yet occur, and there is no existing effective fight-or-flight response to eliminate the threat, individuals are left only with mental attempts to solve the problem. Accordingly, they either manage uncertainty by finding ways to avoid it or prepare themselves, mentally, to cope with it if avoidance is not or no longer possible (Sibrava & Borkovec, 2006). In this respect, the more uncertain they feel about the outcome of a threatening situation, the more they would rely on avoidance to “comfort” themselves and use uncertainty as a tool to maintain hope (Bradac, 2001).

Besides comforting one’s own emotions, avoidance of health behaviors is linked to the desire to maintain the status quo and thus maintain hope. Weinstein (1982) proposed that people’s failure or refusal to act on health recommendations (e.g., preventative screening, vaccination, etc.) is attributed to unrealistic optimism and the egocentric nature in people, in that they believe that misfortunes only happen to others and not themselves. This could be an explanation, but being realistically optimistic about one’s health may be a form of maintaining hope. Among many reasons for avoiding health information, Barbour and colleagues (2012) found that individuals avoid health information to maintain hope or deny so that they may continue with life and resist overexposure because negative information can be depressing (Barbour et al., 2012; Krohne, 1993).

With more cancer cases diagnosed each year, health authorities across the world have been increasing communication to the public of the risk of cancer and the benefits of preventative screening. However, health promotional campaigns often use fear appeals to provoke people to participate in specific health behaviors (Nelissen, Beullens, Lemal, & Van den Bulck, 2015a). Additionally, contention between health experts increases ambiguity, complexity, and confusion. Confusion and uncertainty have shown to lead to greater aversion; hence, people are more likely to avoid this information and recommended health

behaviors, including cancer screening. Furthermore, there is empirical evidence demonstrating that people are more reluctant to adopt health behaviours because of ambiguity. For instance, individuals are less likely to vaccinate because of ambiguity (Ritov & Baron, 1990), believe that they are at higher risk of contracting cancer when exposed to ambiguous estimates (Viscusi, Magat, & Huber, 1991, 1999), and averse to ambiguity of cancer presentation recommendation and that this aversion increases pessimistic beliefs and lowers the belief on the preventability of cancer (Han et al., 2006).

Understanding why people avoid health messages or information on life-threatening diseases would aid in more effective communication. Uncertainty management attempts to offer a theoretical framework that taps on psychosocial measures to explain low take-up rates of health services such as cancer screening.

3.4 Method

The *Health-related Uncertainty Management Model (HUMM)* is an extension of Brashers' UMT and this study aims to develop and validate a multidimensional scale of uncertainty and determine the influence of the uncertainty measures on information avoidance and cancer screening intentions.

The development of the uncertainty measures involved three phases of data collection. The objective of the first phase was to determine the appropriate constructs to be included and in-depth interviews were conducted. The tripartite model of uncertainty factors as the guiding framework to compare with themes emerging from this study. Any refinement of the categories is established in this phase. Quantitative studies with two samples to validate and cross-validate the newly developed measures in the second and third phases. The second phase is to establish and validate the factor structure of the uncertainty scale. I applied Wood and Boyce's (2017) method to create items that combine existing scales with themes uncovered in our research. The scale draws on the perspectives of healthy individuals and

measures health-related uncertainty. This measurement is termed as the *health-related uncertainty scale* (HUS). Using a different sample, the final phase is used to validate and confirm the factor structure obtained to determine the replicability of the factor structure from the previous phase. The fourth phase will also include criterion validity, which will determine the predictability of the HUS on cancer screening intentions.

3.5 Ethics Approval

The application for ethical approval was initiated in September 2018. The application seeks approval for both qualitative and quantitative research methods. The ethical committee at NTU has approved this study in January 2019 (IRB number 2018-11-037) after a few rounds of amendments requested by NTU's ethics committee. A subsequent IRB subsequent amendment was initiated to change the quantitative data collection method. Due to time and resource constraints, the random sampling method was unable to recruit the minimum sample for EFA and CFA. Hence, a decision was made to include data collection by Qualtrics so that a larger sample size is obtained. The ethics committee has approved the amendment.

Chapter 4. Study 1: Development of Uncertainty Typologies

4.1 Qualitative Methods and Procedure

The qualitative paradigm adopted for this study is phenomenology. The phenomenological method is concerned with examining the human experience and of the way people make sense of the experience from the first-person point of view (Gallagher, 2012; D. W. Smith, 2011; Sokolowski, 2000). I conducted respondent interviews and interviewed participants face-to-face where interviewees are encouraged to discuss their perspectives, experiences, and behaviors (Tracy, 2013). The face-to-face interviews ranged from 30 to 160 minutes. From my contact list, I first assumed the convenience sampling, which recruited eight participants. Subsequently, I used the snowball sampling, and the remaining five respondents were recruited through recommendation by the initial group of participants. I

interviewed 13 women of different ages, educational levels, and occupations to achieve maximum variation. Interviews ceased at 13 interviewees as theoretical saturation is achieved. The ages of the interviewees range from 32 to 63. Twelve of the participants are Chinese, and there is one Malay. The women are from different educational backgrounds ranging from postgraduate degrees to technical education. Interviewees also held different occupations from various industries. Table 1 provides the informational background of the participants. All participants are healthy women who have never been diagnosed with cancer or any other form of critical illnesses. Participants were asked to first think about breast cancer when answering the questions. Participants with more experience with other forms of cancer, e.g., cancer experiences of their loved ones, were encouraged to share and include their knowledge and experience of other cancer forms.

Table 1 Background Information of Interviewees

Pseudo name	Age	Occupation	Education
Ada	33	Polytechnic lecturer	Bachelor
Maria	34	Education researcher	Postgraduate
Peggy	37	Real estate manager	Diploma
Kang	41	Freelancer, business owner	Bachelor
Eve	43	Bank officer	Bachelor
Belinda	43	Research administrator	Postgraduate
Nancy	45	Logistics clerk	ITE Certification
Zoe	46	Marketing executive	Diploma
Alice	49	Accountant	Bachelor
Yang	58	Accounts executive	Technical education
Rebecca	59	Personal assistant	Technical education
Linda	59	IT manager	Technical education
Siti	63	Retiree	Secondary education

The interviews were semi-structured. I have an interview guide but made further probes in response to participants' replies. The interviews were flexible and organic so that more information was drawn from participants. The interview schedule was designed with open-ended questions to stimulate participants' responses. Participants were encouraged to share their perspectives, personal feelings, and experiences of cancer and any form of cancer

screening they attempted. Participants were also encouraged to recount interactions they had with family or friends diagnosed with cancer and how these experiences and interactions made them, if any, feel uncertain. Additionally, the interviews were conducted in a collaborative and interactive fashion in which both the participants and I ask each other questions. In the process of data collection, I have critically reflected on my role as an interviewer and have kept my subjectivities aside and derived at meanings of health-related uncertainties of chronic illnesses from participants' perspectives and experiences.

I used constant comparative techniques to analyse interview transcripts (Glaser, 1965). I used *NVivo*, a computer-assisted qualitative data analysis software to code and organized the data. Coding the interview transcripts involved a two-step procedure. The transcripts were first coded line-by-line in open coding. I coded the transcripts in an iterative manner, where emerging codes were constantly compared with previous codes and existing theory. This phase yielded 77 primary codes. The second phase involved categorizing the primary codes. The primary codes were organized into the preliminary typologies proposed in the literature section. In the process of the analysis, new uncertainty typologies emerged from the data. The new categories are added into the existing framework, creating a new set of uncertainty typologies used to define health-related uncertainties that healthy individuals undergo. Table 2 presents the definitions of the various uncertainty typologies derived from data collected from this study.

Table 2 Uncertainty Categories and Definitions

Category	Definitions
Medical uncertainty	informational ambiguity leading to uncertainty of risk required treatment, and scepticism on the reliability and success of cancer treatments and cancer screening
Financial uncertainty	unclear financial consequences if one must undergo medical treatments
Self-efficacy uncertainty	questioning one's abilities to battle chronic illness such as cancer

Interpersonal relationship ramification	evaluation of the potential impact of illness on treasured relationships
Social support availability	evaluation of the availability of social support in the event of illness occurrence

4.2 Sources of Uncertainty

4.2.1 Medical Uncertainty

Medical uncertainty is salient in the healthcare environment as it pertains to issues of diagnosis, symptom patterns, systems, appropriateness, and success rates of treatment and care, disease progression and prognosis, and the incorporation of routines for self-care (Brashers et al., 2000; Donovan et al., 2015). This qualitative study aims to differentiate the perspectives of medical uncertainty between patients with existing illness and healthy individuals and determine uncertainty typologies to be used for items creation. From the analysis, healthy individuals experience medical uncertainty differently because they are not experiencing an illness. Rather, healthy individuals' uncertainty stems from the interaction with information obtained over mass media or through personal experiences and the experiences of their family, close relatives, or friends' cancer or cancer screening experience.

As discussed previously, the proliferation of unproven cancer information available on the internet increases the public's confusion of cancer, its prevention and treatment (Hurley et al., 2011), resulting in increased public uncertainty, confusion, and doubt about health recommendations (Dobias et al., 2001; Schwartz & Woloshin, 2002; M. J. Smith, Ellenberg, Bell, & Rubin, 2008). Furthermore, medical uncertainty occurs as people interact with others or through their personal experiences. Others' experience of cancer and cancer screening act as a form of transference that influences one's perception and behaviour. The negativity bias theory posits that negative past experiences, either personal and of others, tend to have greater effects on individuals' thoughts compared to neutral or positive ones (Kanouse, 1984). Diseases, cancer included, are inherently negative. Negative information

obtained from others could negatively influence individuals' evaluation of their own risk and ability to prevent cancer, which causes uncertainty. Based on the analysis, I define medical uncertainty as informational ambiguity leading to uncertainty of risk, required treatment, and scepticism on the reliability and success of cancer treatments and cancer screening.

Insufficient information on risk and susceptibility. Medical uncertainty could occur when there is insufficient information on how one could contract cancer, which is related to the uncertainty of personal risk in developing cancer. Ada, 33, while thinking about various cancer forms shared, "There's no signs [for breast cancer]. I mean, like, smoking causes lung cancer, but nobody knows why people get breast cancer." This lack of information causes anxiety in some participants, Maria, 34, shared that she is willing to live in the ambiguity of having insufficient information as she stated, "Sometimes it is better not to know." Similarly, Eve, 43, felt that insufficient information does not worry her, but that the lack of information does not allow her to have a good estimate of her risk of breast cancer. She said:

Because I think ... not a lot of people understand what breast cancer is. I think the information is not widely shared... A lot of times, you would think that the chances that married ladies will get a higher chance, but this may not be the case ... The information is not widely shared. Like who has a higher chance of getting it, is it older people?

Unclear treatment type and treatment success rates. This form of medical uncertainty occurs due to the exposure to media or via close family and friends' experiences with cancer, and that cancer treatment is perceived to be drastic with probable low success rates. Most of the participants are uncertain of the treatment type required for cancer. They obtained information through exposure to media or close family and friends' experiences with cancer. Frightening imagery causes medical uncertainty in that participants are unsure of to the type of treatment required for cancer which drives negative affect such as fear, stress, anxiety, and worry. Although not all cancer treatments would lead to surgery or severe treatments, the uncertainty of treatment type causes some participants to envision a "worst-case scenario",

such as double mastectomy for breast cancer. Furthermore, some participants hold a pessimistic view that even removing the cancer tumour or affected organ, success rates may be low. Kang, 41, described, “Cancer is unpredictable... There are some who would equate breast cancer to losing both breasts.” Likewise, Eve expressed that some women may have this fear of uncertain medical treatment, “If a woman really gets it [develop breast cancer], then may need to cut off both breasts. It’s not because they don’t want to seek medication. It’s just fear... that this is the extreme operation needed.” Nancy, 45, recalled her friends’ cancer experience described that treatment is uncertain as it could change depending on the severity of cancer, “Treatment can change over time. My friend was [initially] diagnosed with stage one breast cancer and took pills only. She was going back regularly to check but then the cancer turned worse and she had to do radio therapy or something.” Siti, 63, has the same sentiment of cancer treatment: “I don’t know if I will have the same treatment as my mother. She had to wear a bag to collect faeces after surgery. It is scary and I don’t want to end up like this.”

The success rate of cancer treatments is another source of medical uncertainty for participants. Rebecca, 59, was uncertain of the success of cancer treatments and is not optimistic, “One of my good friends, spent all her fortune for treatments but died after one year. Nobody can tell whether you can survive after treatment. I feel it may not be high [treatment success rates].” As Yang, 58, thought of other forms of cancer, she felt that cancer affecting the digestive systems have higher mortality rates even after treatment. She shared:

Unlike the digestive system, like the colon, stomach, liver... Those are quite deadly. Even after receiving treatment, survival may not be high. Once diagnosed, it’s very fast [leads to quick death].

Diagnosis uncertainty. This source of medical uncertainty relates to the uncertainty on the effectiveness or perceived effectiveness of cancer preventive screening in carrying out its

medical claims². Conflicting claims of the accuracy of preventive screening communicated between health experts cause dissonance for people. It also includes personal or family and friends' experiences with cancer screening. The uncertainty of cancer screening outcomes healthcare professionals' lack of diagnostic certainty causes some participants to feel extremely uncertain, which reduces patients' trust in medical professionals and the procedure. Maria, 34, recalled her episode with a misdiagnosis that gave her a scare because she almost had to undertake an invasive biopsy procedure. Maria shared:

I was advised once, I forgot the name of the test, and that I need to go for a test where they take some sample to check if it's cancerous or not... An oncologist told me that I needed to have that procedure because the lumps in my breast increased in size. The specialist later told me that they measured wrongly, and it didn't increase in size. I am glad that I didn't have to go through the test, but I wondered on the accuracy of the measurement, and that really gave me a scare.

Rebecca also had a similar experience when she decided to opt for mammography provided by Singapore public health authorities. When she went for the scan, the healthcare professional was not able to establish clear imagery on one of her breasts after one of the mammography sessions. She shared that:

After the first scan, I received a call from a nurse at the hospital and she told me I had to go for a second scan... I was worried and thought something must have gone wrong with me. Why would they want me to go for a second scan? I was worried and asked if there was something wrong. And they said that it was just not clear. So they [have to do] an ultrasound in addition to be certain. And so [on the day of the appointment] I went in and I was lying down... There was a nurse carrying out the ultrasound. The problem I had with her is that she kept making a "tsk" sound as she was scanning. And what does it mean? Then I asked her if

² Preventive screening is recommended the medical test to detect signs of cancer or abnormal tissue growth before symptoms appear. Health experts posit that abnormal tissue or cancer when detected early is more treatable, which increases survival rates and ease needless suffering.

she found something... then she said no, and she said that it is just that it is not clear. The nurse clarified that actually she can't find anything from the scan but the report said there is something on my left breast. And she was making that sound because she cannot find it. After I completed the procedure, at the payment counter, [another] nurse asked me if I wanted to book the second appointment, next year's appointment, and I said no thank you.

Siti has doubts on the accuracy of cancer screening in detecting cancer as her brother's initial cancer screening that did not provide a positive result. This caused her to fear cancer screening and avoids the test. She shared:

Before my brother went for his trip to Melbourne, his [medical] check was ok. And he went for a trip to Melbourne, but he kept having fever. Then come back to Singapore, saw the doctor and found out [was diagnosed with cancer]. I don't go for it [cancer screening] because I am worried about what if I find out that there is something.

4.2.2 Financial Uncertainty

In the original tripartite model of uncertainty, personal uncertainty consists of uncertain financial costs and the conflicting role a patient faced (e.g., caregiver versus care-receiver roles). Analysis from this qualitative study revealed that personal uncertainty can be divided into two sources, financial uncertainty and self-efficacy uncertainty (explained in section 6.2.4). Financial uncertainty relates to the unclear financial consequences if one must undergo medical treatments. Medical cost has been on the rise; the global rate of increase is 10% per year, and 15% per year in Singapore (Wai, 2016). The increase in medical costs is reflected in preventive health checks and other costs involving hospitalization, treatment, and long-term medication (Bodenheimer, 2005). The unclear financial consequences, complex health insurance, and unwillingness to become a financial burden constitute to economic uncertainty.

Unclear financial consequences. With rising medical costs, a cause of uncertainty for healthy individuals is financial consequences. Inflation on healthcare costs has directly

impacted the cost of undergoing health checks or screening and the need for potential treatment if diagnosed with breast cancer. Belinda comments about treatment cost, “Then I guess in Singapore, cost of treatment is a concern as well. I don’t know how much it is, but I think it can be cheap.” Cost is also very much linked to treatment methods, inability to work, and the possible of relapse even after recovery. Alice, 49, shared, “For me it will be finance, you know you may be out of a job for a while and physical health... even if I recover, there's this fear of relapse. There will always be this nagging thought that I [may not have enough savings].” Echoing the same sentiment, Maria shared that, “I don’t know how long the treatment will take and whether I will recover from it... I may not have enough money. That’s also a motivator for not wanting to know.”

It is difficult for individuals or medical doctors to estimate the exact cost and the frequency of treatment for cancer as it depends on the patient’s reaction to treatment. Siti experienced first-hand the uncertainty of cancer treatment cost as she shares three of her family members’ experience with cancer and the uncertainty of cost:

The cost in Singapore is very high. If I am not wrong, the chemotherapy could cost \$600 each time depending on the treatment type. I learned about the cost through my brother's medical treatment. When the doctor initially recommended this treatment, he didn't take it up because it was expensive and there was no guarantee. My sister one I saw the bill and it worked out to \$90,000 for the operations, treatment, and the medicine. Then Dr. Ang, said she need another medicine, and it cost between \$19,000 to \$20,000 per treatment. Let's say she has to see the doctor every once a month, and it can work out to \$6000. At the moment, the insurance covers the cost.

Complex health insurance. Even with health insurance, financial uncertainty could persist. Health insurance policies are complex. Policyholders are often unsure of the extent of their insurance coverage. Some may choose to seek information from their insurance

providers, while others choose to remain ignorant. Siti shared of her sister's ignorance of her insurance policy coverage and only found out that she was insured during a hospital visit:

My sister was at KK hospital when she first discovered, after the first operation, she was ok.

But then there was a relapse and the doctors at KK hospital wants to operate again. We

wanted to ask for second opinion and we paid for it [to see a different doctor]. And we went

to the administrative officer [at the second hospital] ... When the officer checked her

insurance, only then we found out that my sister was covered for everything by her insurance.

Similarly, Kang recounted her experience of negotiating with her insurance provider after she underwent a breast screening and a medical procedure to remove a cyst in her breast:

Then, I called to find out how much medical benefits and coverage I will receive. If I go for

the test, would I be covered? Unfortunately, for this case, there is no coverage, for breast

screening and all. It's not even considered a table surgery. I called my insurance agent and

asked if this could be covered. It is not cheap (laugh)... It's \$400-\$500. It includes the

consultations, ultrasound, and procedure. Because it's only an injection, unfortunately, it is

under table surgery. So it is not covered.

Unwilling to become burden. Financial uncertainty also emerged in the form of unclear financial burdens to family. Spending money was one, but what was uncertainty was whether they would recover completely after the costly treatment. This is a cause of concern because they are worried that their medical fees will become a burden to their family members if they do not survive the illness. Ada lamented, "Money, to pay up! If one doesn't have a good insurance plan, and treatment could be expensive. It's just so how much money... If it's too expensive to do the treatment, then I rather die. Cause I don't want to leave my family with debt." While recounting a friend's experience with breast cancer, Sue shared similar concerns about the uncertainty of medical cost. She found out from her friend's

experience that treatment was expensive and has low probability of survival, which led to her decision to avoid treatment and leave her money to her daughters. She said:

Honestly, I am actually mentally prepared, should I one day be diagnosed, I would not want to go through therapy or whatever. Because maybe it is a waste of money. It more or less comes to financial. Sometimes if a person is rich, then ok, but if [I] have financial problems, after going through all the treatment, and if it doesn't help, then I think it is a waste of money. One of my good friends was diagnosed with cancer, and she went all expense to [receive treatment]. She was about 53 or 54, waiting to retire, and found out during her annual check that she got this [breast] cancer. And she didn't survive long. She spent quite a lot of money to get treated... but she just passed on... So I rather leave the money for my daughters.

4.2.3 Self-efficacy Uncertainty

A well-established and validated concept, self-efficacy, is defined as individuals' beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives (Bandura, 1989). In literature, self-efficacy is constantly projected as strong beliefs in self in accomplishing an outcome successfully. Self-efficacy uncertainty, however, relates more to questioning one's abilities to battle chronic illness such as cancer. Individuals question their abilities to cope with the disease, i.e., cancer and cancer treatment. Medical treatment, particularly for breast cancer, may involve tough treatment such as chemotherapy, mastectomy, which requires both mental and physical strength to overcome. Participants expressed that they mentally imagine or evaluate their capabilities to undergo medical treatment and social stigmatization. Participants questioned their abilities to cope with the news of being diagnosed with cancer and treatment if needed. Because of the stories they heard from family or friends who have gone through cancer treatments, they are aware that the probable success of the treatment requires mental and emotional strength.

Uncertain of own ability to cope with illness. This is when participants question their own abilities to deal with the treatment. Zoe, 47, expressed her concern of the duration of treatment and whether she will be able to undergo the tough mental battle:

And then there's the time of getting treatment. How long will it be treated? Is it by months, years? It is a very long-term war... more like a mental [battle]. How long do I have to go through this? So it is quite torturing.

Nancy, 45, is aware that treatment is a lonely journey and that she would need to overcome the disease on her own, shared:

It's like when you know, you have to think about the treatment, and you have to encourage yourself and tell yourself "I can recover." Because you cannot take it, you are alone, and you must take care of a lot of things by yourself. Even if the family is supportive, listen and care for you, how much can they do? Only you yourself.

Sharing a similar stance, Siti, acknowledging her fears and personal limitations, said in concern:

I feel very sad because you see the three of them... erm, my mum is not, I mean, I don't see her suffering [as much compared to my siblings]. But my brother and my sister, they suffered. My brother in pain, especially towards the end, he was in pain. And then my sister now, very uncomfortable. After the operation of the brain tumour, she has to take steroids. Her face is swollen. And her eating habits suddenly become higher. She wants to eat because she gets hungry very fast. Because of the steroids. And doctors cannot assure when she can stop steroids. I mean, it is going to be lifelong... I feel I am still scared. I am worried if I really get it [cancer], how can I take it? Because I am not a strong (mentally) type. I get emotional quickly. I am also not independent. So I am scared, if I know [that I have cancer], what will happen to me.

4.2.4 Social Uncertainty

In the tripartite model of uncertainty, social uncertainty has been defined as unpredictable interpersonal reactions and relational implications a disease has on patients and

their relationship with others. From the qualitative analysis, social uncertainty does not quite exist. Brashers (2007), adopting Folkman et al.'s (1986) coping theory, proposes that individuals evaluate the impact of an illness on treasured relationships. Participants are quite certain of the strength of the relationship even in the event of cancer occurrence. Rather, participants are concerned of the impact of cancer on the relationship with their loved ones. In addition, the qualitative study found the evaluation of the availability of social support. Social support, particularly in the health context, has been a major predictor of better health outcomes (von Wagner et al., 2009). The presence of support from loved ones is particularly important for participants as that would reduce their inclination to avoid information or cancer screening. Hence, social uncertainty is refined into two categories: interpersonal relationship ramification and social support availability.

Interpersonal relationship ramification can be defined as the potential impact of an illness on treasured relationships. Most participants trust that their spouses, partners, parents or children to provide the needed support in the event of illness occurrence. The overall sentiment is that they do not foresee major relational issues or stigmatization when one is diagnosed with cancer. Cancer occurrence is somewhat of a threat to relationships, as some participants acknowledged that cancer could affect the quality of their relationship with their loved ones. When asked if cancer would affect relationships with loved ones and if one would be subjected to stigmatization because of cancer, some participants responded:

Ada is confident that having breast cancer would not lead to major problems with her husband, but while making that statement, she acknowledged that she did not take her husband's feelings into consideration and said, "I hope my husband stays the same!" Ada felt that survivors of breast cancers are not stigmatized, said, "Anyone who's a survivor of breast cancer and think positively. I don't think people in society would treat them any differently."

Maria, a single lady, thought of the impact of cancer on potential relationships, “I don’t know if my [future] partner would make an issue of it, I hope that it wouldn’t.” On societal stigmatization on cancer, Maria continued, “I think now that everyone is more aware of it [cancer]. It’s not something that you have to hide. I don’t see any reasons to be ashamed of it. It’s not like something that you choose. I don’t think there’s a stigma on cancer anymore.”

Some participants acknowledged that cancer could affect the quality of their relationships. Belinda, 45, shared that she is certain that her relationship with her husband will not end negatively (e.g., getting a divorce). However, she acknowledged that being ill or stricken with cancer would, to a certain degree affect her relationship with her husband. She shared:

Relationship... I think in the first place, [if I were to have cancer], I will have to seek treatment. That would affect in terms of time and effort needed, my husband would need to go with me to go see doctor, that’s time taken. So that would already affect [our schedules, time, and effort]. Plus, the treatment of the disease hanging over us can be quite detrimental... so definitely, the relationship will change.

The other category in relation to social uncertainty is the availability of social support, defined as the evaluation of the availability of social support in the event of illness occurrence. In this series of interviews, several participants also shared that the availability of support is a major factor influencing their decisions to take up or avoid cancer screening. Kang shared that she decided to have her breast examine because of her husband’s and mother’s encouragement,

I told my mum and husband about a growth on one of my breasts, and it was a little worrying for me because it [growth] is “there” after one month. But both my mum and husband pacify me by saying that it is common, and this sort of things happen sometimes and that I should just have it check.

Conversely, the inability of social support drives avoidance of cancer screening for fear that there is no one to care for them when they are ill and afraid of becoming a burden to their family. Siti, 63, shared:

I am one of the younger ones among my siblings. The sister that I talked about who has cancer, she is already 70. With her illness, she needs to be taken care constantly. I am worried that there won't be anyone to take care of me. My 5th sister, younger than I, has her own family. We are close, but I don't think she would take care of me. And my youngest sister works, she wouldn't have time. So for me, it's better not to be sick, so I am scared to get check. Especially, the more serious cancer types, because of my mum and sister's cancer. My personality is also the type who do not like to bother or trouble people. Whatever problems I have, I try to solve it on my own. I don't want to bother others. For example, I went for an eye and heart check recently, I went alone.

Figure 2 Health-related Uncertainty Management Model, Finalised

In conclusion, the analysis of the interview has provided valuable insights into the development of the health-related uncertainty scale (*HUS*). From the qualitative analysis, it is evident that healthy individuals do not have a clear understanding of specific cancer types but have a generic sense of cancer. They are not able to distinguish the different types of cancer. In the quantitative, instead of focusing on a specific cancer type, e.g., breast cancer, the general form of cancer is used. Participants need only to think of a type of cancer they deem as most threatening and response to the questions while thinking of that cancer type. *HUS* will be the uncertainty constructs (also independent variables) used to predict avoidance behaviours, cognitive avoidance, and cancer screening intentions. With uncertainty typologies identified in this qualitative study, the finalised model is presented in Figure 3. The next chapter will expound on the quantitative study used to develop *HUS* and determine its predictive power.

Chapter 5. Study2: Development of Health-related Uncertainty Scale

5.1 Items Creation and Hypotheses

Items representing the uncertainty dimensions were developed using Wood and Boyce (2017) approach, which are generated using findings from the qualitative interviews combined with existing scales. The number of items developed is 29. Existing items from established scale, in addition to items created from the qualitative study, for each of the dimensions were adopted as follows:

Medical uncertainty measures informational ambiguity on cancer, the perceived response efficacy of cancer screening, and severity and susceptibility of cancer. Items were adopted from the *uncertainty preference scale (UPS)* (Carcioppolo et al., 2016) and perceived susceptibility, severity, and effectiveness of cancer screening from the *health belief model scale (HBMS)* (Guvenc, Akyuz, & Açikel, 2011). A higher score indicates greater medical uncertainty.

Interpersonal relationship ramification measures the evaluate the threat of cancer occurrence treasured relationships. Items were created using Haslam et al. (2009) and Brashers et al. (2003) studies as reference. A higher score indicates greater perceived threat of cancer on relationships.

Financial uncertainty measures the evaluation of the availability of financial resources to cope with the probability of cancer or illness occurrence. Several items were obtained from HBMS, particularly items relating to cost. A higher score represents greater uncertainty in the availability of financial resources.

Self-efficacy uncertainty measures the belief in one's own ability to cope with cancer. To assess self-efficacy uncertainty, the *General Self-Efficacy Scale (GSE)* (Luszczynska, Scholz, & Schwarzer, 2005) was adapted to the belief in one's competence to cope with cancer as a threatening disease. GSE was developed in accordance with Bandura's theory of self-efficacy. The items were adapted for evaluation of self-efficacy in managing cancer. A higher score indicates higher uncertainty of one's own belief in managing cancer.

Social support availability measures the perceived availability of social support. The measurement of social support uncertainty is obtained from the *MOS social support scale* (Sherbourne & Stewart, 1991) with additional. A higher score indicates greater uncertainty of the availability of social support.

Cognitive avoidance. The short version of the cognitive avoidance scale was modified and used to measure the avoidance of cancer information (Sexton & Dugas, 2008). Participants were asked to respond to three items of the avoidance scale on a 5-point Likert scale (1 = "strongly disagree" to 5 = "strongly agree"). A higher score indicates mental, cognitive avoidance of cancer information.

Cancer screening intentions (DV). The dependent variable used is the intentions scale which was adapted from the healthcare behavioral intentions scale (Ware & Davis, 1983).

The items focused on measuring generic cancer screening. Four items from the scale were modified to cancer information and preventive seeking intentions. Participants were asked to rank their likelihood (1 = “extremely unlikely” to 6 = “extremely likely”) to seek cancer preventive screening in the next 12 months. A higher score indicates higher intentions to adopt cancer screening.

To establish the validity of HUS, we examined criterion and discriminant validity of the scale. Criterion validity exists when a construct predicts relevant outcomes. In this study, we are keen to determine the associations between the uncertainty constructs, information avoidance, and cancer screening intentions. Hierarchical linear regression was conducted with the five uncertainty factors as independent variables and cognitive avoidance and cancer screening intentions as dependent variables. From the factor analysis, five uncertainty constructs were developed; they are medical, financial, and self-efficacy uncertainty and, interpersonal relationship ramification and social support availability. In addition, several demographic variables were used to control for variances. The demographic variables are age, average household income, education, and family history of cancer.

The health-related uncertainty management model posits that the presence of uncertainty will lead to cognitive avoidance. To recap the definitions of the five uncertainty factors; medical uncertainty is informational ambiguity leading to uncertainty of risk, required treatment & scepticism on the reliability and success of cancer treatments and preventive screening. Interpersonal relationship ramification is the evaluation of potential impact of illness on treasured relationships. Financial uncertainty is the evaluation of financial resources available in the event of an illness event. Self-efficacy uncertainty is the evaluation of one’s own capabilities in facing a life-threatening illness. Social support availability is the evaluation of the availability of support in the event of illness occurrence.

Given the pervasiveness of uncertainty in the cancer context and the ambiguity of cancer screening recommendations, individuals are likely to react negatively to the information circulated via mass media. As illustrated in earlier sections, cognitive avoidance is a coping mechanism that protects individuals from distressing stimuli that induce emotional arousal (Krohne, 1993; Krohne et al., 2000). Cognitive avoidance is the deliberate attempt to pay little or no attention to information or situation that is overwhelming and threatening (Krohne, 1989). Uncertainty, caused by incomplete or ambiguity, can be perceived as a threat. The greater the uncertainty, the greater the likelihood of invoking cognitive avoidance as a protection mechanism.

Besides mental avoidance, information avoidance can involve the refusal to seek professional health checks, such as cancer screening, with the intention to circumvent knowing of health status. Avoidance could include the reluctance of cancer screening tests because attending these health checks could implicitly provide individuals with information about their health status. A possible rationale for individuals' avoidance behaviour is the fear of bad results, regardless of the low probability of cancer occurrence, and to maintain hope. As such, the greater the uncertainty, the greater the perceived threat and inability to maintain hope, the less likely individuals intend to adopt cancer screening. As such, following hypotheses are proposed:

H1: The (a) medical, (b) interpersonal relationship, (c) financial, (d) self-efficacy uncertainty positively, and (e) social support availability negatively relates to information avoidance.

H2: The (a) medical, (b) interpersonal relationship, (c) financial, (d) self-efficacy uncertainty negatively, and (e) social support availability positively relates to cancer screening intentions.

5.2 Quantitative Methods and Procedure

Prior to data collection, preparation work was completed to ensure the representativeness of the sample. First, the questionnaire was programmed onto Qualtrics, an online questionnaire software. A copy of the questionnaire is included in the Appendix. In the questionnaire, participants are screened for these two criteria. The criteria are (1) participants must be aged 35 and above and (2) participants are never diagnosed with cancer. These criteria were selected because cancer tends to manifest at the later part of life and the recommended age to begin cancer screening is 35 years for many cancer types (American Cancer Society, 2019) and this study focuses on the eliciting perspectives from healthy individuals. The recruitment of participants for this study was completed in different phases.

In the first data collection phase, the face-to-face data collection method was adopted. Research assistants were engaged to recruit respondents by going door-to-door across different public housing flats in Singapore. A multi-stage random sampling method was applied to ensure that sample representativeness was achieved. First, two of the 28 Singapore districts were randomly selected, followed by cluster sampling for the selection of residential flats. A total of 20 blocks of flats were selected in each of the two districts. Research assistants, carrying tablets containing the questionnaires, then knocked on every 3rd door to complete the data collection. A total of 81 participants responded and completed the questionnaire. Participants took on average, 13.57 minutes to complete the questionnaire.

In the second data collection phase, participants were recruited through Qualtrics, a recruitment company with online panels that is often used by researchers in social and behavioural science to reach a varied sample and improve data collection efficiency. Qualtrics recruited participants from their panel. Approximately 20% of the participants who started the survey on Qualtrics did not complete their responses. One of the reasons for the dropout rate is due to the screening criteria where participants who have not been diagnosed

with cancer and are aged 35 and above may proceed to complete the questionnaire.

Participants took, on average, 10.45 minutes to complete the questionnaire. Participants aged 60 years and above are less likely to use online panels and to ensure that all age groups are represented, I used different data collection methods. The door-to-door method yielded a more evenly spread age range, and I was able to collect data from older individuals in the Singapore population.

5.3 Participants

Participants were Singapore residents ($N = 452$, 206 females, 246 males, $M_{\text{age}} = 45.52$, $SD = 8.70$, age-range = 35–70). Table 3 presents a summary of the demographical information of participants. Recruited participants are representative of the Singapore population. The Singapore population is 76.2% of the population is Chinese, 15% Malay, 7.4% Indians, and 1.4% other ethnicities (The Department of Statistics, 2018). The two samples were then randomly used to conduct the EFA ($n=81$) and CFA ($n=371$). The demographical information of the two samples is presented in Table 3.

Table 3 Demographical Information of Participants

	EFA Sample ($N=81$)	CFA Sample ($N=371$)	Total ($N=452$)
	Percent		
Female	64.2	41.2	45.6
Male	35.8	58.8	54.4
Ethnicity			
Chinese	76.5	76.3	76.3
Malay	8.6	10.2	9.7
Indians	13.6	7.3	8.4
Other ethnic groups	1.2	6.2	5.3
Highest educational level			
No formal educational	3.7	-	.7
Primary	8.6	1.1	2.4
Secondary	35.8	15.1	18.8
Post-secondary	24.8	25.4	25.2
Degree	12.3	44.2	38.5
Postgraduate	13.6	14.3	14.2
Marital Status			
Married	75.3	67.1	68.6

Single (never married, separation, divorce)	24.7	32.9	31.4
Age (mean, SD)	51.6 (10.5)	44.2 (7.6)	45.5 (8.7)
Household income (mean)	7392	7983	7984
Household income (median)	5000	7000	7000

5.4 Results

5.4.1 Data Screening

The health-related uncertainty items were screened for asymmetry, univariate, and multivariate kurtosis, and multivariate outlier was tested using the squared Mahalanobis Distance (MD^2) and Cook's (Kline, 2016). Acceptable values of the normality, skewness, and kurtosis of data were found. There were two out-of-range MD^2 values (greater than 12.72), but both values were well within the accepted range for Cook's distance (less than .05). Hence, the two values were retained. The minimum amount of data for factor analysis was not achieved with a sample size of 81, yielding a ratio of 2.79 cases per variable.

5.4.2 Exploratory Factor Analysis

The factorability of the 29 HUS items was examined using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. Indicators showed favourable factorability, with the KMO measure at .72, which is above the recommended value of .60. The Bartlett's test of sphericity was significant, $\chi^2 (171) = 816.23$, $p < .001$.

Maximum likelihood (ML) estimation method was selected as the data is relatively normally distributed. Fabrigar and colleagues (1999, p. 277) recommends that ML fits best because "it allows for the computation of a wide range of indexes of the goodness of fit of the model and permits statistical significance testing of factor loadings and correlations among factors and the computation of confidence intervals", which is helpful for determining the appropriate number of factors (Brown, 2015). The factor structure was examined using the direct oblimin rotation, which estimates factor correlations, for the factor loading matrix. Initial eigen values indicate that 54.78% of the variance is explained by the first five factors.

The five-factor solution was adopted because (1) there was the levelling off of eigen values on the scree plot after the fifth factor (Figure 3) and (2) there was insufficient number of primary loadings for the sixth and subsequent factors.

Figure 3 Scree Plot for Initial EFA

A total of ten items were removed as they did not contribute to the factor structure and failed to meet the minimum criteria of a primary loading of .4 or above. The items eliminated were “Cancer is a threatening illness”, “I am uncertain of my risk of contracting cancer”, “There is no certainty of survivability from cancer even after receiving treatment”, “Cancer is likely to involve risky surgery and treatments”, “I believe the society do not have a positive view of people with cancer”, “I am afraid of becoming a financial burden to my family”, “Cancer preventive screening does not really prevent cancer”, “Cancer preventive screening is too painful”, “Cancer preventive screening is expensive”, “I feel ashamed to be naked during the test”.

A final round of Maximum Likelihood factor analysis of the 19 items, using the direct oblimin rotation, was conducted, with five factors explaining 68.49% of variance. The final factor loading matrix is presented in Table 4.

Overall, the factor analysis validated that five distinct factors were the underlying healthy participants’ responses to the HUS items and that these factors showed strong internal

consistency. Ten of the items had to be eliminated, but the factor structure supports the uncertainty measures proposed in this study. The names for the five factors are medical uncertainty (MDU), interpersonal relationship ramification (IRR), social support availability (SSA), financial uncertainty (FIU), and self-efficacy uncertainty (SEU).

Table 4 Factor Loadings on a Maximum Likelihood estimation with direct oblimin rotation for 20 items of the Health-related Uncertainty Scale (HUS) (N = 81)

	Factor				
	IRR	SSA	SEU	MDU	FIU
IRR_1 Cancer could threaten my relationship with my spouse or potential partner.	.92				
IRR_2 Cancer could threaten my relationship with my family.	.90				
IRR_3 Cancer could affect my relationship with my boss and colleagues.	.54				
SSA_1 I have someone to help me if I were confined in bed.		-.92			
SSA_2 I have someone to help me with daily chores if I am sick.		-.88			
SSA_3 I have someone to take me to the doctors if I need it.		-.69			
SEU_1 I am unsure if I can manage the disease and take care of myself.			.85		
SEU_2 I am unsure if I can undergo medical treatments, if required.			.78		
SEU_3 I am unsure if I am able to deal efficiently with unexpected events such as cancer.			.76		
SEU_4 I am unsure of my coping abilities to fight cancer.			.54		
MDU_1 I am uncertain of the accuracy of cancer preventive screening.				.42	
MDU_2 The amount of information on cancer can be confusing.				.86	
MDU_3 There's a lot of misinformation about cancer, so it's difficult to know which is truthful.				.57	
MDU_4 The amount of information on cancer out there can be overwhelming.				.48	
MDU_5 The recommendations for cancer preventive screening are always changing.				.41	
MDU_6 There are so many types of preventive screening that it is confusing.				.41	
FIU_1 I am afraid of becoming a financial burden to my family.					.65
FIU_2 I may not have the financial means for cancer treatment.					.59
FIU_3 I may not have or have insufficient health insurance coverage for cancer treatment.					.56

Note. Factor loadings < .4 are suppressed.

5.4.3 Confirmatory Factor Analysis

With the 19 items factor structure solution derived from the EFA, the Confirmatory Factor Analysis (CFA) used to test the *HUS*' factor structure was conducted through IBM AMOS (version 22.0). Maximum Likelihood (ML) was once again selected as the estimation method as it is most widely accepted (Brown, 2015; UCLA: Statistical Consulting Group, 2018). The Chi-Square test (χ^2), the Iterative Fit Index (IFI), the Tucker-Lewis Index (TLI), the Comparative Fit Index (CFI), and the Root-Mean Square Error of Approximation (RMSEA) were used as a measure of goodness-of-fit of the model.

Prior to the CFA, the health-related uncertainty items for this sample ($N = 371$) were screened for asymmetry, univariate and multivariate kurtosis and multivariate outlier was tested using the squared Mahalanobis Distance (MD^2) and Cook's (Kline, 2016). The test of normality showed satisfactory asymmetry, skewness, and kurtosis of the data. There were four out-of-range MD^2 values but well within the accepted range for Cook's distance. Hence, the four values were retained. The minimum amount of data for factor analysis was achieved with a sample size of 371, yielding a ratio of 19.53 cases per variable.

CFA was conducted and the initial model's key goodness-of-fit indicators showed acceptable model fit: $\chi^2 = 375$, $\chi^2/df(142) = 2.64$, $p < .001$, IFI = .94, TLI = .92. CFI = .94, RMSEA = .07. Upon examination of the modification indices, two items were cross-loading; covaries were used. After adding the covaries, the CFA was conducted and on the second analysis (Figure 4), the goodness-of-fit indexes showed good fit after adding the covaries: $\chi^2 = 335$, $\chi^2/df(142) = 2.40$, $p < .001$, IFI = .95, TLI = .94. CFI = .95, RMSEA = .06. The RMSEA, at .07, fell between the acceptable fit range of .05 and .08 recommended by Kline (2016) and Hu and Bentler (1999). The CFI and IFI, and TLI fell within Kline's ($\geq .90$) and Hu and Bentler's criteria ($\geq .95$). The TLI met Kline's fit criteria but did not meet Hu and Bentler's. The p-value indicates a poor fit but large datasets (≥ 250) can produce a value that

is small (Brown, 2015; Kline, 2016). The overall model falls into the acceptable range for good model fit based on Kline's recommended fit criteria.

Figure 4 Factor loadings on a Maximum Likelihood Estimation for the Confirmatory Factor Analysis on HUMS (N = 371)

5.4.4 Criterion Validity (Hypothesis Testing)

Prior to conducting the hierarchical linear regression, a correlation analysis was conducted between the five uncertainty factors and dependent variables (Table 5). Strong correlations between four of the composite scores (i.e., MDU, IPU, FIU, and SEU). However,

there are weak correlations between SSU and the other four factors. The correlation coefficient showed strong to weak relationships between the five uncertainty factors and the dependent variables.

Table 5 Zero-Order Correlations for HUS Five Factors and Dependent Variables

	MDU	IPU	SSA	FIU	SEU	Avoidance	Screening intentions
MDU	1						
IPU	.47**						
SSU	-.01	.07					
FIU	.37**	.35**	.11*				
SEU	.41**	.43**	.13*	.66**			
Avoidance	.40**	.39**	.08	.26**	.27**		
Screening intentions	.13*	.20**	.22**	-.01	-.06	.18**	1

** $p = .01$; * $p = .05$

Hierarchical linear regression analysis was used to determine the predictive power of the five uncertainty factors on the dependent variables. Results of the regression indicated statistical significance, in that the predictors explained 24.4% of variance for cognitive avoidance, $F(9, 361) = 12.96, p < .001, \Delta R^2 = .24$. It was found that medical uncertainty ($\beta = .26, p < .001$) and interpersonal relationship uncertainty ($\beta = .22, p < .001$) positively predicted cognitive avoidance. Hypothesis 1a and 1b are supported. There were no significant relationships found between financial uncertainty ($\beta = .04, p = .56$) and self-efficacy uncertainty ($\beta = .05, p = .40$). Hypothesis 1c and 1d are not supported. Social support availability ($\beta = .11, p = .02$) positively predicted cognitive avoidance, and 1e is not supported.

Results for the relationship between the five uncertainty factors and cancer screening intentions showed statistical significance, in that the predictors explained 11.8% of variance, $F(9, 361) = 5.36, p < .001, \Delta R^2 = .12$. It was found that and self-efficacy uncertainty negatively predicted cancer screening intentions ($\beta = -.13, p = .05$). Hypothesis 2c is supported. Results showed significant positive relationships between medical uncertainty ($\beta =$

.11, $p = .05$), interpersonal relationship uncertainty ($\beta = .19$, $p < .001$) but it was hypothesized that both would be negatively related to cancer screening. Hypotheses 2a and 2b are not supported. There was no statistical relationship between financial uncertainty ($\beta = -.02$, $p = .75$) and cancer screening intentions. Hypothesis 2c was not supported. Social support availability ($\beta = .16$, $p < .001$) positively predicted cancer screening intentions, so hypothesis 2e was supported. The full statistical analysis is presented in Table 6.

Table 6 Hierarchical Linear Regression Beta Scores (N = 371)

	<i>Cognitive avoidance</i>		<i>Cancer screening intentions</i>	
	β	p	β	p
<i>Gender</i>	-.07	.24	.11	.04
<i>Age</i>	-.05	.75	-.02	.67
<i>Household income</i>	-.12	.004	.13	.01
<i>Family history of cancer</i>	.05	.41	-.05	.37
ΔR^2	.02		.03	
<i>Gender</i>	-.06	.22	.09	.08
<i>Age</i>	-.02	.64	.00	.97
<i>Household income</i>	-.12	.01	.09	.07
<i>Family history of cancer</i>	.06	.20	-.04	.42
<i>Medical uncertainty</i>	.26	<.001	.11	.05
<i>Interpersonal relationship ramification</i>	.22	<.001	.19	<.001
<i>Social support availability</i>	.11	.02	.16	<.001
<i>Economic uncertainty</i>	.04	.56	-.02	.75
<i>Self-efficacy uncertainty</i>	.05	.40	-.13	.05
ΔR^2	.24		.12	

Chapter 6. Discussion, Implications, and Limitations

6.1 Discussion

The increase in cancer incidence and mortality drove many cancer centres, local and international health authorities to recommend cancer screening as prevention, early treatment, so to manage the cancer epidemic (Bray et al., 2018). However, cancer screening adoption remains low in many countries. The goal of this study is to utilize a conceptual framework to explain this avoidance behaviour. The theoretical framework being explicated is the uncertainty management theory (UMT). The UMT is an evaluative process that adopts the

notion that uncertainty occurs due to informational ambiguity, complexity, and that the probabilistic judgement of an event or situation is unclear or unpredictable (Babrow, 2001; Babrow et al., 1998; Brashers & Babrow, 1996). Though UMT is a theory that can provide the needed conceptual framework for a predictive model explaining the avoidance phenomenon, existing empirical studies have not fully developed UMT. Specifically, several endogenous variables identified in the literature have not been operationally defined. Therefore, the goals of this study were to (1) identify the sources of uncertainty from the perspective of healthy individuals, (2) establish a scale that operationally defines the identified sources of uncertainty, and (3) determine the predictive power of the uncertainty scale on cancer avoidance and cancer screening intentions.

A qualitative study using in-depth interview was developed and analysed with the iterative method. The tripartite model of uncertainty, a model that describes the causes of uncertainty from the perspective of patients with illness, was used as the guiding framework in the analysis of the interview transcripts. The intent of the qualitative research is to determine if healthy individuals experience uncertainty as they appraise cancer and the sources of uncertainty (RQ1). Findings from the data analysis found that healthy individuals do experience uncertainty and that there are differences in the sources of uncertainty. From the qualitative study, five uncertainty sources were identified, and they are medical, financial, and self-efficacy uncertainty and interpersonal relationship ramification and social support availability.

Using the typologies obtained from the qualitative research in this study and existing scales, a set of items were created to operationally define the five uncertainty factors (RQ2). The EFA and CFA were used to test the validity of the factors, change from the initial factor structure was found. Instead of the initial five factors, response efficacy was subsumed with medical uncertainty, and social uncertainty was divided into two factors, namely

interpersonal relationship uncertainty and social support uncertainty. The remaining uncertainty factors economic uncertainty and self-efficacy remained, with a few items removed from the initial items pool. To complete criterion validity of the uncertainty factors, hierarchical linear regression with cognitive avoidance and cancer screening intentions as the dependent variable was conducted.

Table 7 Summary of Findings

	Details	Statistical significance
RQ1	The tripartite model of uncertainty was present in healthy individuals, but the typologies are further segregated. Instead of the three, five sources emerged from the qualitative analysis. The five uncertainty typologies are medical, financial, self-efficacy uncertainty and interpersonal relationships ramification and social support availability.	N.A.
RQ2	The EFA and CFA supported the five uncertainty constructs.	N.A.
H1a	Positive relationship between medical uncertainty and cognitive avoidance	Supported
H1b	Positive relationship between interpersonal relationship ramification and cognitive avoidance	Supported
H1c	No significant relationship between financial uncertainty and cognitive avoidance	Not supported
H1d	No significant relationship between self-efficacy uncertainty and cognitive avoidance	Not supported
H1e	Positive relationship between social support uncertainty and cognitive avoidance	Not supported
H2a	Positive relationship between interpersonal relationship ramification and cancer screening intentions	Not supported
H2b	Positive relationship between interpersonal relationship ramification and cancer screening intentions	Not supported
H2c	No significant relationship between financial uncertainty and cancer screening intentions	Not supported
H2d	Negative relationship between self-efficacy uncertainty and cancer screening intentions	Supported
H2e	Positive relationship between social support availability and cancer screening intentions	Supported

As shown in Table 7, several hypotheses were supported. Statistical significance was found between medical uncertainty and interpersonal relationship ramification and cognitive

avoidance. The positive relationship between medical uncertainty (*H1a*), interpersonal relationship uncertainty (*H1b*) and cognitive avoidance were as predicted. *H1a* in this study performed as expected. Medical uncertainty of cancer occurs when conflicting or ambiguous information is communicated via mass media may increase confused with the required behaviours that could help to reduce risk to preventive screening. Though the purpose of communicating is to offer informed choices, the ambiguity of information, and the overexposure to confusing information turn people away. The negative relationship between medical uncertainty and cognitive avoidance lends support that ambiguity turns people away.

Results from the regression analysis confirmed a positive relationship between interpersonal relationship ramification and cognitive avoidance (*H1b*). Interpersonal relationship ramification is the evaluation of the potential impact of illness on treasured relationships. Folkman et al.'s (1986) coping theory has provided the theoretical support for interpersonal relationship ramification and cognitive avoidance. They posit that when faced with a threat, individuals would appraise the threat's impact on their loved ones. This finding suggests that people avoid cancer information for fear of the impact of cancer occurrence has on their treasured relationships.

There is also no statistical significance between self-efficacy uncertainty and cognitive avoidance. Hypothesis 1d was not supported. The lack of findings could be attributed to the perceived impact of information avoidance. Because there is no immediate threat, whether one is self-efficacious, would not influence information avoidance.

It has been hypothesized that the greater the social support availability, the less likely one would avoid information. This hypothesis, 1e, was not supported. Instead, a positive significant relationship was found. Results showed that the greater the availability of social support, the more likely one would avoid information. This was an unexpected finding. A

plausible explanation is that there are other factors moderating the likelihood to avoid information. Nelissen et al. (2015a) suggest that fear of cancer to be a moderating factor.

Medical uncertainty was hypothesized to negatively relate to cancer screening intentions, but a positive significant relationship was found. H2a was not supported. This finding is not unexpected. This finding is contrary to current evidence (Han et al., 2006) pointing towards the public's distrust of healthcare institutions and professionals due to confusing and ambiguous information. This shows that people trust medical professionals and would seek their professionalism and advice on ambiguous health issues.

It was hypothesized that interpersonal relationship ramification would negatively relate to cancer screening intentions, but there was a significant positive relationship. The hypothesis (*H2b*) was not supported. This finding could be caused by the weak operationalisation of the items for this factor. The items were worded quite ambiguously which could have led to misinterpretation.

It has been hypothesized that self-efficacy uncertainty would negatively relate with cancer screening intentions and a significant negative relationship was found. Hypothesis 2d was supported. This finding performed as expected. Low self-efficacy (*H2e*) uncertainty signifies one who is confident of his or her abilities to cope with cancer. Self-efficacious individuals have shown to be more tenacious and harder (Bass et al., 2006) in coping with difficult tasks and vice versa. The less self-efficacious one is, the more likely to be inclined to avoid cancer screening.

There was a significant positive relationship found between social support uncertainty and cancer screening intentions. This result supported H2c. A plethora of existing literature supports that social support has positive influence on better health behavioural outcomes (Stafford et al., 2018; von Wagner et al., 2009; Walker et al., 2003). As social support availability is high, the greater likelihood to adopt cancer screening as individuals are likely

to perceive the unavailability of resources (e.g., not having anyone to care for them when they are sick) to cope with cancer, it may deter participants from cancer screening.

The regression analysis showed no statistical significance between financial uncertainty and cognitive avoidance and cancer screening intentions. This is a surprising result because financial uncertainty was a cause of concern for all the participants in the qualitative interviews. The results could be related to several reasons. First, the Singapore government offers a public healthcare system that greatly subsidizes cancer preventive screening as well as cancer treatment costs. Participants may be cognizant of the healthcare benefits. Hence, financial uncertainty is not a predictor of cognitive avoidance and cancer screening intentions. Second, individuals may not be affected by financial uncertainty until a time comes when they need to consider the cost. Individuals would need to feel threatened by cancer for uncertainty to drive cognitive avoidance and behaviour. There could be additional factors, for example perceived susceptibility, that moderate the relationship between financial uncertainty and cognitive avoidance and cancer screening intentions.

6.2 Implications of Study

This study has several contributions to academic knowledge and practical applications. To date, there are no known uncertainty antecedents relating to health matters. The uncertainty constructs available in current literature describes generic uncertainty factors, which may not apply to health-related issues. Combining evidence found in the qualitative study and existing literature, five uncertainty antecedents, medical, financial, and self-efficacy, and interpersonal relationship ramification and social support availability were developed. These antecedents are more descriptive and useful in establishing motivations that drive people to avoid health information, services, or behaviors. This study has also contributed to the creation of health-related uncertainty measures. Operational definitions for each of the five uncertainty constructs were developed and statistically validated. This study,

albeit its limitations, has contribution to the existing literature as there are no constructs that measure health-related uncertainty concept.

This conceptual model contributes to existing knowledge and is useful in informing practitioners such as health promotion authorities and policymakers when developing policies or health promotional campaigns. The conceptual model elucidates the predictive power of uncertainty factors and cognitive avoidance and cancer screening intentions. Results showed that uncertainty does explain 24% and 12% of variance to the respective dependent variables. For instance, the inclusion of social support availability provides further evidence that social support is an important factor in driving behaviors. If greater social support is present, more healthy individuals may be willing to adopt cancer screening. Hence, the uncertainty factors could be used to inform and improve health policies so that greater cancer screening adoption can be achieved.

6.3 Limitations and Future Studies

One of the limitations was the challenge of developing the items to measure the various uncertainty factors. In an extensive scale development process, Wood and Boyce (2017) recommend more than a hundred items to test factor structures when developing theoretical constructs. In this study, the minimum number of five to seven items per factor was developed. This limitation, however, can be overcome by conducting discriminant validity using other samples. Discriminant validity needs to be tested on different populations and samples (e.g., Australians) or with different health contexts (e.g., vaccination avoidance). This would further test the robustness of the scale and replicability of the study. Second, there were approximately four cases that were retained in the EFA and CFA sample even though they failed one of the two outlier checks. Third, financial uncertainty did not significantly predict cognitive avoidance or cancer screening intentions. The theoretical model may be universally valid, but the Singapore healthcare system may have undermined the results. In

some cultures, e.g., the U.S., there is evidence showing high healthcare costs and insurance leading to avoidance of cancer screening (Delmerico, Hyland, Celestino, Reid, & Cummings, 2014; Raz et al., 2019). Hence, HUS on information and behavioural intentions would need to be tested on other cultures.

In addition, the study has intended to specifically examine breast cancer and only women participants were recruited. The qualitative study revealed that healthy individuals do not possess a clear view of specific forms of cancer. When questioned, they draw experiences from various forms of cancer to inform their perceptions. Hence, in the second study, which is the development of the uncertainty scale and using these factors to predict avoidance behaviour, a general form of cancer was adopted, and male participants were recruited. The inclusion of male participants has aided in generalising findings to the wider population.

In the original UMT, Brashers (2001, p. 481) argued that evolutionary or revolutionary changes of an uncertain situation could take place across time and would render a change in management strategy. This claim is also theoretically supported by Nelissen et al. (2015). They suggest that the relationship between fear and openness to receiving or avoiding information is an inverse U relationship. The model may not be as linear as Brashers suggested. Individuals may choose to avoid, seek, or concurrently seek and avoid. Individuals may choose to avoid initially but they could switch to seek information when certain conditions compel them to seek information. For instance, an elderly lady suspects that she is ill but avoided thinking about the issue because it is distressing. As the medical condition persists, she decides to discuss this with her children who encourage her to seek medical consultation. Uncertainty management changes as situation changes. Therefore, uncertainty management is process-oriented and that there is a potential relationship between uncertainty and cognitive avoidance and health behavioural intentions.

Instead of a linear, one-sided relationship, the uncertainty management would resemble more of a process. It could be that the tendency to avoid would reach vertex and decrease (i.e., forming the inverse U-shape) because the risk of not knowing could potentially increase health risk. This study did not measure information-seeking nor test the inverse U-shaped relationship between information or behavioural seeking and avoidance as the objective is to focus on the development of uncertainty factors. Though this is a sound proposition, there is no empirical support for this inverse U relationship. Perhaps more novel research designs would have to be devised to test this phenomenon or that there could be mediating or moderating factors that could invoke a change of strategy from avoidance to adoption (i.e., information seeking and high screening intentions).

In conclusion, this thesis has contributed to the existing literature by developing a set of uncertainty constructs used to measure health-related context. Several of the hypotheses were supported, indicating that the uncertainty factors predicted avoidance behaviours. This has contributed to existing literature in that there no existing studies that used uncertainty factors other than medical uncertainty and that there are few studies that looked at the impact of uncertainty on avoidance behaviour. This study has laid the foundation for future work on the uncertainty concept development. To further examine the validity of the uncertainty factors, other health context, such as vaccination, can be used. Findings from this study have demonstrated that uncertainty does influence cancer screening intentions and cancer information avoidance. If so, health authorities can tweak their communication to reduce uncertainty and help individuals reduce negative affect in relation to cancer screening.

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Appendix

Interview Guide

Thank you so much for agreeing to this interview. The purpose of this study is to understand why women seek or avoid preventative health screening. The interview will be voice recorded. The recordings will be kept private and they will be used solely for the purpose of analysis. Your identity will be kept confidential. The interview would start with some general questions about medical consultations and will progress to more specific questions on breast cancer screening. You can choose to answer or not answer the questions.

1. Befriending... how has your day been?
2. Recall your last visit to a clinic or hospital for consultations, how was your experience?

Generative questions:

1. What do you think are some reasons people seek medical consultations?
2. What do you think are some reason people avoid medical consultations?
3. How about you, when do you seek or avoid medical consultations?
 - a. If seek, how often do you seek medical consultations?
 - b. If avoid, how often would you avoid? Would you constantly avoid, or would there be a trigger where you would seek consultations?

Directive questions (Specific to breast cancer screening):

1. Based on your opinion, what are some reasons women avoid mammogram?
 - a. If time is mentioned... Based on clinical information, it takes about 5 to 10 minutes to complete the procedure, if you make an appointment with a clinic, you can most likely finish the entire visit in an hour or less.
 - b. Are there any other reasons?
2. What are some reasons women seek to do mammogram?
3. Have you tried mammogram? Why or why not?
 - a. [Probe if needed] Do you think it that mammogram is useful or not useful? Can you please elaborate?
4. What are your perceptions of breast cancer? [Probe: do you think it is scary, common, treatable, untreatable?]
 - a. Would it (your perceptions of breast cancer) affect whether you seek or avoid mammogram?
5. Do you think it is easy or difficult to understand health information on breast cancer?
 - a. Can you elaborate why it is easy / difficult to understand?
6. How about your family and friends' opinions of breast cancer, would their opinions cause you:
 - a. To impact your perceptions of breast cancer (i.e. positively or negatively)
 - b. to be more likely or less likely to do a mammogram?
7. How about your colleagues, bosses? Would their opinions of breast cancer cause you to be more likely or less likely to do a mammogram? [To add: colleagues need not know if you would do it or not]
8. How about societal views, does it affect your perceptions of breast cancer?

- a. [Looking if participants mentioned something about social stigma (meaning: shame or disgrace that society placed on women who have this illness)]
9. When you think about cancer, what is the first thing that comes to mind?
10. How would you evaluate, in general, the types of health information that is communicated? Do you think it is scary, confusing, good, or informative?
11. What aspects of these health information on cancer do you take note most?
12. Are there any aspects of health information on cancer you find confusing?
13. Do you think you are a person who would actively seek health information (i.e. watch health programs, see the doctors when you are sick, and maybe speak to family and friends about health) or do you normally avoid health information?
14. Do you think that the information that has been communicated about cancer help you understand more about cancer? If yes/no, how/why?
15. Have you tried any form of cancer screening? Why or why not? Please elaborate.
16. Do you think that the cancer screening is useful or not useful? Please elaborate.
17. Do you think cancer can be easily treated? Please elaborate.
18. Do you think you are at high or low risk of contracting cancer? Please elaborate.
19. Would your perceptions of your risk of contracting cancer affect whether you seek or avoid cancer screening?
20. How severe do you think contracting cancer would be?
21. Do you think it is easy or difficult to understand health information on cancer? Please elaborate.
22. Do you think that contracting cancer would affect your relationships with your family and friends?
23. How about societal views, does it affect your perceptions of cancer?
24. If someone contracted cancer, what other concerns do you think he/she would have?

We have come to the end of the interview but before we end,

Closing questions

1. Can you please fill up some of your information on this card?
2. Do you have any questions?

SECTION A: SCREENING QUESTIONS

- ## SECTION B: MEDICAL INFORMATION

- EU: Extremely unlikely; U: Unlikely SU: Somewhat unlikely; SL: Somewhat likely; L: Likely; EL: Extremely unlikely

[illegible]

SECTION C: UNCERTAINTY TYPES

8. Please indicate the extent of whether you agree or disagree with the following statements as you think about cancer and the possibility of being diagnosed with the illness.

	SD	D	N	A	SA
Medical uncertainty					
a. Cancer is a threatening illness. (1)	☐	☐	☐	☐	☐
b. I am uncertain of my risk of contracting cancer. (24)	☐	☐	☐	☐	☐
c. There is no certainty of survivability from cancer even after receiving treatment. (21)	☐	☐	☐	☐	☐
d. Cancer is likely to involve risky surgery and treatments. (4)	☐	☐	☐	☐	☐
e. The amount of information on cancer can be confusing. (25)	☐	☐	☐	☐	☐
f. The amount of information on cancer out there can be overwhelming. (5)	☐	☐	☐	☐	☐
g. There's a lot of misinformation about cancer, so it's difficult to know which is truthful. (6)	☐	☐	☐	☐	☐
Social uncertainty					
h. Cancer could threaten my relationship with my spouse or potential partner. (7)	☐	☐	☐	☐	☐
i. Cancer could threaten my relationship with my family. (26)	☐	☐	☐	☐	☐
j. Cancer could affect my relationship with my boss and colleagues. (8)	☐	☐	☐	☐	☐
k. I believe the society does not have a positive view of people with cancer. (9)	☐	☐	☐	☐	☐
l. I have someone to take me to the doctors if I need it. (10) ³	☐	☐	☐	☐	☐
m. I have someone to help me if I were confined in bed. (11)	☐	☐	☐	☐	☐
n. I have someone to help me with daily chores if I am sick. (12)	☐	☐	☐	☐	☐
Economic uncertainty					
o. I do not know the actual cost of cancer treatments. (13)	☐	☐	☐	☐	☐
p. Cancer treatment is costly. (22)	☐	☐	☐	☐	☐
q. I may not have the financial means for cancer treatment. (14)	☐	☐	☐	☐	☐
r. I may not have or have insufficient health insurance coverage for cancer treatment. (15)	☐	☐	☐	☐	☐
s. I am afraid of becoming a financial burden to my family. (16)	☐	☐	☐	☐	☐

³ MOS social support survey (Sherbourne & Stewart, 1991)

Efficacy uncertainty

- t. I am unsure of my coping abilities to fight cancer. (17) ☐ ☐ ☐ ☐ ☐
- u. I am unsure if I can undergo medical treatments, if required. (18) ☐ ☐ ☐ ☐ ☐
- v. I am unsure if I can manage the disease and take care of myself. (19) ☐ ☐ ☐ ☐ ☐
- w. I am unsure if I am able to deal efficiently with unexpected events such as cancer. (20) ☐ ☐ ☐ ☐ ☐

9. Please indicate whether you agree or disagree with the following statements as you think about the cancer preventive screening.

	SD	D	N	A	SA
Response efficacy uncertainty					
a. The recommendations for cancer preventive screening are always changing. (1)	☐	☐	☐	☐	☐
b. I am uncertain of the accuracy of cancer preventive screening. (2)	☐	☐	☐	☐	☐
c. There are so many types of preventive screening that it is confusing. (3)	☐	☐	☐	☐	☐
d. Cancer preventive screening does not really prevent cancer. (4)	☐	☐	☐	☐	☐
e. Cancer preventive screening is too painful. (6)	☐	☐	☐	☐	☐
f. Cancer preventive screening is expensive. (7)					
g. I feel ashamed to be naked during the test. (8)					

10. Please indicate whether you agree or disagree with the following statements:

	SD	D	N	A	SA
Cognitive avoidance questionnaire (Sexton and Dugas, 2008)					
a. I think about trivial details so as not to think about cancer that worries me. (1)	☐	☐	☐	☐	☐
b. I distract myself to avoid thinking about cancer which is a disturbing subject. (2)	☐	☐	☐	☐	☐
c. I avoid promotional events or advertising that lead me to pay attention to information on cancer. (3)	☐	☐	☐	☐	☐

11. What is your highest obtained education level?

☐ No formal education	☐ Polytechnic diploma or equivalent
☐ Primary / PSLE	☐ Bachelor's degree or equivalent
☐ Secondary / GCE 'N'/'O' levels	☐ Master / Doctorate
☐ Junior College / GCE 'A' levels	

12. What is your gender?

☐ Female

☐ Male

13. What is your ethnicity?

☐ Chinese

☐ Malay

☐ Indian

☐ Others (please specify) _____

14. What is your marital status?

☐ Single, never married

☐ Single, others

☐ Married

15. How many members are there in your household (including yourself)? (Ratio)

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ >10

16. Please select the figure that is nearest to your average household income. (Ratio)
0 to greater than 25000

17. What is your housing type?

☐ 2-room HDB

☐ 3-room HDB

☐ 4-room HDB

☐ 5-room HDB

☐ >5-room HDB

☐ Private condominium/apartments

☐ Private landed

☐ Rented

☐ Not listed