

DISSERTATION

COMPREHENSIVE HEALTH LITERACY ASSESSMENT FOR COLLEGE STUDENTS

Submitted by

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## ABSTRACT

### COMPREHENSIVE HEALTH LITERACY ASSESSMENT FOR COLLEGE STUDENTS

This study presents the content of a new health literacy assessment tool tailored specifically for the 18-24 year-old college student population. The new tool encompasses a more comprehensive measurement of comprehension, numeracy, media literacy, and digital literacy.

The current leading health literacy assessment tools do not assess the entire concept of patient health literacy, have limited empirical evidence of construct validity, are lacking in their psychometric properties, and are not targeted specifically for the young adult population. Research shows that many higher educated individuals are currently graduating without the necessary skills needed to adequately and efficiently navigate the healthcare system. Poor patient health literacy may be an even stronger predictor of a person's health status than age, income, employment status, education level, and race (Institute of Medicine, 2004).

The author created an initial item pool of 229 questions based on research. Health education experts reviewed the initial item pool and helped select the best items that might represent the sub-components of health literacy. This first version of the test was administered to 144 college students. Item Response Theory analysis helped eliminate non-performing items. A second version of the test was administered to 426 college students and analyzed again using Item Response Theory. The new assessment tool was also compared with the current gold standard health literacy tool to establish construct

validity, and the two tools were compared for how well each predicts certain health behaviors.

Fifty-one items were selected for the assessment based on good psychometric properties. The final version has good internal consistency (Cronbach's alpha = 0.81). Convergent validity and discriminant validity were supported with expected sub-component correlations with the gold standard tool. And the new assessment tool shows better predictive validity with health-related quality of life, exercise frequency, overall participation in physical activities, and alcohol consumption over the current gold standard tool.

The new instrument is recommended for research use in measuring health literacy in young adult populations, especially college students, to help identify deficiencies and strengths in the sub-concepts of health literacy.

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## **Introduction**

The purpose of this study was to develop a more comprehensive health literacy assessment tool using modern psychometrics for young adults between 18 and 24 years old. The current leading health literacy assessment tools do not assess the entire concept of patient health literacy, have limited empirical evidence of construct validity, are lacking in their psychometric properties, and are not targeted specifically for the young adult population.

The standard health literacy tools used today mainly measure comprehension (which is defined in terms of “reading ability” in this context), and only do so in a limited way that may not provide a thorough overview of understanding (and misunderstanding). Health care researchers have expanded the concept of patient health literacy to include additional skill sets, primarily including numeracy, media literacy, and computer literacy (in addition to comprehension).

Patient health literacy has long been recognized as an essential component in patients being able to make informed health care decisions and to adequately and efficiently navigate the healthcare system. Poor patient health literacy may even be a stronger predictor of a person’s health status than age, income, employment status, education level, and race (Institute of Medicine, 2004).

In this study, the author created an assessment that encompasses the expanded concept of health literacy as it is more widely recognized today. She compared the new assessment tool with an already well-established health literacy tool to establish construct validity, and also compared how well the new tool predicts health status and current health behaviors with the gold standard tool.

## **Background**

### **Health Literacy: History of the Term, Measurement, Concept, and Lack of Theory**

The term “health literacy” was first used in 1974 in the proceedings of a health education conference discussing health education as a social policy issue (Frisch, Camerini, Diviani, & Schulz, 2011). Since then, interest in “health literacy” – especially concerning its definition and measurement – has increased.

Interest in measuring literacy skills as they related to healthcare was initiated by the 1993 National Adult Literacy Survey (NALS) of functional literacy in the U.S. Although the survey did not include a direct measure of literacy as it pertained to healthcare materials, it uncovered serious difficulties with reading and writing across the nation (Chinn, 2011). Health communication researchers found this troubling in a country where completing medical insurance and Medicare forms is a crucial step in the access to health care (Chinn, 2011; J. M. Mancuso, 2009). Therefore, in the early 1990s, the term “health literacy” was identified as meaning “reading and writing skills in the healthcare environment” (Chinn, 2011; Frisch, et al., 2011). The definition was first thought of as the ability to read and comprehend appointment slips and other clinical materials, and follow oral and written instructions (Amalraj, Naeim, Nguyen, & Starkweather, 2009; Frisch, et al., 2011).

Therefore the first assessments (which are still considered the “gold standards” today) were created specifically to assess reading and writing skills in the clinical environment. (Chinn, 2011). The Rapid Estimate of Adult Literacy in Medicine (REALM) and the Test of Functional Health Literacy in Adults (TOFHLA) were developed with the primary focus being to assess the ability of patients to read various instruction and

information forms in clinical situations (D. W. Baker, Parker, R.M., Williams, M.V., & Clark, W.S., 1998; Davis, Michielutte, Askov, Williams, & Weiss, 1998; Gazmararian, Parker, & Baker, 1999; Scott, Gazmararian, Williams, & Baker, 2002; Servellen, Brown, Lombardi, & Herrera, 2003). And the 2003 National Adult Literacy Survey also included a measure of “health literacy” (defined as reading and writing in the healthcare environment) in its nationwide assessment. The exact methodology of the NALS survey is not available for use by others (and so it is not a good candidate for adoption as part of a new health literacy tool), but it is clear that they only assess reading comprehension of health materials in their assessment (Pleasant & McKinney, 2011).

The main goal with these early health literacy assessments (which, again, are still the “gold standards” used today) was to figure out what reading level patients were capable of, so that patient materials could be written (or re-written) to “match” that corresponding reading level (Andrus & Roth, 2002). The idea was for a direct translation between health literacy scores (or reading levels) and the appropriate reading level of patient materials (which were assessed through readability scores, such as Flesch-Kincaid and the Gunning Fox index) (Andrus & Roth, 2002). The emphasis on measurement – up until recently – has therefore been focused on determining how well patients *read*. And the materials included for assessing reading ability did not go beyond printed clinical materials (such as instruction forms and prescriptions).

Because the first assessments (REALM, TOFLHA, and a shortened version of the TOFHLA) were developed as specialized literacy assessments (and maintaining the original understanding of ‘literacy’ as the ability to read and write), they were all tested for their correlations with traditional educational reading assessments (such as the Adult Basic Learning Examination) to establish their validity (Amalraj, et al., 2009). However, these tools are limited

to evaluating a narrow view of reading skills. For example, the TOFHLA and s-TOFHLA use the cloze formatted reading test (a popular method used in education to measure literacy – although usually in conjunction with other methods) and the REALM evaluates “health literacy” through an oral word recognition test of medical words. However, neither provides a comprehensive assessment of reading skills, which would require using more than one technique (Marcotte & Hintze, 2009; Spear-Swerling, 2006).

In addition, these tests also do not measure the more advanced comprehension skills needed to navigate the healthcare system today. Neither goes beyond a very basic level of understanding in their assessments – and yet the healthcare materials available from websites such as WebMD or the National Cancer Institute would require more advanced reading skills. For example, most of the comprehension questions on the TOFHLA resemble items such as the following:

QUESTION: Before supper you should only have a \_\_\_\_\_ snack of fruit.  
a) little; b) broth; c) attack; or d) nausea.).

So are these tests even adequate measures of the reading skills necessary to understand new health information, treatment options, and good prevention measures? A good assessment should include question items that reflect the various types of health materials available to the public for understanding more about their health – and the materials currently available definitely require more advanced reading skills than just understanding basic vocabulary.

Furthermore, none of the current tools were designed with theory in mind or to test or advance an underpinning theory of health literacy (Pleasant & McKinney, 2011). In a recent discussion involving 80 researchers and practitioners who work in or care about health literacy, a

primary theme in their discussion reflected that these professionals have not found a suitable health literacy measurement tool that meets their needs in comprehensively assessing health literacy as it is more widely recognized today (Pleasant & McKinney, 2011). They complained that the current tools only focus on a single skill (e.g., reading of medication labels), whereas most definitions of health literacy today involve multiple skills and conceptual domains. They were also frustrated that the current tools do not provide information on the exact literacy problems that participants are having trouble with – they merely provide a score of low, moderate, or high health literacy.

In addition, a critical review of existing health literacy assessments revealed that most instruments have limited empirical evidence of construct validity and are seriously lacking in their psychometric properties (Jordan, Osborne, & Buchbinder, 2011).

### **The New Concept of Health Literacy**

Most major health-related institutions and researchers are now in agreement that health literacy most definitely encompasses more than just being able to read and understand health information in clinical settings (which was essentially the early definition of health literacy, and what our current “gold standard” health literacy assessment instruments are based on).

The World Health Organization goes beyond just reading ability and defines health literacy as “the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health” (World Health Organization, 2010).

The U.S. Department of Health and Human Services (HHS) also goes beyond just reading ability and now defines health literacy as “the degree to which individuals have the

capacity to obtain, process, and understand basic health information needed to make appropriate health decisions and services needed to prevent or treat illness” (U.S. Department of Health and Human Services: Office of Disease Prevention and Health Promotion, 2010). They believe that health literacy is *not* just the ability to read, but requires a group of complex skills including reading, listening, analyzing, decision making, and the ability to apply these skills specifically to health care-related situations. HHS explains that some of the main tasks patients must accomplish when faced with health information and treatment decisions are the following:

- Evaluate information for credibility and quality
- Analyze relative risks and benefits
- Calculate dosages
- Interpret test results
- Locate health information

In order to accomplish these, HHS says that patients must be visually literate, computer literate, information literate and computationally literate. They also point out that oral communication skills are key to health literacy (2010).

Similarly, several other researchers have identified essentially these same additional skills – beyond just reading comprehension – that are part of this concept *or theory* of patient health literacy. For example, Bernhardt and Cameron identify reading literacy, numeracy, media literacy, computer literacy, and the ability to communicate effectively with health care providers as the main cognitive and social aspects of health literacy that are important for people to get around in the health care system today (Bernhardt & Cameron, 2003). And the Centre for Literacy in Quebec identified a similar set of skills as necessary for health literacy at their 2008

health literacy curricula conference: reading, writing, listening, speaking, numeracy, and critical analysis, as well as communication and interaction skills (Centre for Literacy, 2008).

Although there are several variations in the exact definition of health literacy, researchers seem to be in general agreement over what the concept of patient health literacy should include (that is, that it encompasses comprehension, numeracy, media literacy, computer literacy, and communication and interaction skills). Therefore, creating an assessment based on these widely recognized health literacy skills seems both appropriate and essential.

As mentioned previously, none of the existing assessments are based on theory or designed to test or advance theory. Because there is no current “theory of health literacy,” nor an appropriate blanket theory to use in creation of a new health literacy assessment, the new tool outlined in this report is also unfortunately not based on an underpinning theory. However, the new tool is based on the overall current consensus of what “health literacy” means and encompasses. And the author believes the new health literacy instrument will allow her to examine how this comprehensive concept may influence deliberate and planned behavior in future research. She believes that this new, validated instrument will enable her to use the tool to help ground the more comprehensive and advanced health literacy concept in behavioral theory. Her hope – long-term – is that this will help researchers identify the clear link between health literacy and the consequences and benefits of improving health literacy.

### **Importance of Health Literacy**

Although the old tools (which are still the standard tools) are based on the archaic definition of health literacy (ability to read clinical materials) and not the more comprehensive definition of health literacy (which encompasses comprehension, numeracy, media literacy, computer literacy, and communication and interaction skills), they have, however, provided an

enormous amount of interest over the past three decades in “health literacy” and its association with health outcomes. In fact, in a study that examined health literacy articles between 2003 and 2011, the authors found that 96 of 111 quality articles reported using the REALM, TOFHLA, s-TOFHLA or variations of these tests to measure health literacy (Berkman, Sheridean, Donahue, Halpern, & Crotty, 2011). Results from the standard tools have consistently shown that patients with low scores on these tests also tend to have poor health knowledge and worse health outcomes compared with those who score well on these tests (Berkman, et al., 2011).

Health communication professionals have long recognized the importance for making informed health care decisions (Ancker & Kaufman, 2007; Lipkus & Peters, 2009; Reyna, Nelson, Han, & Dieckmann, 2009) and the REALM and the TOFHLA and variations of these tests have established the association between poor health literacy and poorer health status (Weiss, Hart, McGee, & D'Estelle, 1992), an increase in emergency room visits (D. W. Baker, Gazmararian, J.A., Williams, M.V., Scott, T., Parker, R.M., Green, D., Ren, J., & Peel, J., 2004), an increase in the length of time patients stay at hospitals (Friedland, 1998), low scores on knowledge about current medical conditions (Williams, Baker, Honig, Lee, & Nowlan, 1998; Williams, Baker, Parker, & Nurss, 1998), lower use of preventative services (Davis et al., 1996; Lindau et al., 2002; Reyes-Ortiz et al., 2007), poor compliance with prescribed treatments (Nichols-English & Poirier, 2000), increased health care costs (Ad Hoc Committee on Health Literacy for the Council of Scientific Affairs, 1999; Nielson-Bohlman, Panzer, & Kindig, 2004) and being less likely to ask their physicians to further explain information they didn't understand (Amalraj, et al., 2009).

Approximately 80 million U.S. adults are thought to have limited health literacy, which puts them at risk for lower health outcomes (Berkman, et al., 2011).



The U.S. Department of Health and Human Services continues to recognize consumer health literacy as one of its primary objectives (2010). And the Institute of Medicine says that improved health literacy could help transform health care in the United States for both consumers and the health care system (Institute of Medicine, 2004). According to their 2004 report, nearly 90 million people in the U.S. have trouble understanding and acting on health information (Institute of Medicine, 2004). They also indicated that poor health literacy is a stronger predictor of a person's health status than age, income, employment status, education level, and race.

Patients are now expected to be able to make comparisons and decisions based on information they are given at a doctor's office about which treatment option to go with, or which medical plan to follow (Reyna, et al., 2009). This is because today's health care system now operates on more of a patient-centered model, whereby patients are expected to understand health-related information to make informed choices about their medical care (Eggly, 2002; Parrott, 2009; Peters, Hibbard, Slovic, & Dieckmann, 2007; Reyna, et al., 2009). The problem is that by emphasizing greater responsibility in the patient, this could put those with limited health literacy skills at an even greater disadvantage.

Furthermore, the Patient Protection and Affordable Care Act (ACA) that was passed into law on March 23, 2010 extends health insurance coverage to about 32 million lower-income adults, many of whom are likely to have low health literacy (Somers & Mahadevan, 2010). In the past, research shows that low literacy is disproportionately high among lower-income Americans who are eligible for publicly financed care through Medicare or Medicaid (Somers & Mahadevan, 2010). This pattern of low literacy is likely to continue with individuals who are newly eligible for health insurance coverage through the ACA. As of October 1, 2013,

individuals and small businesses will be able to purchase affordable health plans in a new competitive insurance marketplace (U.S. Department of Health and Human Services, 2013). But those with low levels of health literacy – who probably make up a large majority of those who are eligible for the increased access to coverage – are probably least equipped to benefit from the new health plans, which could result in additional unnecessary costs for both the consumers and those who deliver their health care.

The Health Care Reform legislation doesn't directly address health literacy as one of its featured concerns, but several of the ACA provisions acknowledge the need for greater attention to health literacy, such as the need to communicate health and health care information clearly; the need to train providers on cultural competency, language, and literacy issues; and to provide patient information at appropriate reading levels

(Somers & Mahadevan, 2010). Low-literacy individuals with the new coverage are expected to have trouble “understanding eligibility guidelines for the various insurance programs; participating in the buy-in process of the exchange or high-risk pools; providing supplemental identification and citizenship documentation necessary for enrollment; understanding which services are covered; recognizing cost-sharing and premium responsibilities; and choosing a health care provider” (Somers & Mahadevan, 2010). All of these tasks require significant consumer health literacy and those who are ill equipped may be at a considerable disadvantage.

Poor health literacy also affects the economy. In the past, researchers have estimated that a low level of health literacy has cost the U.S. health care system between \$30 billion and \$73 billion per year for unnecessary doctor visits (Riggs, 2001). Average annual health care costs are estimated to be four times greater for low literate individuals than those with higher health literacy (Pawlak, 2005). The expansion of health insurance coverage from ACA on its own is

expected to cost nearly one trillion dollars over the next 10 years (Somers & Mahadevan, 2010) – and if low health-literate individuals make up a significant proportion of those newly covered, there could be additional very costly repercussions resulting from poor understanding of health information and services.

As noted at the beginning of this section, the associations between reading ability of health materials (essentially the original definition of health literacy) and health outcomes have helped establish the importance of health literacy in health care. However, we don't yet know how other parts of the now-more-widely-recognized concept of health literacy are associated with health outcomes and behaviors. This is something we need to test so that we have a better understanding on how each aspect (comprehension, numeracy, media literacy, digital literacy) affects health and understanding of health so that we are better able to provide appropriate interventions. Although Americans may have more access to healthcare in the coming years, they will still be expected to make their own informed choices about their medical care. The more we understand about their health literacy and how it directly affects their health behaviors and outcomes, the more likely we'll be able to provide targeted assistance and create appropriate materials.

### **Tool for College-Aged 18-24 Year-Olds**

Most health literacy tools are focused specifically on the general adult population and have only been validated in the general adult population (Chisolm & Buchanan, 2007). No known assessment tools have been created specifically for measuring health literacy in the 18-24 year old population (or specifically in the 18-24 year-old college student population). And yet this population may be in a better position to help change their health literacy at a time before

needing more comprehensive healthcare. Furthermore, the college student population also most likely has access to several resources to help them better their health literacy, if needed.

Limited health literacy is strongly associated with several socioeconomic indicators, including race/ethnicity, age, and education (Paasche-Orlow & Wolf, 2007; Pawlak, 2005). While most socioeconomic indicators are static, education level can change. And college students have perhaps the best access to make the necessary educational changes to increase their health literacy.

But the fact is, college students are currently graduating without the necessary skills needed in the healthcare system today. Schwartz and colleagues found that higher educated individuals still have difficulty understanding and utilizing medical information. And a significant number of college graduates don't have the necessary numeracy skills needed for health-related tasks (Schwartz, Woloshin, Black, & Welch, 1997). The American Institutes for Research found that 20 percent of U.S. college students who completed four-year degrees and 30 percent of those with two-year degrees had only the most basic quantitative literacy skills (American Institutes for Research, 2006). They also found that more than 75 percent of those with two-year degrees and 50 percent of those with four-year degrees scored below a proficient level of literacy (meaning, they lack the skills to perform complex literary tasks such as summarizing arguments in newspaper articles – which, if related to health material, might lead to misunderstandings about health care risks, prevention, and treatment opportunities, etc.).

Therefore, an assessment specifically aimed at measuring health literacy in 18-24 year-old college students could help inform both students and university staff of the areas in health literacy that need attention for optimal navigation and utilization of today's healthcare system. Providing specific deficit information during the freshmen or sophomore years could then

potentially enable students and staff to work toward increasing students' knowledge over the next few years.

### **Critique of Existing Measures**

The following section includes an analysis of the existing health literacy assessment tools. Appendix A also includes a table outlining the main difference between the tools, including an overview of what each tool is “missing” in terms of analyzing health literacy (according to the author's definition of health literacy, as outlined in this paper).

### **Standard health literacy assessment tools.**

Currently, the two most widely used instruments for studying health literacy appear to be the Rapid Estimate of Adult Literacy in Medicine (REALM) and the Test of Functional Health Literacy in Adults (TOFHLA) – or some variation of these tests. The original REALM was developed in 1991, followed by a shortened version in 1993, and the TOFHLA was developed in 1995 (J. M. Mancuso, 2009; Parker, Williams, & Nurss, 1995; Shea et al., 2004).

#### ***REALM.***

The REALM is a word recognition test that consists of common medical words (Andrus & Roth, 2002; Davis et al., 1993; Murphy, 1993). The original version consisted of 125 words, but a shortened 66-word version is now most commonly used (Murphy, 1993). The words are arranged in three columns, and are listed in order of increasing difficulty. Patients read the words aloud and are scored based on how well they pronounce each word. The 66-word version takes approximately one to three minutes to complete. Grade levels of 3<sup>rd</sup> and below, 4<sup>th</sup> to 6<sup>th</sup>,

7<sup>th</sup>-8<sup>th</sup>, and 9<sup>th</sup> and above are assigned based on how many words are pronounced correctly (Andrus & Roth, 2002; Davis, et al., 1993; Murphy, 1993).

However, the REALM does not test all of the various concepts important to health literacy – only word recognition, which the test creators believe is a proxy for reading comprehension of health materials. It also doesn't directly measure a person's understanding of the words, only their sight-reading ability.

### ***TOFHLA.***

The TOFHLA is considered to be the “gold standard” of health literacy testing (J. M. Mancuso, 2009). It has strong reliability and validity data and is available in Spanish – making it appealing for health literacy studies in the U.S. It consists of two sections: a 50-item reading comprehension test and a 17-item numeracy test, which takes about 22 minutes to administer (Parker, et al., 1995). The reading test has three health-related passages – a gastrointestinal passage, a Medicaid application, and a procedure-informed consent form – each with every 5<sup>th</sup> to 7<sup>th</sup> word deleted (this is referred to as the *cloze* technique). Participants choose the missing word by selecting from one of four options – one of which is correct and the other three are similar, but either grammatically or contextually incorrect. The numeracy section involves the participants' reading numbers on prescription bottles and appointment slips, and then telling the administrator about the information they just read. The numeracy score (out of 17 items) is multiplied by 2.941 to create a score from 0 to 50 so that there is a similar range with the reading section. The total TOFHLA test scores therefore range from 0 to 100 (Nurss, Parker, Williams, & Baker, 2003).

Like the REALM, the TOFHLA does not test all of the various skill sets identified earlier as important to health literacy. However, it does more comprehensively assess reading

comprehension (using the cloze technique), and it also measures numeracy (which the REALM does not do). But it still doesn't provide any information about media literacy, computer literacy, or communication and interaction skills. And the numeracy questions are focused on reading prescriptions that test simple mathematical skills such as understanding dates and times of medication dosage (Parker, et al., 1995). But it does not include a comprehensive assessment of more complex skills such as multi-step math, probability, and problem solving.

### **Other commonly used health literacy assessment tools.**

#### ***Wide Range Achievement Test (WRAT).***

The WRAT test consists of three subtests: reading recognition, spelling, and arithmetic (Andrus & Roth, 2002). The reading subtest involves two sections: letter reading, whereby the participant must name the letters of the alphabet on a sheet; and oral word reading, whereby the participant tries to pronounce 42 words. This test does not specifically evaluate health literacy, but literacy in general; however, the test is often referred to as a possible literacy measurement in health care contexts.

Although the test is easy to score, it only measures the recognition of words by sight and not by understanding. Besides word recognition, the test does not take most of the health literacy concepts into account: reading comprehension (at least not comprehensively), media literacy, computer literacy, nor communication and interaction skills.

### ***Medical Achievement Reading Test (MART).***

This test was modeled after the WRAT to specifically measure medical literacy (Andrus & Roth, 2002). The subject reads medical words off of a prescription bottle and is scored based on the number of words pronounced correctly.

The main advantage of this test is that it can be administered and scored quickly (3-5 minutes). However, the test does not measure understanding of the terms, merely how well the participant pronounces the words. The test also has not been correlated with other comprehension tests for validity. And like the WRAT, the test does not measure most of the health literacy concepts mentioned in this proposal.

### **Newer, less well-known health literacy tools.**

Several researchers have attempted to create new health literacy assessment tools within the past several years; however, none of them thoroughly test all of the concepts of health literacy. And most of these tools are modeled after either the TOFHLA or the REALM.

### ***Newest Vital Sign (NVS).***

The Newest Vital Sign is a six-question numeracy test that involves asking participants for information about an ice cream nutrition label (Weiss et al., 2005). The researchers wanted to create a health literacy tool that would take less time to administer than the standard health literacy tests that specifically measure comprehension and numeracy (i.e. the TOFHLA). They believe patients must be able to use and understand both text and numbers to effectively navigate today's healthcare system, so they concentrated on testing numeracy skills. Whereas the TOFHLA takes 18-22 minutes to administer and score, the NVS takes approximately 3 minutes (Johnson, 2008). But this tool is also not a comprehensive assessment and doesn't test all of the health literacy concepts important to health literacy.



The six questions on the test include the following (Weiss, et al., 2005):

1. If you eat the entire container, how many calories will you eat?
2. If you are allowed to eat 60 g of carbohydrates as a snack, how much ice cream could you have?
3. Your doctor advises you to reduce the amount of saturated fat in your diet. You usually have 42 g of saturated fat each day, which includes 1 serving of ice cream. If you stop eating ice cream, how many grams of saturated fat would you be consuming each day?
4. If you usually eat 2500 calories in a day, what percentage of your daily value of calories will you be eating if you eat one serving?
5. Is it safe for you to eat this ice cream? (The patients are told they must imagine they have an allergy to peanuts, and then must notice that the ice cream contains peanut oil in it – which would make it unsafe to eat).
6. (Ask only if the patient responds “NO” to question 5): Why not? (Correct answer: Because it has peanut oil).

### ***Bilingual Multimedia Talking Touchscreen.***

Yost, Webster, Baker, Choi, Bode, and Hahn created a bilingual computer-based health literacy assessment tool based on the types of items included in the TOFHLA, the 1992 National Adult Literacy Survey and the 2003 National Assessment of Adult Literacy (Yost et al., 2009). The multimedia tool includes three sections: a prose section, which includes a modified cloze technique (like the TOFHLA); a document section, which includes questions about an image such as a table, graph, or prescription label; and a quantitative section, which requires participants to answer arithmetic questions.

While this test provides fairly comprehensive comprehension and numeracy sections, it still does not test the other concepts of health literacy (media literacy, computer literacy, or communication and interaction skills).

### ***Medical Data Interpretation Test.***

Schwartz, Woloshin, and Welch created the Medical Data Interpretation Test for measuring people's ability to interpret medical statistics (Schwartz, Woloshin, & Welch, 2005). The assessment is modeled after the quantitative and document literacy portions of the National Adult Literacy Survey (NALS). The test includes 18 numeracy items (20 questions) on consumer prescription drug advertisements, news media reports, and statements that physicians might make to patients.

This tool provides a more thorough examination of numeracy skills, but doesn't measure the other concepts of health literacy.

### ***Oral Health Literacy Instrument (OHLI)***

The OHLI is a dental-specific literacy test modeled closely after the TOFHLA – with both a reading comprehension section based on the cloze technique and a numeracy section (Sabbahi & Lawrence, 2009). The reading comprehension section has two passages – one on dental caries and the other on periodontal disease. The OHLI numeracy section tests comprehension of taking common prescriptions associated with dental treatment as well as following instructions often given after dental appointments (also very similar to the TOFHLA's numeracy section). As indicated in Table 1, the OHLI does not thoroughly measure health literacy according to the conceptual definition in this report.

### ***Korean Health Literacy Scale***

The Korean Health Literacy Scale is a health literacy test based on the TOFHLA created specifically for testing adults in Korea (Lee, Kang, Lee, & Hyun, 2009). The test uses a cloze technique for the comprehension section and has a numeracy section much like the TOFHLA. The researchers also included a third section on interpreting graphics (unlike the TOFHLA),

whereby participants must identify what's happening in a graphic that shows foods that contain cholesterol.

### ***Brief Screening for Identifying Inadequate Health Literacy***

Chew, Bradley, and Boyko tested 16 individual screening questions to see if the questions could identify people with inadequate or marginal health literacy (Chew, Bradley, & Boyko, 2004). They determined participants' level of health literacy (inadequate, marginal, or adequate) by administering the STOFHLA to 332 patients. They found that three of their screening questions (see below) were effective at detecting inadequate health literacy (as indicated by the amount of area under the receiver operating curve statistic), but the questions were not very strong for detecting marginal health literacy.

The three questions they identified, with corresponding areas under the receiver operating curve in parentheses, are the following:

1. How often do you have someone help you read hospital materials? (0.87)
2. How confident are you filling out medical forms by yourself? (0.80).
3. How often do you have problems learning about your medical condition because of difficulty understanding written information (0.76).

The patients select one of five answers from a Likert scale (always, often, sometimes, occasionally, never) when answering each question.

The researchers acknowledge that the screening tool is still in the exploratory stage and that they did not adjust for potential confounders in their analysis. They also say that the multiple comparisons they made may have increased the Type I error rate. Further, their pilot testing was on predominantly white male patients, which could mean their results are not generalizable. However, the authors believe their study shows promise that one single screening

question may be able to correctly identify about 80 percent of adult patients who have inadequate literacy.

### ***Stieglitz Informal Reading Assessment of Cancer Text (SIRACT)***

The Stieglitz Informal Reading Assessment of Cancer Text (SIRACT) is a cancer-specific health literacy assessment for cancer patients (Agre, Stieglitz, & Milstein, 2006). The researchers wanted to create a tool that specifically measured patients' understanding of cancer information, and they wanted to avoid the often used word-recognition format (like the one used in the REALM) because they believe unfamiliar words can be pronounced correctly even when their meanings are foreign to the participant (and they believe the reverse is true; that people who read well can also mispronounce words out loud), and they also wanted to avoid the cloze technique (like that used in the TOFHLA) because it does not really measure passage-level comprehension. They also wanted to find a different way of categorizing patients' health literacy level than the standard "inadequate, marginal, or adequate functional health literacy," like that used in the TOFHLA.

The SIRACT test involves a series of cancer texts that are arranged in increasing difficulty. Patients answer five passage-level questions at the end of each text from a multiple choice list (i.e. "What is the first sign of colorectal cancer? Answer: blood in the stool). The patients are also asked to indicate their level of interest in each passage.

The test is scored based on the percent of answers correct. Seventy-eighty percent correct indicates the patient is at an "instructional level," which means the researchers believe the patient has fairly good comprehension of the text and that additional instruction can then be given by the physicians or nurses. Above eighty percent indicates an "independent level," which corresponds to an understanding that the patient can read the material with little difficulty and

does not need instruction; and “frustration level” is reached when patients comprehend less than 70 percent, indicating learners may not be able to benefit from any readings, even with instruction.

***REALD-99: Dental Health Literacy Word Recognition Instrument***

The REALD-99 is a dentistry-specific word recognition test, based on the REALM (Richman et al., 2007). The test includes 99 dentistry words taken from the American Dental Association’s Glossary of Common Dental Terminology, and from words or terms they found common on dental brochures and other patient materials from the University of North Carolina at Chapel Hill’s School of Dentistry Clinic.

Like the REALM, the words are arranged in order of increasing difficulty, and scores are based on the number of words pronounced correctly.

***Final note about existing health literacy tools***

Both the standard measurement tools used for health literacy (the REALM and the TOFHLA) as well as the other tools listed here only provide limited information about an individual’s health literacy. And none of them are designed specifically for measuring health literacy in young adults.

## **Content of New Health Literacy Tool**

Based on the main concepts identified by the U.S. Department of Health and Human Services and several other health communication researchers as important to health literacy, a new assessment tool (that can be measured quantitatively) should test comprehension of health materials, health numeracy, media literacy, and computer literacy. And eventually, a qualitative in-depth survey or interview component is recommended for exploring students' communication and interaction skills with health care staff.

A description of each of the concepts that can be tested quantitatively in this assessment tool is provided here.

### **Comprehension of health materials**

Comprehension is generally defined by other health literacy instruments (such as the TOFHLA), as the ability to understand health-related texts in terms of reading ability. In education, reading comprehension is understood to be dependent on reading ability, reasoning skills, attention, and memory.

Most health literacy tests (such as the TOFHLA, REALM, and MART) are based on standardized comprehension measurement techniques that were already developed for measuring comprehension in the education environment (such as oral reading fluency and the cloze technique). The following table provides a brief explanation of how the various forms of comprehension techniques work.

**Table 1.** Comprehension measurement techniques

<b>Test</b>	<b>How it works</b>
Cloze	Every 5 <sup>th</sup> to 7 <sup>th</sup> word is deleted in a passage. Reader must then figure out what vocabulary words fit in the blanks.
Maze	Modified cloze technique, but reader can choose from a list of multiple-choice answers.
Sentence verification technique	Subject reads a passage and then selects sentences that either mean or do not mean the same thing as the sentences in the original passage. The subject must select from one of four kinds of test sentences for the most equivalent meaning to the original sentence in the passage.
True/false and multiple choice	True false (or yes/no) questions and multiple-choice questions are often used to analyze a subject's overall comprehension of a document (i.e., "Did 'X' happen in the passage?" Yes/No?).
Open-ended questions	Open-ended questions querying comprehension of the overall document. Some formats are oral (so reader reports back verbally) and some are written (reader writes a response).
Vocabulary tests	Several different versions, but mainly tests a person's vocabulary knowledge (can be health-specific as part of health literacy tests).
Oral reading tests	Usually involves a participant either reading aloud an entire passage, or just a set of vocabulary words. An examiner records how often a participant mispronounces a word and a score is given based on the number of words read correctly. Oral reading tests are often timed (so how many words a participant reads correctly over one minute, for example).

Royer – a researcher in psychology who is dedicated to studying reading comprehension – said in an interview, published by Shaghnessy, that it's hard to tell whether standard comprehension assessment tools can actually be used for diagnostic purposes (Shaughnessy, 2005). The problem – he says – is that it's hard to tell whether poor performance means that a student is deficient in reading skills or if it means that he or she does not have the prior knowledge needed to construct an interpretation of the text. Therefore, a good health literacy measurement should probably also take the participant's background knowledge into consideration and some type of evaluation of understanding overall context as well.

Spear-Swerling -- an advisor for LD Online, an organization dedicated to helping children and adults with learning disabilities and ADHD -- suggests using more than one test to

assess reading comprehension (Spear-Swerling, 2006). She recommends using the average of at least two or three different kinds of comprehension tests to give a more accurate indicator of comprehension performance. Marcotte and Hintze found – in their study of formative measures of reading comprehension – that multiple measures of reading comprehension explain the variability associated with reading ability much better than oral reading fluency alone (which has become increasingly popular among researchers because it is quick and easy to administer and score) (Marcotte & Hintze, 2009). They discovered specifically that the Maze, Sentence Verification Technique, and Written Retell each provided between 3 and 8 percent of the observed variance beyond the currently popular oral reading fluency test.

The existing health literacy tools use just one of the different types of comprehension techniques (i.e., the cloze technique is used in the TOFHLA, and oral reading fluency is used in the WRAT and MART). A new health literacy tool should encompass more than one comprehension measure (to account for the different kinds of comprehension and brain processes that take place during comprehension) and include some evaluation of context and background knowledge.

### **Comprehension measurement in new health literacy tool.**

In this new tool, both the sentence verification technique and the cloze technique are used. The cloze technique is already widely used in standard health literacy assessments, including the TOFHLA. The technique involves having participants read a passage with every Xth word deleted (typically spanning a range, such as every 5<sup>th</sup> to 7<sup>th</sup> word deleted, as in the TOFHLA). The participant then fills in the blank based on a multiple choice set of answers (Wilson, 2000). Research shows that the cloze technique has good validity (Bormuth, 1968; Hafner, 1966; Taylor, 1953, 1957), and test-retest reliability for normal readers has been found



high (.88) (Taylor, 1957). Because the cloze technique has been used as the primary tool for measuring comprehension in health literacy in past tools, it will also be included in this assessment. However, the existing standard health literacy assessments only test for a very basic level of comprehension (such as being able to identify the difference between the need for an adjective versus a noun). In this health literacy assessment intended for young adult college students, more advanced skills will be tested to reflect the reading skills needed to understand various kinds of health materials available from websites such as WebMD or the National Cancer Institute.

The Sentence Verification Technique (SVT) – developed by James Royer, mentioned above as an expert on reading comprehension – is based on the idea that when people read passages, they form a memory representation of that passage (meaning, people should be preserving the meaning of each sentence in the passage) (Royer, 2004). Therefore, the test measures whether participants have comprehended a passage by checking their accuracy for determining if sentences mean or do not mean the same things as sentences in the original passage. The test always consists of four different passage types of test sentences: 1) *Original*: an exact duplication of the sentence in the original passage; 2) *paraphrase*: some or all of the words in the sentence have been changed from the original, but without altering meaning; 3) *meaning change*: one or two words have been changed in the passage sentence in order to change the meaning of the sentence; and 4) *distractor*: consistent with the theme of the passage, but unrelated in meaning to any sentence in the passage (Royer, 2004).

Therefore, participants would read through a passage and then, without looking back at the original passage, would respond to the test questions with either “YES” or “NO.” “YES” sentences are defined as sentences that are the same or mean the same as the original passages

(original and paraphrase). “NO” sentences have a different meaning than the original passage sentences (meaning change or distractor).

Most of the researchers who have used the SVT have used approximately 12-sentence passages and included either a 12-sentence SVT test with three each of original, paraphrase, and meaning change sentences, or with an additional four distracter sentences to form a 16-sentence test (Royer, 2004). Three-passage tests with 16-test sentences have been shown to have reliabilities in the .5 to .6 range. Longer tests (with four to six passages and accompanying 16 test sentences for each passage) have been found to have reliabilities ranging from .7 to .9 (Royer, 2004).

The assumption behind the SVT is that comprehension is a constructive process that involves an interaction between context, the linguistic message in the passage, and the knowledge base of the reader. As a result, the reader creates an interpretation of the passage that preserves the meaning, but not necessarily the structure of the passage (Durwin & Sherman, 2008; Royer, 2004; Royer & Cunningham, 1981; Royer, Hastings, & Hook, 1979). So while the SVT technique contains sentence-level questions, research suggests that it is a measure of passage comprehension rather than sentence-level comprehension (Durwin & Sherman, 2008; Royer, 2004; Royer, Lynch, Hambleton, & Bulgareli, 1984) – which makes it an excellent addition to the cloze technique (a sentence-level examination of comprehension) that can be measured quantitatively in a health literacy assessment.

The SVT has been used in numerous comprehension studies, including at the college level (Durwin & Sherman, 2008; Lehto & Anttila, 2003; Marcotte & Hintze, 2009; Ordonez, Carlo, Snow, & McLaughlin, 2002; Pichette, 2005). The test has been shown to have good convergent and discriminant validity (Royer, 2004; Royer, Carlo, & Cisero, 1992), good

reliability (Royer, 2004) and is a good predictor of learning performance, as measured at the college level (Durwin & Sherman, 2008; Royer, Marchant, Sinatra, & Lovejoy, 1990).

Therefore, this technique will be included as part of the comprehension measurement for assessing reading comprehension of health texts in the new health literacy tool.

## **Health Numeracy**

Many researchers say that there is no general agreement on the definition of numeracy in a health care context (Golbeck, Paschal, Jones, & Hsiao, 2011; Reyna, et al., 2009; Rothman, Montori, Cherrington, & Pignone, 2008). They do, however, seem to agree that it is a broad and important concept because understanding and acting on anything health-related involves so many different numerical tasks.

Golbeck and colleagues (2005) believe *health numeracy* is a much broader concept than just *numeracy*, which makes it difficult to incorporate into a definition of health literacy, and calls for a separate definition on its own. Therefore the author provides her definition of numeracy here as it relates to health:

**HEALTH NUMERACY:** The ability to understand and act on numerical health information.

This means being able to understand numerical information presented in text, graphs, or other printed means, as well as orally through communication with a healthcare provider. It also means being able to act on numerical information, ranging from such simple tasks as taking the appropriate medication dosage to making decisions about screening or treatment based on statistics reported. Adequate health numeracy includes basic, computational, analytical, and

statistical skills, as identified by Golbeck and colleagues (2005). For example, health numeracy includes tasks such as the following:

- Being able to make sense of quantitative data without having to do any complex calculations (such as identifying the appropriate number of pills to take per day on a prescription bottle, as suggested by Ancker and Kaufman (Ancker & Kaufman, 2007)).
- Being able to compute numbers in everyday health situations (e.g., determining the amount of fat grams in a meal when combining ingredients with different nutrition labels, as suggested by Ancker & Kaufman, 2007).
- To interpret and follow medical treatment plans (e.g., following directions for at-home care after a procedure).
- Being able to make sense of probabilities, proportions and percentages (since so much statistical information in health is presented in this way).
- Being able to judge and make decisions based on the relative risks and benefits of medical treatments (especially when more than one option is presented. Involves being able to make comparisons between decimals, fractions, percentages, probabilities, etc.).
- Being able to accurately communicate orally with healthcare provider about numerical information (such as talking about cholesterol and blood pressure numbers and how they compare to past numbers and ideal ranges).

Like many of the other health communication researchers who have already done so, the author adopts Golbeck and colleagues' (Golbeck, Ahlers-Schmidt, Paschal, & Dismuke, 2005) four functional categories of health numeracy as part of an explication of health numeracy.

These four categories from Golbeck and colleagues (2005) are the following:

1. “BASIC: Ability to identify numbers, and make sense of quantitative data requiring no manipulation of numbers.
2. COMPUTATIONAL: Ability to quantify, compute, and otherwise use simple manipulation of numbers, quantities, items, or visual elements in a health context so as to function in everyday health situations.
3. ANALYTICAL: Higher level of literacy. Ability to make sense of information, which involves higher level concepts such as inference, estimation, proportions, percentages, frequencies, and equivalent situations.
4. STATISTICAL: Involves understanding basic biostatistics involving probability statements, skills to compare information presented on different scales (e.g., probability, proportion, and percent). And the ability to critically analyze quantitative health information such as life expectancy and risk, and an understanding of statistical concepts such as randomization and blind studies” (pp. 375-376).

However, the author believes it is important not to operationalize numeracy so that a certain score might be said to correspond to one of these levels. Golbeck and colleagues (2005) suggest that these levels represent a hierarchical knowledge of health numeracy. The author adopts these four categories as important to the health numeracy concept – but doesn’t consider one as higher than another. Although these numerical skills are most likely learned in the education system in a hierarchical fashion (such that one would have to learn basic skills before moving on to computational skills, and computational skills before moving on to analytical skills, and so on), the author believes some people may have stronger skills in one category (regardless of the order) and weaker skills in another.

Lipkus and Peters (2009) point out that sometimes, for the highly numerate, simple tasks can seem too simplistic. These tasks are therefore not processed in depth so that the simple information may paradoxically have a negative impact on the highly numerate and they don't accurately comprehend the information (Lipkus & Peters, 2009). Therefore, it's still possible for people with more advanced numeracy skills to get "easier" math tasks wrong (in terms of the hierarchical categories).

For this reason, the author doesn't think it would be beneficial to operationalize numeracy – for a numeracy assessment -- in such a way that a certain "score" from a numeracy test would correspond to one of the four categories of numeracy. Instead, in the numeracy component of this health literacy tool, the questions derived from each of the four categories (and that pertain to the health tasks outlined above in bullet points) and overall cumulative health numeracy scores will be used to get an estimate of whether a participant has inadequate, adequate, or advanced numeracy for understanding health information. A percent score could be calculated based on the number of total correct answers. Following the well-established and validated *Test of Functional Health Literacy in Adults (TOFHLA)* scoring system for overall health literacy (Williams et al., 1995), someone who scored 59 percent and below would be considered to have low numeracy, someone who scored between 60 and 74 percent would be considered to have marginal numeracy, and someone who scored above 75 percent would be considered to have adequate numeracy (p. 1679).

For more information about which types of tasks individuals have problems with, the health communication researcher could look at the exact questions answered incorrectly on the numeracy test. These questions would each be labeled as belonging to one of the four category types.

### **How new definition compares to others and translation for new tool.**

The definition provided above by the author for health numeracy is perhaps more comprehensive than many of the other definitions that have been used in the past, as it provides concrete examples and categories of health numeracy. For example, some of the more popular definitions of health numeracy developed by scholars in the past:

- “How facile people are with mathematical concepts and their applications” (Lipkus & Peters, 2009). These authors conceptualize numeracy as an application of general numeracy, just put in a healthcare context.
- “The ability to understand numbers” and use them to comprehend and use important health information (Peters, et al., 2007).
- “The ability to compare risks and put risk estimates into context (i.e., to see how specific data fit into broader health concerns and to know what additional information is necessary to give a medical statistic meaning.” (Schwartz, et al., 2005) While this is an important component of numeracy – to analyze risks – it does not take other aspects of health numeracy into account, such as the ability to analyze nutritional information, read and interpret numerical graphs, follow instructions with numerical information, etc.
- “The ability to comprehend, use, and attach meaning to numbers” (Nelson, Reyna, Fagerlin, Lipkus, & Peters, 2008). The researchers believe numeracy is needed for being able to understand and weigh risks and benefits of treatment, for deciphering survival and mortality curves, and for navigating medical insurance forms and informed consent documents. Like the definition provided by Schwartz and colleagues (2005), this definition is useful, but not comprehensive enough to cover the many different skills needed in numeracy.

Unlike the above definitions, the new definition includes a more comprehensive set of health numeracy skills – not just one or two aspects from one of the four categories. This helps translate into a more comprehensive operationalization of health numeracy for the assessment. The TOFHLA (the gold standard health literacy tool – and the only one to date that includes a numeracy component) only includes basic computational skills in its assessment.

However, there are some existing definitions that include elements that the author's definition doesn't. For example, Golbeck and colleagues (2005): "Health numeracy is the degree to which individuals have the capacity to access, process, interpret, communicate, and act on numerical, quantitative, graphical, biostatistical, and probabilistic health information needed to make effective health decisions." This is an excellent, comprehensive definition and it includes the capacity to "access" health information, which the author's definition does not. But "access" was not included because this issue will be included in the computer literacy section of this instrument.

Ancker and Kaufman (2007) also include two other components they believe important to health numeracy that the author did not include: 1) the design of the documents; and 2) the health care providers' communication skills. Because the focus of health numeracy for this instrument is on the patient/health care consumer, other aspects of numeracy that are controlled by (or at least the responsibility of) the health care professional or communication professional are not included.

The definition provided here includes the important categorical areas of numeracy as well as specific examples, which are important for translation into an assessment that would enable health education professionals to see which areas of numeracy tasks an individual is lacking in and needs targeted support.



Based on the definition and explication of health numeracy above, the numeracy component of this health literacy assessment will contain questions from all four categories of numeracy in a healthcare context.

### **How others have measured numeracy as it relates to health.**

Numeracy has only been measured with a health focus in a few known instruments (the TOFHLA, the Newest Vital Sign, a scale created by Lipkus and colleagues (Lipkus, Samsa, & Rimer, 2001), and the Medical Data Interpretation Test). The TOFHLA is the only known health literacy test that also includes numeracy as one of its health literacy components. However, the numeracy section in this test has not been properly assessed for concurrent validity (Reyna, et al., 2009).

Researchers believe the TOFHLA was not designed to accurately measure numeracy in its entirety and is more focused on reading ability (Rothman, et al., 2008). The numeracy questions are focused on reading prescriptions that test simple mathematical skills such as understanding dates and times of medication dosage (Parker, et al., 1995). But the TOFHLA's numeracy section does not include a comprehensive assessment of more complex skills such as multi-step math, probability, and problem solving.

The Newest Vital Sign measures understanding of a nutritional label (Rothman, et al., 2008). However, it doesn't go beyond asking the participant to identify caloric information in a container of ice cream (so doesn't really go beyond analytical skills – no statistical skills are assessed in this instrument).

An expanded seven-item numeracy questionnaire was created by Lipkus, Samsa, and Rimer (Lipkus, et al., 2001) based off of a general three-question numeracy scale, but this questionnaire only focuses on risk and probability information and doesn't take other areas of

health numeracy into account, such as interpreting medical treatment plans and using numbers in everyday health situations (like analyzing nutritional content in food).

Schwartz, Woloshin, and Welch (Schwartz, et al., 2005) created the Data Medical Interpretation Test, which is an excellent assessment of risk perception and probability, but like the other tests – it too does not measure all of the different aspects of health numeracy.

A more comprehensive assessment of health numeracy is needed. The above mentioned tests are all missing several aspects of health numeracy – making them weak assessments of the total concept of health numeracy.

### **Why is numeracy important to health literacy?**

Although comprehension has already long been recognized as an important component (if not the base) of health literacy, the reasons for including the other three components – numeracy, media literacy, and computer literacy – may not be as clear.

Research shows that health numeracy has a significant impact on patient-provider relations. In the U.S., patients are now expected to be able to make comparisons and decisions based on information they are given at a doctor's office about which treatment option to go with, or which medical plan to follow, etc. (Reyna, et al., 2009). This is because the health care system in the U.S. now operates on more of a patient-centered model, whereby patients are expected to understand health-related information to make informed choices about their medical care (Eggly, 2002; Parrott, 2009; Peters, et al., 2007; Reyna, et al., 2009).

A major concern here is that emphasizing greater responsibility by the patient may further disadvantage those who have more limited numeracy skills. Innumeracy is associated with the inability to make informed comparisons using numerical information (Reyna, et al., 2009). So, the new patient-centered model may make it especially difficult for low numerate

individuals to make informed decisions when their providers present them with numerical information to help them compare medical plans or treatment options.

People with higher numeracy also tend to trust information in numerical format better than those with lower numeracy, who have been shown to trust verbal information more (Peters, et al., 2007; Reyna, et al., 2009). Lipkus and Peters hypothesize that people who are less numerate are less confident in numerical data so their conclusions based on numerical data is more influenced by how much they trust the source (Lipkus & Peters, 2009). This has implications for the patient-provider interaction because low numerate patients -- when presented with numerical information from their providers about treatments, medical plans, etc. -- are more likely to base their decisions on whether they a) trust their provider; and b) if they trust their provider, whichever option he/she seems to be suggesting. Rather than asking about alternative options, comparing the numbers, and asking other providers' expert opinions -- the innumerate patient will more likely base his/her decision on how much he/she trusts the provider.

When a health care provider asks specific questions to an innumerate patient about his/her numbers, the innumerate patient is also more likely to give incorrect answers (Lipkus & Peters, 2009). Therefore, innumeracy can affect the reliability and validity of self-reported quantitative measures that are asked by physicians verbally or through a medical history questionnaire.

Additionally, research shows that less numerate patients have a hard time weighing long-term benefits and are more likely to make decisions based purely on short-term benefits (Peters, et al., 2007). A health care provider who presents long-term and short-term information about risks and benefits to his/her patient -- which almost always includes numerical probabilities and

percentages – may not have much success in communicating about the long-term effects and the patient may make a decision based purely on what they understand about the short-term effects.

People who are less numerate have also been found to be more likely to be influenced by emotion when making decisions, whereas the more numerate are more likely to make decisions based on numbers and numerical comparisons (Lipkus & Peters, 2009; Reyna, et al., 2009; Shapira et al., 2008). Patients are often susceptible to changing moods and highly emotional states when visiting the hospital (because they are often in pain), and innumerate patients are therefore more likely to be influenced by these emotions when making decisions with their health care providers.

And less numerate patients are more influenced by framing effects (Ancker & Kaufman, 2007; Reyna, et al., 2009). For example, presenting the risk of a surgical operation as either a 20 percent chance of death or as an 80 percent chance of survival (gain vs. loss framing) can have a significant impact on innumerate patients' decisions about whether to choose that surgical option (Reyna, et al., 2009).

Innumeracy is also related to the distrust and non-acceptance of numerical information to make decisions (Lipkus & Peters, 2009; Peters, et al., 2007). Less numerate individuals prefer to base their trust on the sources' credibility and other information provided in the mediated context, rather than on the numerical information because they don't understand the numbers (Lipkus & Peters, 2009).

Further, research shows that people with low self efficacy in a subject are less likely to choose that subject as a way of analyzing (Baus & Welch, 2008). Therefore, people with low math self-efficacy are less likely to use math as a way of analyzing health information.

Overall, the more numeracy a person has, the more likely he/she is to use numbers to help make decisions related to health care and the more likely he/she is to critically analyze numerical information given.

### **Media literacy**

Media literacy is often referred to by the definition created at the National Leadership Conference on Media Literacy in 1992: “the ability to access, analyze, evaluate, and communicate messages” (NAMLE, 2011). The National Association for Media Literacy Education believes it empowers people to be both critical thinkers and creative producers of messages and that it is necessary in this ever-changing electronic environment (2011). The National Communication Association believes being media literate allows a person to assign value, worth, and meaning to media use and media messages (National Communication Association, 1998).

Even though several scholars agree that media literacy is an essential skill for making informed decisions in just about every discipline, and they seem to agree with the general definition created at the National Leadership Conference identified above – there is still a lot of variance in the full explication of media literacy. The concept is multidimensional and seems to involve numerous skills and knowledge, ranging from the ability to access different types of media, to analyzing and evaluating messages, to engaging with the media, to creating one’s own media (Burke, 2008; Handron, 1989; National Council for the Social Studies, 2009; Potter, 2010; Van der Linde, 2010).

Because media literacy is multifaceted and often overlaps with the explication of computer literacy and digital literacy (especially concerning how people access information), the

author intends to focus on the critical analysis component of media literacy. That is, the ability to evaluate information for quality and credibility. Some scholars refer to this as “critical media literacy” (Potter, 2008).

### **Impact of media literacy/lack of media literacy.**

There appear to be four common themes in research about the importance of media literacy: 1) the media can negatively affect consumers; 2) having good media literacy will help people protect themselves against the negative effects and help people have more control over being potentially influenced; 3) media literacy is a skill that people must develop, they are not born with it; 4) and media can influence people cognitively, attitudinally, emotionally, physiologically, and behaviorally (Potter, 2010).

Media literacy researchers argue that the current media education in the K-12 system only provides very limited instruction on media literacy (Arke & Primack, 2009; Burke, 2008; Van der Linde, 2010). This is largely because there is little funding in the U.S. for teaching media literacy and it is not a graduation requirement for most U.S. schools (Burke, 2008). In fact, U.S. students may be more capable of creating various media messages, but their ability to critically evaluate messages lags behind Canada, Australia, Great Britain, and New Zealand (Arke & Primack, 2009; National Council for the Social Studies, 2009). Yet research shows that by the time people in the U.S. reach the age of 18, they spend approximately six hours per day with all types of media (Rideout, Roberts, & Foehr, 2005). Just about every U.S. citizen is impacted on a daily basis by the media they consume and media literacy skills are essential so that people can be critically aware of the messages they are receiving and protect themselves from unsuitable messages, especially in a healthcare context.

Media literacy is now being recognized as extremely important to health (Brown, 2006; Center for Media Literacy, 2011; Norman & Skinner, 2006; Primack, Gold, Land, & Fine, 2006; Yates, 1997). The Center for Media Literacy acknowledges its importance to public health, explaining media literacy can help people make sense of messages concerning such topics as obesity, steroids, and violence (Center for Media Literacy, 2011).

Several researchers have studied the impact of media literacy on health. Results show that increasing media literacy can reduce current smoking habits and reduce the susceptibility of future smoking (Primack, et al., 2006; Primack, Sidani, Carroll, & Fine, 2009), reduce students' beliefs that most peers use tobacco (Hust & Cohen, 2005), help reduce harmful health behaviors related to alcohol use (Austin & Johnson, 1997), and help curb unhealthy behaviors related to obesity and eating disorders (Rosenbaum, Beentjes, & Konig, 2008).

Media literacy is obviously an important component of understanding health, and therefore an importance concept to health literacy. Any tool claiming to measure "health literacy" should include a media literacy component.

### **What will be included in the new health literacy assessment?**

The National Association for Media Literacy Education (NAMLE) has encompassed all of the skill sets outlined from the 1992 National Leadership Conference on Media Literacy (except for *creating a new message*) in a framework of suggested key questions to ask when analyzing media messages. *Creating* new media messages is beyond the scope of this new assessment tool, so this aspect of media literacy will not be tested. The focus of media literacy in the proposed tool will be on evaluating health information for credibility and quality. NAMLE's framework for analyzing messages has already been successfully used by several scholars studying media literacy (Arke & Primack, 2009; Primack, et al., 2006). However, the framework

consists of open-ended questions based on their three identified areas of media literacy: audience and authorship (such as, “Who is the target audience for this message?”); messages and meanings (such as “What is this message about?”); and representations and reality (such as, “When was this message made?”). To date, no known health literacy tool has included a measurement for media literacy. In this health literacy tool, NAMLE’s framework -- on questions related to critical analysis of information -- is used to help create close-ended questions on health care messages from various sources.

### **Computer literacy**

Most colleges and universities that offer computer literacy courses focus on learning objectives that include learning how to use operating systems such as Windows and/or Mac, learning how to use spreadsheet and word processing software (usually Microsoft Word and Excel), and learning how to use the Internet to search for specific information (College of Southern Idaho, 2011; University of Illinois, 2011; University of Massachusetts, 2011). PC Magazine notes that computer literacy is not about how the computer works, but rather it is a conceptual understanding of the computer system being used and implies being able to use the most common applications (such as word processing and spreadsheets) as well as being able to browse and search the Web and send and receive e-mails (PC Magazine, 2011).

Because most college students today are expected to possess basic computer skills and understanding of common applications (such as Microsoft Word), these skills will not be tested for this target population in relation to health literacy, as the differences in knowledge of common applications would probably be negligible. However, one aspect of computer literacy – digital literacy (and specifically digital health literacy) – will be included in the health literacy assessment. Digital literacy is the ability to appropriately use digital tools to identify, access,



manage, analyze, and synthesize digital resources, which ultimately helps construct new knowledge, create new media, and communicate with others (Koltay, 2011; Martin, 2006). It typically includes four core concepts: 1) Internet searching; 2) hypertext navigation; 3) knowledge assembly; and 4) content evaluation (Gilster, 1997; Koltay, 2011).

### **Impact of digital literacy skills and lack of digital literacy skills.**

Many researchers believe that digital literacy skills today are as equally important to people's ability to solve problems and think critically about information as reading and writing skills (Katz, 2007; Partnership for 21st Century Skills, 2003). College students may be impressively technologically literate in today's digitally advanced environment, but some researchers and educators today say there is increasing evidence in the classroom that shows that students are less information savvy than earlier generations because they do not use the technology effectively when they conduct research (Breivik, 2005; Katz, 2007; Rockman, 2004). Young adults often have poor online research skills and little patience, which are likely related. In fact, some researchers suggest that access and ability to effectively navigate are two very different issues (Hargittai & Hinnant, 2008).

In a recent study, van Deursen and van Dijk assessed the Internet skills for finding specific health information of 88 randomly selected adults (van Deursen & van Dijk, 2011). The researchers found that 73 percent of the adults had basic Internet skills (they were able to use an Internet browser and search engine successfully), 73 percent were able to successfully navigate the Internet (which included being able to navigate through different Web and menu layouts and keeping a sense of orientation), but only 50 percent were able to find specific information successfully (choosing a way of searching, defining search queries, and selecting relevant

information), and only 35 percent were able to strategically use the information (to make decisions based on the information found and gain personal benefits by making the right decisions for their health). As this study demonstrates, even when basic computer and Internet-searching skills are high, finding specific relevant health information and figuring out how to use the information can be more difficult. Assessing digital health literacy skills will therefore be included in the new health literacy instrument.

### **What will be included in the new health literacy assessment?**

Because media literacy and digital literacy can have some overlapping characteristics (such as evaluating and synthesizing resources), but are often thought to emphasize dominating traits (the emphasis of media literacy is traditionally on analyzing information for credibility and quality; the emphasis of digital literacy is on successfully searching for relevant information in a digital environment), the two concepts will be assessed separately in the assessment. However, the author will test to see if the two concepts are conceptually different enough to be considered separate factors when she analyzes the first set of data.

The digital literacy questions will be based on five of the seven performance areas of information literacy in digital environments identified by the Educational Testing Service (ETS) (Katz, 2007). The ETS assembled an International Literacy Panel in 2001 to investigate the relationship between literacy and information and communication technologies and after 15 months of discussion among literacy experts, they came up with recommendations for a framework for an assessment on information literacy in digital environments (Katz, 2007). The five performance areas that will be included in this health literacy instrument include the ability to *define* (understand and articulate) the scope of an information problem in order to facilitate an online search for information; the ability to *access* that information online, including the ability

to generate and combine key search terms for a specific task; the ability to *evaluate* whether information retrieved actually satisfies the original information problem; the ability to *manage* that information; and the ability to *integrate* that information, including synthesis and comparison of multiple sources. The sixth performance area is the ability to *create* new information in digital environments, but this aspect will not be tested in the new health literacy tool, as it is outside the scope of this quantitative testing instrument. And the seventh performance area is the ability to *communicate* and disseminate information in a digital format, but this aspect was also not included as part of this quantitative assessment because evaluating communication skills is more of a subjective measurement. As discussed earlier, communication and interaction skills are not included in this measurement tool at this stage; however, the author intends to add a qualitative component to the tool including this sub-concept of health literacy in future research.

In addition, some general digital literacy questions will be included that assess participants' abilities with Internet searching, hypertext navigation, knowledge assembly, and content evaluation. These questions focus on the four core concepts of digital literacy as outlined by Gilster (1997) and Koltay (2011).

Some questions about personal online searching for health information are also included, based on recommendations by academic health education experts at Colorado State University (expert review discussed in more detail in Methods section). This includes questions such as "Have you searched for health information on the Internet" and "How difficult was it to find the information you needed?"

## **Health Literacy and Associations with Other Measures**

Several studies have demonstrated significant associations between limited health literacy and poor health status (D.W. Baker, Parker, Williams, Clark, & Nurss, 1997; C. A. Mancuso & Rincon, 2006; Schillinger, Barton, Karter, Wang, & Adler, 2006; T. L. Sentell & Halpin, 2006; R.L. Sudore et al., 2006; M. S. Wolf, Feinglass, J., Thompson, J., & Baker, D.W., 2010; M. S. Wolf, Gazmararian, & D.W., 2005). Several of these associations have been established using either the full or shortened version of the Test of Functional Health Literacy in Adults (C. A. Mancuso & Rincon, 2006; Schillinger, et al., 2006; M. S. Wolf, et al., 2005). Therefore in addition to establishing construct validity of the new health literacy tool with the gold standard s-TOFHLA, the author also examines how well the tool predicts health status in comparison to the gold standard.

The relationship between health literacy and current health behaviors is also examined in this study. Associations have been established between poor health literacy and a higher risk for cardiovascular-related death (David W. Baker et al., 2007), a higher likelihood for hypertension (Shibuya et al., 2011), worse glycemic control in patients with diabetes (Schillinger et al., 2002), less knowledge about health effects of smoking (Arnold et al., 2001), higher rates of depression (T. Sentell, Baker, Onaka, & Braun, 2011), increased discomfort about asking for explanations for health information (Ussher, Ibrahim, Reid, Shaw, & Rowlands, 2010), and an increase in mortality in the elderly (Rebecca L. Sudore et al., 2006). Because health literacy seems to have an effect on health and behaviors that affect health, the author assesses participants for their current behaviors related to health and health risk (e.g., nutrition, exercise, smoking, alcohol consumption, depression, medication adherence, and safety). Similar to the analysis of health

status, the author compares how well the new tool associates levels of health literacy with current health and risk behaviors in comparison with the gold-standard s-TOFHLA.

The literature concerning these health-related variables will not be explored in detail, but instead used for an informal assessment of predictive validity with health literacy (as measured by the new instrument and the S-TOFHLA).

## Research Goals

The main goal of this study is to create a reliable and valid new health literacy tool for young adults that provides a more comprehensive assessment of health literacy than the standard assessment tools. The new tool is compared with the short form of the Test of Functional Health Literacy in Adults (s-TOFHLA), which is currently the gold standard instrument for measuring health literacy.

The relationship between the new health literacy tool and health status, along with some other health-related and risk-taking behaviors (such as risks associated with tobacco use, alcohol use, and nutrition) is also evaluated and compared with the same relationships present with the S-TOFHLA to see how well both tools predict these measures.

Stated more formally, this study evaluates the following specific goals and research question:

**Goal 1:** Develop a new health literacy tool that has good internal consistency, with a Cronbach's Alpha  $\geq 0.70$  (according to Bland and Altman (1997), criteria for the Cronbach's Alpha should exceed a value of 0.70 for an instrument to be considered reliable).

**Goal 2:** The new instrument should have a modest correlation between the comprehension section of the new tool and the S-TOFHLA, but overall the correlations between the new instrument and the S-TOFHLA should be low, since the new tool measures more advanced skills beyond comprehension.

**Goal 3:** The new health literacy instrument should be a better predictor of health-related behaviors than the S-TOFHLA.

**Goal 4:** Health literacy – as measured by the new tool and/or the gold standard s-TOFHLA – should have some predictive validity with risk behaviors that are often prevalent in college students.

## Methods

The following section provides details on both the creation and validation of the new health literacy tool. The author generated a large number of potential assessment questions. She then met with experts to figure out which question items were best suited to address the four areas of health literacy being tested in this tool (comprehension, numeracy, media literacy, and digital health literacy). Once the first draft of the test was ready, it was pre-tested on a group of CSU students. The data from the pretest were then analyzed using item response theory to see which questions helped define and quantify the four separate main areas of health literacy the best. The second version of the test was then administered to a larger group of CSU students, in addition to the existing gold standard assessment (S-TOFHLA). Item response theory analysis was used again to check for final item selection and internal consistency of the author's assessment. Both the new assessment and the standard S-TOFHLA were then compared to see how well they each predict health status and health behaviors.

This chapter is essentially organized in order of the methods that took place in construction of the new health literacy instrument, although some sections include descriptions of what took place during both the pre-test and final-test stages (as they were fairly similar). It also includes explanations of the techniques used in the assessment, as well as descriptions of the techniques used to help evaluate the assessment. That is, it begins with the creation of the initial item pool of questions; followed by the experts' review of the initial item pool; the recruitment procedure (for both the pre-test and final test, since they are nearly the same); the assessment procedure (again, for both the pre-test and final test, since the procedures are very similar); a description of how the pre-test results were used to help figure out which items were performing



better than others (pre-test calibration using Item Response Theory), along with a brief explanation of how Item Response Theory works and how it's been used in the past; the procedures used for coding the data and eliminating the outliers in both the pre-test and final test; and the methods used to evaluate the performance, reliability, and validity of the instrument from creation through final test results.

### **Creation of the Initial Item Pool**

Good assessment development – that is fair, valid, and reliable – requires several steps. As the Educational Testing Service says, “an assessment is only as good as each item on it” and so it's important to use high-quality items (Educational Testing Service, 2012).

Planning and conceptualization is the first step, and includes a thorough identification and literature review of all the constructs that will be included in the assessment (Painter, 2004). A thorough literature review helps determine what kind of assessment is needed (and if it's needed at all), and whether it's possible to adopt or adapt existing scales (Clark & Watson, 1995). The author did this first, by examining how health literacy is conceptualized today. She developed a theoretical framework (as detailed in the literature review on the “Content of New Health Literacy Tool”) for the construct of health literacy drawing on previous work from others. The four main constructs – that can be assessed quantitatively – that emerged from her exhaustive literature review included the following: comprehension, numeracy, media literacy, and digital literacy.

Creating the item pool is perhaps the most crucial stage in the assessment construction. Because the main goal is to include all content that is potentially relevant to each factor in a

broad and comprehensive initial item pool (Clark & Watson, 1995), the author created 229 initial health literacy question items. These questions were distributed as follows (and are available in Appendix B: Initial Item Pool of Health Literacy Assessment Questions):

- 47 Comprehension question items using the Sentence Verification Technique
- 53 Comprehension question items using the Cloze technique
- 30 Numeracy question items
- 52 Media literacy question items
- 48 Digital literacy question items

### **Comprehension.**

The comprehension section has significantly more items; however, this was purposefully done for two reasons: 1) previous health literacy assessments focus on the comprehension section (for example, the TOFHLA includes 50 comprehension items, but only 17 numeracy items), as comprehension is usually considered the base of health literacy; and 2) as identified in the literature review on comprehension, at least two measurement techniques should be used to collectively measure comprehension for a more accurate assessment. In order to effectively assess both techniques and choose the appropriate items within each technique section, a large number of question items were created to ensure good selection of the best items.

### ***Sentence Verification Technique.***

For the Sentence Verification Technique section, the author chose three passages for the initial item pool, with the intention of eventually selecting one passage with corresponding questions for the final assessment (based on which passage and questions seemed most

appropriate to the health education experts). She included topics of varying familiarity (to a young adult population) and with varying levels of technical jargon and grade-level readability. All three of the health information passages were from credible patient education websites.

- *Questions and Answers about Gout*: Flesch Kincaid grade-level of 10.5. (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2011)
- *Sexually Transmitted Diseases: Chlamydia*: Flesch Kincaid grade-level of 12. (World Health Organization, 2011)
- *What is Metastatic Cancer?*: Flesch Kincaid grade-level of 8. (American Cancer Society, 2011)

Passages with approximately 12-16 sentences were chosen from each of the health information documents listed above. Most researchers who have used the technique for measuring comprehension have used 16 test-sentence assessments (Royer, 2004).

The author created corresponding test sentences for each passage, with approximately equal numbers of original, paraphrase, meaning change, and distracter sentences (about 4 of each, equaling about 16 test sentences total for each passage). These test sentences are defined as follows:

- *Original*: An exact duplication of the sentence in the original passage.
- *Paraphrase*: Some or all of the words in the sentence have been changed from the original, but without altering meaning.
- *Meaning change*: One or two words have been changed in the passage in order to change the meaning of the sentence.

- *Distracter*: Consistent with the theme of the passage, but unrelated to any sentence in the passage.

As outlined in the comprehension chapter of this dissertation, participants would read through a passage and then, without looking back at the original, would respond to the test sentences with either “YES” or “NO” answers. “YES” sentences are defined as sentences that are the same or mean the same as the original passage (original and paraphrase). And “NO” sentences have a different meaning from the original passage (meaning change or distracter).

The sentences were arranged in the same order as the original passage (regardless of whether it was a sentence that meant the same thing as the original or not) so that the new passage still made sense and flowed well. However, the types of test sentences given were in random order. For example, in the test-version of the metastatic cancer passage, the first few test sentences were in this order: paraphrase, paraphrase, meaning change, meaning change, original sentence, meaning change, original sentence, and distracter. This section can be seen in the Sentence Verification Technique chapter of Appendix B: Initial Item Pool of Health Literacy Assessment Questions.

### ***Cloze.***

Three different health information passages were also chosen for creating questions with the cloze technique, also with varying levels of possible familiarity with the topic (for young adults), and also with varying levels of readability. The following three passages were chosen:

- *High Cholesterol and Triglyceride Levels*: Flesch-Kincaid grade level of 12 (Johns Hopkins Medicine, 2011).

- *HPV, also called Human Papillomavirus*: Flesch-Kincaid grade level of 7.2 (Medline Plus, 2011b).
- *What is Sleep Apnea?*: Flesch-Kincaid grade level of 7.0. (National Heart Lung and Blood Institute, 2011)

Each short passage contained approximately 150-250 words. Based on the standard instructions for using the cloze technique (Wilson, 2000) and following suit with the TOFHLA, every 5<sup>th</sup> to 7<sup>th</sup> word was deleted in both the HPV and sleep apnea passages. And in the cholesterol passage, the cloze procedure was slightly modified based on suggestions by D. Porter (Porter, 1976) for assessing more advanced reading (and this passage had a grade level of 12). The first three sentences were left completely intact (in order to allow the theme of the passage to become established), and then every 8<sup>th</sup>-12<sup>th</sup> word was deleted.

The author then created a multiple-choice set of answers for each deletion, which consisted of four possible options. Careful thought went into the possible answers so that only one of the four options could be considered correct.

While the TOFHLA tests for only very basic literacy by including answer choices with only one grammatically correct option and three grammatically incorrect options (e.g., choosing the correct part of speech, such as an adjective over a noun), the new health literacy test includes more advanced options. Because the new tool is intended for assessing health literacy of young adult college students (who are expected to have a basic understanding of the English language), the multiple-choice options include vocabulary choices to test for understanding of context, but it does not include an assessment of understanding basic grammatical concepts, such as identifying the need for a noun versus an adjective. All answer choices in the new assessment are the same

part of speech, so test-takers must identify the correct vocabulary word based on the context of the sentence.

Furthermore, the three passages chosen for possible inclusion in the new instrument are more complex than those found in the TOFHLA. The TOFHLA only includes very basic passages (e.g., with a Flesch-Kincaid grade level of 6). However, most health information available for the public on credible health websites contains more advanced, complex information. Therefore, to be more reflective of the kind of health information available, the author chose the three aforementioned passages directly from major health websites with Flesch-Kincaid grade levels of 7.0, 7.2, and 12.0. This section can be seen in the Cloze Technique chapter of Appendix B: Initial Item Pool of Health Literacy Assessment Questions.

### **Numeracy.**

As outlined in the Numeracy chapter of the literature review, the author created four groups of questions based on Golbeck and colleagues' (2005) four functional categories of numeracy: basic, computational, analytical, and statistical. All of the questions are based on real health information and data obtained from credible sources, such as the University of California San Francisco Medical Center, the Mayo Clinic, the Centers for Disease Control and Prevention, Medline Plus, etc. (as referenced in Appendix B of the Numeracy section of the Initial Item Pool of Health Literacy Assessment Questions).

The basic category includes questions about making sense of quantitative data, but requires no actual computation. For example, one set of questions requires the examinee to read a short paragraph of instructions for at-home care after surgery. The subsequent questions

address quantitative information mentioned in the instructions, but require no manipulation of the numbers – just an understanding of what they mean.

The computational section involves simple manipulation of numbers, such as figuring out whether triglyceride levels are normal or high based on ranges given, and dividing numbers in half.

The analytical section requires participants to make sense of information involving higher-level concepts, such as inference, estimation, proportions, and percentages. For example, one question involves translating a percent into a proportion (such as 12.5 percent of women will be diagnosed with breast cancer at some point in their lives is the same as 1 in 8 women).

The statistical section involves understanding basic biostatistics involving probability statements and the ability to critically analyze quantitative health information, such as life expectancy and risk. For example, one of the questions asks what the chances of passing on a genetic condition are (based on the statistical information given and background information on how gene inheritance works).

### **Media literacy.**

The author used the conceptual framework created by the National Association for Media Literacy Education (NAMLE) to create the media literacy questions. NAMLE's framework consists of open-ended questions that they've identified as important indicators of good critical media literacy (the ability to analyze information for credibility and quality) (NAMLE, 2011). The questions include three principle performance areas when analyzing media messages: 1) Audience and authorship (such as "Who made this message?"); 2) messages and meaning (such

as “What information is left out of this message?”); and 3) representations and reality (such as “How credible do you think this message is?”).

Approximately 3-4 key questions were chosen from each of the three performance areas outlined by NAMLE for critical media literacy. Because the new assessment is a quantitative measurement, the author changed the open-ended questions into close-ended ones with multiple-choice options (where only one of the options is correct).

The media literacy questions were based on health information web pages. Online health information sources were chosen because research shows that health information seeking via the Internet has remained fairly steady since 2007, while there is a significant decline – from 33 percent to 18 percent between 2007 and 2010 – in the use of print media as a source for health information (Tu, 2011). Meanwhile about 81 percent of U.S. adults use the Internet and 80 percent of these adults look for health information online (Pew Internet and American Life Project, 2012). Thirty-five percent of these Internet users say they have used the Internet to try and figure out what medical condition they or someone they know have, and 46 percent of these self-diganosers say that a medical professional confirmed their initial self-diagnosis (Fox & Duggan, 2013). Furthermore, about 42 percent of young adults aged 18-29 search for health information online using their smartphones (Fox & Duggan, 2013). Therefore it seems reasonable, especially for this college student population, to focus on assessing media literacy of health information available online versus print sources.

Five different web pages – each from different sources – were included in the initial draft of the assessment. Each web page was followed by the same set of key media literacy questions about the health information available on the web page. A mixture of highly credible, quality



websites in addition to some not-so-credible ones were included. One page was taken from the National Cancer Institute on general information about Melanoma. Another page was taken from someone's personal website on anorexia (and their advocacy of it as a way of losing weight). Another page was created by the author and included misleading information about the nutritional value of carbohydrates (and lacked essential information for indicating good credibility). A web page was included from the Worldwide Health Center (who sell alternative health products that have not been medically approved) and provided a description of the correlation between digestion and depression. And an advertisement by Merck for the Gardasil vaccine (for protection against the Human Papillomavirus) was also included.

This range of websites included varying levels of credibility, quality, authorship, accuracy, funding background, and institutional goals. The main goals were to see if participants could differentiate between high-quality, credible websites and those lacking in credibility and quality, understand who is responsible for the information on the webpage (author or publisher), understand the purpose of the webpage, and when the webpage was created. The questions can be viewed in Appendix B: Initial Item Pool of Health Literacy Assessment Questions.

### **Digital literacy.**

The first draft of digital literacy questions includes three sections: 1) Personal digital literacy questions; 2) general digital literacy questions; and 3) Scenario-based digital literacy questions. These three sets of questions cover the essential concept of digital literacy: the ability to appropriately use digital tools to identify, access, manage, analyze, and synthesize digital resources, as outlined by Koltay (2011) and Martin (2006). And also include the four core

concepts of digital literacy, as outlined by Gilster (1997) and Koltay (2011): Internet searching, hypertext navigation, knowledge assembly, and content evaluation. As well as five of the performance areas outlined by the Educational Testing Service (2012): the ability to define the problem, access the information, evaluate the information, manage the information, and integrate the information.

The personal digital literacy questions evaluate how often the participant has searched for health information on the Internet in the past, how difficult it was to find the information needed, which websites are used most often when looking for specific health information, and what kind of health-related digital applications (if any) are used (such as exercise journaling, nutrition applications, etc.). These questions cover the ability to identify and access digital resources.

The general digital literacy section includes questions on Internet browsing (such as how to open a link in a new browser window), digital literacy terminology (such as differentiating between a blog and a chat group), managing digital information, figuring out the funding source of a website, figuring out who manages and runs a website, determining a website's main purpose, where the information on the website came from (sources), and how current the health information provided in the website is. These questions cover the ability to manage, analyze, and synthesize digital resources.

The scenario-based digital literacy questions are based on the Educational Testing Services' (ETS) conceptual framework for assessing information literacy in digital environments. The ETS defines seven key performance areas for digital literacy, and the author has included assessment questions based on five of these seven key areas. The five areas include: 1) the ability to define the scope of an information problem in order to facilitate an online search for information; 2) the ability to access that information online; 3) the ability to

evaluate whether information retrieved actually satisfies the original information problem; 4) the ability to manage that information; 5) and the ability to integrate that information, including synthesis and comparison of multiple sources. The two areas not included, as outlined in the chapter on the conceptual framework for digital literacy, are the ability to create new information in digital environments; and the ability to communicate and disseminate information in a digital format.

The author created assessment questions based on these five performance areas outlined above. For example:

**Table 2.** Digital literacy assessment questions

PERFORMANCE AREA	QUESTION
The ability to define the scope of an information problem in order to facilitate an online search for information.	Participants are given a scenario, such as just discovering their father has Stage 1 prostate cancer and he asks them to help him learn more about his treatment options. Then the question includes how the participant would go about searching for information on the Internet (including what search terms he/she would use).
The ability to access information.	Questions about what search engine the participant would use and what websites they would most likely go to for information.
The ability to evaluate whether information retrieved satisfies the original information problem and the ability to manage information.	Participants are provided with a list of possible sources and asked which one provides the most useful, accurate, and up-to-date information for answering the question about the topic.
The ability to integrate information and compare information to other sources.	Participants are asked to rank websites in terms of which ones provide the most useful information and which ones don't help answer their query at all.

Some of the scenario-based questions included open-ended answers in the first draft. This was not originally part of the plan (since this is a quantitative measurement); however, these questions seemed like the most appropriate way to address some aspects of ETS's five

performance areas (such as addressing the ability to define the scope of an information problem in order to facilitate an online search for information with questions like “What key words would you type into a search engine to search for X topic?”). The author included these open-ended questions in the first pre-test version so that the health education experts could decide whether they might be important to keep for the pre-testing phase with the assessment.

All of the digital literacy questions can be viewed in Appendix B: Initial Item Pool of Health Literacy Assessment Questions.

### **Institutional Review Board**

After the initial item pool of questions was completed, the research project proposal was sent to IRB for approval before proceeding with an expert review of the questions and subsequent data collection with participants. Because the study required three rounds of data collection – an evaluation of the questions by health education experts, data collection with the first draft of the assessment with participants, and data collection with a final draft of the assessment with participants – IRB required the project to be submitted three separate times for each round of data collection so that they would have the latest version of the assessment before each round of testing.

### **Expert Review of Assessment**

Four health education experts from Colorado State University – who were not on the dissertation committee – reviewed the initial item pool of questions to help decide which question items were most appropriate (if at all) for addressing the four areas of health literacy.

These experts all held doctoral degrees, are directly involved in clinical or health education research, and were interested or involved in health literacy research. The experts reviewed the items anonymously (they were promised their identities would not be revealed, other than as “health education experts at Colorado State University”) and confidentially from each other (they each reviewed the items separately, not as a team).

The health education experts were identified via the Colorado State University Health Network (the campus support service for medical, mental health, and prevention services for students and the campus community) and the list of public health faculty currently working in the Master of Public Health Program at Colorado State University. Ten experts were identified as potentially appropriate for reviewing the health literacy question items, based on their professional background in public health, health education, measurement in health, and/or health literacy. The author initially hoped to get at least five experts, based on suggestions from her dissertation committee. The experts were contacted via email with a brief explanation of the study to see if they might be willing and able to participate (see Appendix C: Expert Recruitment E-mail). Five of the ten experts initially agreed to participate, but one was unable to commit to the review at the last minute.

The four health education experts who were able to partake in the evaluation of the health literacy questions were then sent the consent form, an evaluation questionnaire (where they were asked to rank how well each question item worked on Likert scales of “definitely doesn’t work well” to “works very well”), and the draft of initial health literacy question items (see Appendix D: Expert Evaluation of Health Literacy Assessment Questions for the evaluation questionnaire). Three of the experts requested these documents be sent electronically via email and one expert requested a hard copy be delivered to her office.

The experts all sent their evaluations of the health literacy questions back to the author via snail mail. Evaluation of the questions took each expert approximately 2-3 hours. Upon receipt, the author sent them \$15 gift cards to a coffee shop for their participation (as promised in the consent letter).

## **Subject Recruitment and Assessment Procedure**

### **Pretest recruitment.**

The pre-test version of the assessment – which consisted of 87 of the original 229 questions, as selected by the health education experts for being the most appropriate questions for measuring health literacy in young adult college students – was uploaded to QuestionPro, an online survey website that houses complex surveys and assessments. This pre-test version also included four demographic questions – on age, gender, ethnicity, and year in school – at the beginning of the assessment. This pre-test 87-question version can be viewed in Appendix E.

Participants were recruited from four summer 2012 online sections of JTC 300 Technical Communication (with about 25 students in each online section) and from one fall semester in-class section of JTC 300 Technical Communication (with about 120 students) at Colorado State University. Students in these sections of JTC 300 were from various majors throughout the university, as the course fits many students' general requirement for a writing course. Inclusion criteria included college students over the age of 18. Exclusion criteria included non-students.

The JTC 300 instructors gave the author permission to recruit students to participate. Students received 5-10 points of extra credit (depending on the instructor and his/her grading system) in exchange for participation. They were also provided with the option for an alternate

activity (writing an essay) for extra credit. But both extra credit opportunities were considered optional. The author provided the online participants with a detailed description of the study, a consent form, and a link to the Question Pro website housing the assessment. In-class participants received both a brief five-minute description of the study announced at the beginning of one of their classes, as well as a printed description of the study (with the website address) and consent form. Participants completed the assessment during their own time outside of class. Participants were ensured that their identities would be kept confidential. Completion of the entire pre-test assessment took participants between 20 and 45 minutes. The pre-test invitation to participate and consent form is available in Appendix F.

#### **Final test recruitment.**

Following the initial item response theory analysis for deciding which question items should be deleted from the pre-test version of the assessment, the final version of the assessment – which consisted of 51 questions (20 comprehension, 12 numeracy, 8 media literacy, 6 health information seeking, and 5 digital literacy) – was uploaded to the Question Pro website. In addition, the shortened version of the TOFHLA, which consists of 35 Cloze comprehension questions and takes about 12 minutes to complete, was also included with the final assessment (this instrument can be acquired through Peppercorn Books at [https://www.peppercornbooks.com/catalog/information.php?info\\_id=5](https://www.peppercornbooks.com/catalog/information.php?info_id=5)). And a measurement of health status and health risk behavior questions (14 questions total), created by the National Cancer Institute and Centers for Disease Control and Prevention, respectively, were also included in the final assessment survey.

Participants were recruited from two sections of JTC 300 Technical Communication (with about 200 students) and two sections of JTC 100 Media in Society (with about 250

students) at Colorado State University. Like the pre-test population, students in both courses were from various majors throughout the university. Inclusion criteria included college students over the age of 18 and exclusion criteria included non-students.

The JTC instructors in both courses gave the author permission to recruit students to participate. Students received 10-20 points of extra credit (depending on the instructor and grading system) in exchange for participation. They were also provided with the option for an alternate activity (writing an essay) for extra credit. But both extra credit opportunities were considered optional. The author provided the students with a brief 5-minute explanation of the study at the beginning of one of the classes and also gave the students printed consent forms if they chose to participate. Participants completed the assessment during their own time outside of class. They were ensured that their identities would be kept confidential. Completion of the entire assessment and additional measures took between 30 and 45 minutes.

#### **Assessment procedure.**

Both the pretest and final test were administered online via the Question Pro website. Participants could log onto the survey website during their own time within a 10-day span. They were given no time limit, although they were warned that completion of the assessment would likely take 30-45 minutes. Upon entering the website, they were provided with another overview of the research study and reminded that there are no foreseeable risks associated with taking the assessment, that their answers would remain confidential, and that data from this research would only be reported in the aggregate. Participants were also warned that they would only be able to move forward with the assessment, and would not be able to use the back button to go back and change answers. And in the final version of the assessment, participants were not allowed to



move to the next set of questions before answering the previous set of questions (each set consisted of 2-10 questions, depending on the section). This limitation was included to help reduce the problem of missing data in the final round of data collection.

## **Data Analysis**

### **Calibration of pre-test items and test formation.**

The first task with the assessment was to reduce the scale size by eliminating all non-performing question items. This was done by conducting a calibration pre-test with the first version of the assessment (the first version resulting from the expert review of the initial item pool). Two methods were implemented in the elimination of question items. First, Item Response Theory-based item characteristics were obtained for each question item in the assessment using the MPLUS version 6 Statistical Modeling Program (the basic principles and history of Item Response Theory are explained in the next section). The author evaluated the individual items with regard to their relationship to their respective theoretical domains (comprehension, numeracy, media literacy, and digital literacy). The question items' discriminations and difficulties were inspected in order to determine which items offered the least information with regard to their respective domains.

Items with discrimination values below 0.3 were --for the most part -- eliminated, and those above 0.3 were examined further in a phased-approach. The phased approach involved conducting additional IRT analyses until all of the items performed well with good discrimination values. Research suggests that a discrimination of 0.3 and above indicates a good item; and 0.6 and above is very good (Wise, 2012). Higher numbers indicate more difficult or discriminating items (Schapira et al., 2012) and negative numbers indicate that test-takers have a

higher probability of obtaining the correct response if their ability is lower (therefore, all negative items were also eliminated).

Second, the items were also inspected for how well they fit in the four separate constructs – comprehension, numeracy, media literacy, and digital literacy – by assessing goodness-of-fit indices for various models based on these theoretical domains. The Categorical Variable Methodology approach available in MPLUS was used to fit the models under consideration. This approach, usually referred to as a robust weighted least squares approach in the literature (Muthen, Toit, & Spisic, 1997; Tsai, Ling, Wang, & Liu, 2007), or WLSMV, provided three good indices that were used for evaluating model fit: comparative fit index (CFI), Tucker-Lewis index (TLI), and the Root Mean Square Error of Approximation (RMSEA) – which have all been shown to be useful in assessing model goodness-of-fit for data with categorical outcomes (Hooper, Coughlan, & Mullen, 2008).

The models with the best-fit indices and corresponding best item discrimination values were kept as measurement constructs for the final version of the assessment.

### **Introduction to item response theory.**

Item Response Theory (IRT) helps provide a framework for evaluating how well assessments work and how well individual items on an assessment work. It's a psychometric approach that takes both a question item's parameters into account, such as difficulty, as well as the test-taker's skill level (or strength of an attitude) (Ayala, 2009; Furr & Bacharach, 2008; Partchev, 2004; Thomas, 2010). Therefore, persons and items are located along the same continuum. The analysis method allows researchers to obtain information about the people taking the test, the individual question items, and the test as a whole (Ayala, 2009; Furr &

Bacharach, 2008; Partchev, 2004). It's also often referred to as latent trait theory, or latent trait modeling, in behavioral science research.

Advocates for IRT say that this analysis method for assessments is superior to classical test theory (CTT) because CTT can only provide a test-level focus (F.B. Baker & Kim, 2004; Furr & Bacharach, 2008). In IRT, the focus is on the theory of each individual item and how it contributes to the test as a whole. It's based on the idea that the probability of a correct answer to a question is a mathematical function of the combination of a person's skill level (or strength of attitude toward a trait) and the question item's parameters (such as the level of difficulty of the question and the degree to which the question can differentiate people who have high skill levels from low skill levels) (Furr & Bacharach, 2008; Thomas, 2010). Therefore, IRT models assume that the probability of a test taker passing a question -- which may mean answering the question correctly or affirmatively, depending on whether it's a right/wrong item or a trait characteristic item -- is a function of two parameters: 1) that person's ability level or standing on the latent variable; and 2) the characteristics of the item.

The ultimate aim of IRT is to establish the position of an individual along some dimension of ability. As noted above, the probability of each response to each question is a function of the person's ability and the item parameters (in this case: difficulty of the item and discrimination of the item). For an IRT model to work, the item parameters must be known, which means that a calibration test should be run on the assessment before the final assessment is used for testing a population. This involves conducting a pre-test (calibration test) on the assessment with participants to help establish the parameters of the question items. The data from this first round of testing can then be used to help determine which question items work

best for the assessment (the question items with reasonably accurate item parameters) (Partchev, 2004).

### ***History and application of Item Response Theory.***

Item Response Theory has been well used in the development of assessments for measuring ability and achievement. Development of Classical Test Theory (CTT) first led to the belief that traits and abilities could be quantified (Thomas, 2010). However, IRT has rapidly become the more mainstream theoretical basis for measurement (Embretson & Reise, 2000)

Lord and Novick (1968) were dissatisfied with CTT's discontinuity between the test score and the question items that made up the test (F.B. Baker & Kim, 2004; Lord & Novick, 1968). They felt that a test theory should begin by looking at the characteristics of the items that make up that test, not just on the overall score, and so they worked to reformulate the basic constructs of CTT.

Lawley (1943) helped solidify the connections between the characteristics of the individual items on the test, the true score in terms of the items on the test, and showed that the classical reliability coefficient can also be expressed as a function of the item parameters (F.B. Baker & Kim, 2004; Lawley, 1943). Lord extended Lawley's work and showed that CTT constructs could be expressed as functions of the test item characteristic curves (F.B. Baker & Kim, 2004). And a separate line of development of IRT can also be traced to George Rasch (1960), who created a family of one-parameter IRT models that were applied to measures of reading and tests for the Danish military (Rasch, 1960). Overall the work of these men helped establish the basic concepts of Item Response Theory.

IRT models have been used widely in both Europe and the United States. Rasch models – which are one-parameter models that just include a measurement of the item’s difficulty – are particularly popular in Europe (Thomas, 2010). However, because Rasch models are based on identical discrimination parameters (and only vary in terms of item difficulty), they don’t work well with older technology that demands item discrimination (Thomas, 2010).

The two parameter model – which includes item discrimination in addition to item difficulty – is more commonly used in clinical assessments in the United States because of its close relation to common factor theory and because it has greater flexibility (Thomas, 2010). The two-parameter model therefore seemed most appropriate for analyzing the assessment in this study.

IRT has also become fairly popular in computerized adaptive testing in the United States (Embretson & Reise, 2000). Computerized adaptive testing works by making sure test-takers receive items that are optimally selected to help measure their specific potential. This means that each test-taker may not receive the same items as another test-taker. IRT helps ensure that only the most appropriate items are selected for each individual, based on how they answer each question (Embretson & Reise, 2000).

IRT has also been applied to the creation of personality trait measurements, attitude and behavior ratings, clinical testing issues, the Scholastic Aptitude Test (SAT), and the Graduate Record Examination (GRE) (Embretson & Reise, 2000).

### ***How Item Response Theory works.***

Item response theory works much like a regression equation, where the function is a theoretical statement about how the variables in the study are related. Item parameters in IRT

are similar to parameters in factor analysis with categorical variables, in fact IRT and confirmatory factor analysis are very similar (Thomas, 2010). But IRT allows for more robust and sophisticated analysis specific to question items and scale analysis, and is appropriate for use with categorical items (Thomas, 2010).

The three most common models in IRT are the Rasch (or one-parameter) model, the two-parameter model, and the three-parameter model. Each successive model includes an additional item parameter, making the model more complex. In the one-parameter model, item difficulty is estimated separately for each item. The two-parameter model adds the discrimination parameter, and the three-parameter model adds the potential for guessing (Thomas, 2010). The two-parameter model, as noted above, is most often used in clinically related assessments and is most appropriate for evaluating this health literacy assessment. However, a disadvantage of the two-parameter model is the lack of one-to-one correspondence between the number of items correct on the test and the total test score. The one-parameter model provides a direct score (the number of items correct = the total test score), whereas the two-parameter model weights each item differently, depending on its level of discrimination (Schapira, et al., 2012). But given that IRT software is not likely to exist in practice, scoring by simply counting the number of correct items may be a more realistic option, as noted by Schapira and colleagues (2012) in the creation of their numeracy assessment.

The two-parameter model can be represented mathematically as follows, where  $\theta$  represents a person's ability,  $a$  represents the discrimination of an item,  $b$  represents the difficulty of the item,  $e$  is the constant 2.718, and  $P$  represents the probability of a correct response (Frank B. Baker, 2001):

$$P(X=1|\theta) = \frac{1}{1 + e^{-a(\theta - b)}}$$

The concept of IRT is based on the measurement of standard error – in fact, information is inversely related to standard error. Therefore, higher information is indicative of higher reliability, lower standard error, and better variable estimates. Items are most informative at their difficulty parameter. For example, when an examinee has a 50 percent chance of scoring the item correctly.

#### **Data coding and eliminating outliers.**

For both the pretest and the final test, all data was loaded into SPSS first. Missing values were treated as incorrect (or no point added) and coded as “0.” For the pretest calibration round, there were only eight missing values across all of the variables – each variable with only one participant's missing answer. For the final assessment (including the STOFHLA and health status and risk questions), there were 7 question items with one missing value each (which were from three participants: one participant who didn't answer three questions, another who didn't answer three questions, and another who didn't answer one question). Missing data problems were reduced in the final assessment by not allowing participants to move to each new group of

questions before finishing the previous group of questions (except entering height and weight – as part of the health status questions -- were optional).

All values in the new assessment and the STOFHLA were changed to binary values (0 or 1) to indicate correct/incorrect answers (or to provide a point/no point for use/no use of websites or digital applications).

Two of the digital literacy questions included answer options that involved “Not at all useful,” “Not very useful,” “somewhat useful,” and “very useful.” These answers were translated into binary answers by combining “not very useful” and “not at all useful” into one category (of not useful) and “somewhat useful” and “very useful” into another category (of useful). Because these questions had very definitive answers (either the website in question was useful in answering a particular question or it wasn’t), transforming the answers into binary data to match the rest of the existing data seemed appropriate.

Two other digital literacy questions involved asking participants whether they had ever used a list of very popular health websites and the other a list of popular digital health applications (or any other websites or digital applications that weren’t listed). These items were transformed into binary data by splitting the number of websites/digital applications used at the mean: which ended up to be the use of two or more websites/digital applications equaling one point, and those who used one or less as zero points (for both question items).

No outliers were detected from the calibration pretest, but 26 potential outliers were detected in the final round of testing. It was obvious, just from looking over the data, that there were some participants who just randomly clicked answers (or were intentionally answering the questions wrong). However, the author conducted a more thorough analysis to check these potential outliers.



The STOFHLA scores helped provide the main confirmation on which participants were answering seriously and truthfully on all of the questions. As mentioned in the literature review, the STOFHLA consists of relatively easy health literacy questions (at least for a college student population) – such as identifying when to use a verb in a sentence instead of a noun. As expected, 95.6 percent of the college students scored very well in terms of the STOFHLA scoring system (scores of 23 and above), which means they had the highest form of health literacy on the test, “adequate functional health literacy.” This means that 24 participants (out of 426 total) didn’t achieve adequate functional health literacy. And upon further inspection of these “low health literacy” participants’ overall answers, it definitely appeared as if they just randomly clicked answers.

All of these low-scoring STOFHLA participants also had low scores on the new assessment, helping confirm that they were likely randomly clicking or intentionally answering the questions incorrectly. But for a more thorough analysis, the author looked at whether the participants’ scores on the STOFHLA helped predict their scores on the new assessment. The STOFHLA scores were regressed on the new assessment’s scores, and then the studentized deleted residuals, DFFIT values, and Cook’s Distance values were all calculated. Of the 12 DFFIT values identified as concerning (when the absolute value exceeds  $2 \cdot \sqrt{[\text{number of parameters}/n]}$ , or .14 in this case), 10 of these cases were also among the low-scoring STOFHLA scores. And of the 13 calculated Cook’s Distance values that were concerning (general rule of thumb is that values higher than  $4/n$ , or .009 in this case, elicit concern), 11 of these were also among the low-scoring STOFHLA scores. Five of the 20 concerning studentized deleted residuals were also among the low-scoring STOFHLA scores. All of the low-scoring STOFHLA

cases that weren't also identified by one of the other tests were also individually examined – and these cases still appeared to consist of randomly guessed answers.

The author also checked on two additional cases that scored 24/36 correct on the STOFHLA, as these cases were also identified as potential outliers by one of the tests mentioned above. Upon further inspection, it appeared these two additional cases were likely the results of guessing or intentionally answering wrong, as it took the participants significantly less time to finish the whole test battery compared to the average (participants took an average of 40 minutes to complete the whole test battery, and these two participants took 10 and 12 minutes each to finish the test). And these cases also contained some answers with red flags (such as a 54-year-old student who drinks 15 alcoholic beverages per day).

Therefore, 26 cases (6 % of the total sample) were eliminated from the data set leaving a sample size of 400 for analysis.

### **Final calibration, model fit, and reliability.**

The psychometric properties of the question items were evaluated once again – using Item Response Theory analysis with MPlus software – after collecting data with the final version of the test to see if they were still resulting in good discrimination parameter values. The items were also inspected for how well they fit into the five skill areas – comprehension, numeracy, media literacy, health-information seeking (identified as an additional area in the pretest), and digital literacy – by assessing goodness-of-fit indices (CFI, TLI, and RMSEA). And internal consistency of the instrument was evaluated with Cronbach's alpha of reliability.

### **Evaluation of validity.**

Expert reviewers were asked to provide feedback on the initial item pool of possible assessment questions to help establish which question items worked best for measuring health literacy in young adults. Their thorough review and ranking of the question items (which included commenting on items they believed were good measurements of health literacy as well as those that were not so good), helped establish initial content validity of the first version of the assessment.

The author calculated the correlations between the participants' scores on each of the five skill-set areas and the S-TOFHLA to help assess convergent and discriminant validities. Because the new assessment tool is unlike any previously created health literacy assessment tool known to date, it was not assessed for convergent validity ("the extent to which two measures intended to assess the same construct are associated with one another" (Fabrigar & Estrada, 2007)) of the entire instrument. However, it was assessed for the comprehension component only, with the expectation that the two would show some differentiation because the new assessment provides a more comprehensive measurement of comprehension. Discriminant validity ("the extent to which measures designed to assess different constructs are, in fact, distinct from one another" (Fabrigar & Estrada, 2007)) was assessed for the other three constructs included in the new health literacy instrument (numeracy, media literacy, and digital literacy).

Criterion-related validity was assessed by regressing health status and health behavior-related variables (separately – as outcome variables) on the five skill-set areas of the new instrument (hierarchically) and then the same outcome variables in a separate regression analysis with the S-TOFHLA. These two separate sets of regression analyses (one for the new instrument

and one for the S-TOFHLA) help to see which instrument better predicts health status and health risk behaviors.

## **Results**

### **Expert Review of Assessment**

The four health education experts reviewed the initial item pool of 229 questions and provided feedback via an evaluation questionnaire (see Appendix D: Expert Evaluation of Health Literacy Assessment Questions). The experts ranked each question on a 5-point Likert scale (with 1 indicating they didn't think it was a very good question, to 5 indicating they felt strongly that it was a good question). According to Lawshe, if more than half of the subject matter experts agree that an item works well in a construct, the item has some content validity (Lawshe, 1975). Therefore, if at least three of the four experts agreed that an item would work well, it was generally kept. Based on their feedback on which question items worked best for measuring the four included constructs of health literacy, 142 questions were eliminated and 87 questions were selected for the first round of testing with the instrument (which consisted of 32 comprehension items [14 SVT technique, 18 Cloze technique], 19 numeracy items, 17 media literacy items, and 19 digital literacy items).

#### **Expert review of comprehension, Sentence Verification Technique.**

For the Sentence Verification Technique, three passages – on gout, metastatic cancer, and Chlamydia – and corresponding YES/NO test sentences were included in the initial item pool. The experts were asked to indicate which of the three passages overall worked best to include in the comprehension section, and two voted for the gout passage, and another two voted for the metastatic cancer passage. The experts were also asked to

indicate which passage they felt young adult college students would be least familiar with, and all four experts agreed or strongly agreed that Gout would work well as a potential topic that most college students would likely be unfamiliar with. In addition, all four experts provided positive feedback on the test questions in the Gout section as being clearly answerable as either “Yes” or “No” test sentences. Therefore, the Gout passage was chosen as the final topic for the Sentence Verification Technique section of the comprehension section.

Including a topic that the audience would likely have less background knowledge on and exposure to seemed like a better topic for measuring comprehension than one that might include more of an imbalance in exposure (e.g., more females likely to have background knowledge of Chlamydia, as pointed out by one expert; and exposure to cancer is perhaps more likely than exposure to gout).

#### **Expert review of comprehension, Cloze Technique.**

For the Cloze Technique, another three passages – on sleep apnea, human papillomavirus, and high cholesterol – were included for review (with their corresponding Cloze questions). The experts indicated that HPV and high cholesterol were the best passages, with overall appropriate corresponding cloze questions. One expert pointed out that females would likely have more background knowledge on HPV than males. Although both passages received overall equally positive feedback, it only made sense to include one in the assessment, as each cloze passage included about 15-18 questions. The high cholesterol passage seemed the most appropriate, given there would unlikely be any differences in background knowledge between males and females or other sub-groups in

the population. Three out of the four experts agreed (with rankings of 4-5 on the Likert scale) that the Cloze questions included in the high cholesterol passage were appropriate and seemed to include only one answer (and one expert gave it a rank of “2,” but also included comments on a specific question that wouldn’t work well, which was then changed for clarity before administering the assessment).

#### **Expert review of numeracy.**

Out of the four basic numeracy questions, three questions were rated by at least three of the four experts as good basic numeracy questions that should be included in the health literacy assessment (with ratings of 4 or higher on the Likert scale). The last basic numeracy question included a split: two experts strongly agreed it was a good question and should be included in the assessment, and two experts disagreed. Although there was a split, this question was kept for the first round of administering the assessment and calibration analysis because it still seemed like a good measurement of basic numeracy.

All of the computational and statistical question items were rated highly (agree or strongly agree that they were good questions for inclusion in the health literacy instrument) by at least three out of the four experts. One of the analytical question items was rated poorly by three of the experts (question 4 in the initial item pool, which can be viewed in Appendix B) and therefore this question was eliminated.

#### **Expert review of media literacy.**

Out of the five possible websites (and corresponding questions, which were the same for every website) included for analyzing media literacy, all four experts ranked the

National Cancer Institute's webpage on melanoma treatment as the their top choice. And Merck's webpage on an advertisement for Gardasil was the second choice for three out of the four experts. Both of these website pages and corresponding media literacy questions were included in the assessment so that the results could be compared between a fairly well known health website and an advertisement.

Out of the 10 corresponding media literacy questions (they were the same for all of the websites), at least three out of the four experts agreed or strongly agreed that 9 of these questions should be included in the health literacy instrument. Question 8 – which asked the examinees about their perspective of the health message communicated in the website (e.g., whether they believe following the advice recommended on the webpage would be good for their health) – was eliminated because two of the experts felt this question would not work well as part of the health literacy assessment (they “strongly disagreed” that this question would work well).

#### **Expert review of digital literacy.**

There were three sections included in the digital literacy section: one on personal digital health literacy (e.g., how often examinees search for health information on the Internet), one asking general digital literacy question (e.g., figuring out the source for a website's funding), and one section with specific scenarios (e.g., participant has just discovered his/her father has prostate cancer and needs help finding out more information about available treatments – and the participant must then indicate how he/she would go about searching for helpful information and also choose between the most useful websites with helpful information).



All of the experts rated the personal digital health literacy questions with values of 3 or 4 on the 5-point Likert scale (with 1 as strongly disagree and 5 as strongly agree). One of the experts commented that she wasn't sure how these questions could be interpreted along with the other information in the health literacy assessment. But because all five questions still received favorable ratings, they were kept for the first version of the assessment.

Three of the questions in the general digital literacy section were eliminated based on the comments and ratings from the experts. One of the experts noted that one of the questions would have different answers depending on whether the individual was searching for information on a Mac vs. a PC, so this question was eliminated. And two additional questions with poor ratings were also eliminated. The other questions – which received good ratings among all four experts – were kept.

Three scenarios – one on a father with prostate cancer, one on a close college friend with a drinking problem, and another on experiencing some symptoms of depression – with corresponding questions were ranked by the experts. Three out of the four experts thought the scenario involving a father who has just been diagnosed with prostate cancer would work the best, and so this scenario was kept for the first version of the assessment and the other two were eliminated.

All four of the experts also agreed or strongly agreed that the open-ended questions in the scenario section should be kept as part of the digital health literacy section. These questions involved asking participants to describe how they would go about searching for health information (e.g., what key terms they would use in a search engine, etc.) and explaining why they felt certain sources were better than other ones.

### **Study Population for Calibration/Pre-test**

A total of 144 participants from both the summer and fall JTC 300 Technical Communication courses completed the first version of the assessment (out of 209 students total registered for the courses; 69%). The participants included 59 males and 85 females, who ranged in age from 18 to 31 ( $M = 20.83$ ). The participants were mostly juniors (41.7 %) and seniors (44.4 %), with some sophomores (13.9 percent). Participants identified as 86.1 % white, 9% Asian, 6% Hispanic, and 5% other (with 0% black/African-American), and these characteristics are similar to the overall Colorado State University student population with 86 percent white and 14 percent ethnic minorities (Colorado State University, 2011).

### **Item Selection from Pre-test**

As a result of the preliminary data analysis, 44 question items were identified for deletion based on both Item Response Theory statistics and review of goodness-of-fit indices of the various tested models for the four areas of health literacy.

As mentioned in the methods section, items were inspected for how well they fit into the four separate constructs – comprehension, numeracy, media literacy, and digital literacy – by assessing goodness-of-fit indices (CFI, TLI, and RMSEA values), and their parameters were also calculated using Item Response Theory statistics. Items with discrimination values below 0.3 were – for the most part – eliminated, and those with values above 0.3 were examined further in a phased approach.

Each of the four potential constructs were analyzed and modeled as separate factors, although the author checked to see if media literacy and digital literacy worked better as a single model or as separate models (as the two constructs share some similar characteristics). Otherwise, the author felt confident that these sets of questions (in each construct) clearly belonged in separate factor categories. Each construct includes a very different set of questions that are based on extensive research for that construct (and they don't seem to have many, if any, overlapping characteristics – with the exception of media literacy and digital literacy).

The results for each construct – comprehension, numeracy, media literacy, and digital literacy – are provided separately.

### **Comprehension.**

Twenty total comprehension items – which consisted of 8 SVT questions and 12 Cloze questions – were kept in the final model, which means that 12 questions were identified for deletion.

In Table 3, the item parameters for the comprehension section – calculated using Item Response Theory statistics – are reported. Seven question items (SVT GOUT items 2, 5, 10, 12, and 13; and Cloze items 2 and 4) had poor discrimination values (below 0.3) and were therefore eliminated (these items are in ***bold italics***). Testing the new scale of items, with the seven aforementioned questions now deleted, revealed that an additional SVT item – Gout 7 – had a discrimination value below 0.3. This item was therefore also eliminated. After these two phases of calculating Item Response Theory statistics, all of the remaining question items had discrimination parameter values above 0.3.

However, because the Cloze technique works by eliminating every X<sup>th</sup> word in a passage (in this case, every 8<sup>th</sup> to 12<sup>th</sup> word), the first six Cloze questions were eliminated entirely (since two questions had poor discrimination values in the first six, and because the next new paragraph didn't start until the seventh cloze question) in order to keep a consistent flow with the technique. The final values, all with discrimination parameter values above 0.30, can be viewed in Table 4.

Typically IRT difficulty parameters range from -3.0 to 3.0 (Embretson & Reise, 2000; Schapira, et al., 2012). As Table 3 illustrates, only a couple of the items in the comprehension section have values above 0, indicating that most of the items (negative) would be considered fairly easy for this population. GOUT8 and GOUT11 (both Sentence Verification Technique questions) are the most difficult items, with IRT difficulty parameters of 0.23 and 0.09, respectively. All of the comprehension items – using both the Sentence Verification Technique and the Cloze technique – were highly discriminating (values above 0.60 are considered very good, and above 0.30 are considered good (Wise, 2012)).

In Table 5, the Chi-square and goodness-of-fit indices of the various tested models for the comprehension construct are reported. These values were identified in Mplus 6.0 using WLSMV, which is the weighted least square estimate that uses both the mean- and variance-adjusted test statistic. Because there is a high sensitivity of  $\chi^2$  tests to sample size, it's often a less appealing choice for assessing overall fit of the model. And as can be seen in the table, the significant chi-square values were indicative of a poor fit for all of the models. Therefore, although these values are included here for a comprehensive report, the other goodness-of-fit indices were used comparatively to help decide on the best

model. However, the comparison between models in terms of their  $\chi^2$  statistics can still be somewhat informative. The comparison between models A and D shows a reduction of 297.45 in their  $X^2$  values with a difference of 294 degrees of freedom. And the difference between models D and F shows a reduction of 237.43 in their  $\chi^2$  values with a difference of 93 degrees of freedom. The differences between models A,B, and C, and also between E and F are not as considerable.

Root mean square error of approximation (RMSEA) values should be as close to 0.06 and below as possible to indicate good fit. However, some previous studies have shown that RMSEA values in the range of 0.05 to 0.10 are considered an indication of a fair fit (Hooper, et al., 2008). Comparative fit index (CFI) values  $\geq 0.95$  are presently recognized as indicative of a very good fit, but values above 0.90 have also been considered as good in past research (Hooper, et al., 2008; Tsai, et al., 2007). TLI values are similar, with values above 0.95 recognized as having a very good fit, but many researchers have reported values above 0.90 as having a good fit (Tsai, et al., 2007).

Although Model F demonstrates the best model fit overall according to WLSMV statistics, this model (and the one before it, E) eliminates all of the Sentence Verification Technique items. Because the research suggests that at least two methods should be used to measure comprehension (as mentioned in the literature review), and because several of the Sentence Verification Technique Gout items had very good discrimination parameter values (above 0.6), the author chose to keep the well-performing SVT items (those represented in Model D) for the next round of testing with the health literacy instrument. Therefore, Model D is represented in the assessment for the final round of testing, although

these items will be carefully studied after the final round of testing since the best model in this calibration pre-test doesn't include them.

**Table 3.** Item-level analysis of comprehension questions in health literacy test

<b>Question Item</b>	<b>Difficulty</b>	<b>Discrimination</b>
Sentence Verification Technique GOUT 1	-1.20	0.59
<b><i>Sentence Verification Technique GOUT 2</i></b>	<b>-1.23</b>	<b>0.21</b>
Sentence Verification Technique GOUT 3	-1.12	0.46
Sentence Verification Technique GOUT 4	-0.68	0.49
<b><i>Sentence Verification Technique GOUT 5</i></b>	<b>-4.15</b>	<b>0.29</b>
Sentence Verification Technique GOUT 6	-1.74	0.53
Sentence Verification Technique GOUT 7	-0.57	0.30
Sentence Verification Technique GOUT 8	0.24	0.40
Sentence Verification Technique GOUT 9	-1.83	0.43
<b><i>Sentence Verification Technique GOUT 10</i></b>	<b>1.73</b>	<b>-0.20</b>
Sentence Verification Technique GOUT 11	0.08	0.55
<b><i>Sentence Verification Technique GOUT 12</i></b>	<b>-4.46</b>	<b>0.27</b>
<b><i>Sentence Verification Technique GOUT 13</i></b>	<b>-6.57</b>	<b>0.13</b>
Sentence Verification Technique GOUT 14	-3.54	0.60
Cloze Technique Cholesterol CLOZE 1	-1.68	0.66
<b><i>Cloze Technique Cholesterol CLOZE 2</i></b>	<b>2.06</b>	<b>0.22</b>
Cloze Technique Cholesterol CLOZE 3	-2.10	0.71
<b><i>Cloze Technique Cholesterol CLOZE 4</i></b>	<b>-3.54</b>	<b>-0.08</b>
Cloze Technique Cholesterol CLOZE 5	-2.28	0.32
Cloze Technique Cholesterol CLOZE 6	-0.71	0.81
Cloze Technique Cholesterol CLOZE 7	-1.30	0.94
Cloze Technique Cholesterol CLOZE 8	-0.41	0.75
Cloze Technique Cholesterol CLOZE 9	-1.02	1.20
Cloze Technique Cholesterol CLOZE 10	-1.69	1.30
Cloze Technique Cholesterol CLOZE 11	-1.04	1.14
Cloze Technique Cholesterol CLOZE 12	-1.35	1.30
Cloze Technique Cholesterol CLOZE 13	-0.95	1.71
Cloze Technique Cholesterol CLOZE 14	-1.51	1.35
Cloze Technique Cholesterol CLOZE 15	-1.04	1.14
Cloze Technique Cholesterol CLOZE 16	-1.56	0.95
Cloze Technique Cholesterol CLOZE 17	-1.24	1.09
Cloze Technique Cholesterol CLOZE 18	-1.23	1.68

\*Note: Items in bold italics have discrimination values below 0.30 and were therefore eliminated.

**Table 4.** Item-level analysis of final model (D) of comprehension questions

Question Item	Difficulty	Discrimination
Sentence Verification Technique GOUT1	-2.00	1.00
Sentence Verification Technique GOUT3	-1.15	0.77
Sentence Verification Technique GOUT4	-0.74	0.77
Sentence Verification Technique GOUT6	-1.78	0.88
Sentence Verification Technique GOUT8	0.20	0.77
Sentence Verification Technique GOUT9	-1.82	0.74
Sentence Verification Technique GOUT11	0.07	0.94
Sentence Verification Technique GOUT14	-3.79	0.92
Cloze Technique Cholesterol CLOZE7	-1.33	1.55
Cloze Technique Cholesterol CLOZE8	-0.43	1.25
Cloze Technique Cholesterol CLOZE9	-1.03	2.03
Cloze Technique Cholesterol CLOZE10	-1.70	2.22
Cloze Technique Cholesterol CLOZE11	-1.02	2.07
Cloze Technique Cholesterol CLOZE12	-1.34	2.23
Cloze Technique Cholesterol CLOZE13	-0.95	2.98
Cloze Technique Cholesterol CLOZE14	-1.49	2.41
Cloze Technique Cholesterol CLOZE15	-1.04	1.99
Cloze Technique Cholesterol CLOZE16	-1.56	1.64
Cloze Technique Cholesterol CLOZE17	-1.27	1.82
Cloze Technique Cholesterol CLOZE18	-1.22	3.03

**Table 5.** Chi-square and goodness-of-fit indices for comprehension models

Factor Model	DF	X <sup>2</sup>	CFI	TLI	RMSEA
(a) All comprehension items	465	667.068	0.797	0.783	0.055
(b) Minus 7 items	276	493.015	0.797	0.779	0.074
(c) Minus 7 items above + GOUT 7	253	456.901	0.807	0.790	0.075
(d) Minus items above + CLOZE 1-6.	171	369.620	0.800	0.778	0.090
(e) Minus items above + All SVT GOUT items, CLOZE 5	91	172.947	0.921	0.909	0.079
(f) Minus items above + CLOZE 1	78	132.188	0.947	0.938	0.069

### **Numeracy.**

Eight numeracy question items were identified for elimination, which means that 11 numeracy items were kept in the final model.

In Table 6, the IRT item parameters for the numeracy section are reported. Five numeracy questions had discrimination values below 0.3 (***bold and italicized***) and were therefore eliminated. One item – STATS3 – was also eliminated, even though it had a good discrimination value, as the author realized upon an additional review of the assessment that this question was not worded correctly. A second-phase of Item Response Theory analysis yielded an additional item, Computational question 2, with a discrimination value below 0.3; and a third-phase analysis yielded another item, Statistical question 1, with a value below 0.3. These additional two items were eliminated, leaving the remaining items with discrimination parameter values all above 0.6, which can be seen in Table 7.

None of the numeracy items would be considered very difficult items for this population, as they all have negative difficulty parameters. All of the items are highly discriminating (values above 0.6).

In Table 8, the Chi-square and goodness-of-fit indices of the various tested models for the numeracy construct are reported. RMSEA values are fair for all four of the models (below 0.10). CFI and TLI values are not significant for any of the models (above 0.90 indicates a good fit), but Model D has the highest values and this was the model included in the final version of the instrument for testing.



**Table 6.** Item-level analysis of numeracy questions in health literacy test

<b>Question Item</b>	<b>Difficulty</b>	<b>Discrimination</b>
Basic Numeracy Items		
Basic 1: Understanding instructions	-1.73	0.59
Basic 2: Understanding missing info	-1.58	0.44
<b><i>Basic 3: Measurement/dosing medication</i></b>	<b>4.27</b>	<b>-0.44</b>
Basic 4: Understanding instructions/food	-2.15	0.61
Computational Numeracy Items		
<b><i>Computational 1: Range triglycerides</i></b>	<b>-20.87</b>	<b>0.06</b>
Computational 2: Out of context	2.30	0.27
<b><i>Computational 3: Applying risk basic calc</i></b>	<b>5.23</b>	<b>-0.10</b>
Computational 4: Missing # information	-3.04	0.425
Computational 5: Division	-2.52	0.99
Analytical Numeracy Items		
Analytical 1: Percent to ratio	-1.33	0.99
Analytical 2: Making sense of different units	-1.55	0.66
Analytical 3: Calculating probability	-1.33	0.66
Analytical 4: Calculating percent	-1.82	0.82
Statistical Numeracy Items		
Statistical 1: Ratio to percent population size	-0.80	0.33
<b><i>Statistical 2: Ratio to percent population</i></b>	<b>-1.05</b>	<b>0.21</b>
Statistical 3: Calculating ratio population	-1.48	0.48
<b><i>Statistical 4: Calculating risk</i></b>	<b>-3.72</b>	<b>0.27</b>
Statistical 5: Calculating risk	-0.30	0.93
Statistical 6: Calc risk based on previous	-0.46	0.75

\*Note: Items in bold italics have discrimination values below 0.30 and were therefore eliminated.

**Table 7.** Item-level analysis of final model (D) numeracy question items

<b>Question Item</b>	<b>Difficulty</b>	<b>Discrimination</b>
Basic Numeracy Items		
Basic 1: Understanding instructions	-1.73	1.00
Basic 2: Understanding missing info	-1.58	0.75
Basic 4: Understanding instructions/food	-1.99	1.15
Computational Numeracy Items		
Computational 4: Missing # information	-2.51	0.92
Computational 5: Division	-2.44	1.80
Analytical Numeracy Items		
Analytical 1: Percent to ratio	-1.34	1.67
Analytical 2: Making sense of different units	-1.47	1.22
Analytical 3: Calculating probability	-1.29	1.18
Analytical 4: Calculating percent	-2.02	1.18
Statistical Numeracy Items		
Statistical 5: Calculating risk	-0.33	1.35
Statistical 6: Calc risk based on previous	-0.44	1.38

**Table 8.** Chi-square and goodness-of-fit indices for numeracy models

<b>Factor Model</b>	<b>DF</b>	<b>X<sup>2</sup></b>	<b>CFI</b>	<b>TLI</b>	<b>RMSEA</b>
(a) All Numeracy Items	171	381.662	0.420	0.352	0.07
(b) Minus 5 items	78	149.485	0.580	0.510	0.08
(c) Minus items above & Computational 2	66	137.755	0.554	0.473	0.09
(d) Minus items above & Statistical 1	55	120.541	0.570	0.475	0.09

**Comparing media literacy and digital literacy as separate scales.**

Because media literacy and digital literacy can have some overlapping characteristics (such as evaluating and synthesizing resources), these concepts were first tested to see if they should be considered as two separate scales (as intended) or as part of one single scale. As outlined in the literature review, the emphasis of media literacy is traditionally on analyzing information for credibility and quality and the emphasis of digital literacy is on successfully searching for relevant information in a digital environment, which is how these two concepts were operationalized for this assessment.

As noted in Table 9, media literacy and digital literacy items assessed together did not fit well along any of the goodness-of-fit indices. And upon further inspection, only six of the question items (out of 30 questions) had R-square values above 0.20 when both sets of question items were combined – and they were all media literacy items (these six items were CNCER7, CNCER8, GARDML3, GARDML4, and GARDML5). None of the items intended for the digital literacy scale had R-square values above 0.20 when analyzed as part of a joint-scale with media literacy. Research suggests that items with low R-square values (less than 0.20) should be removed from analysis as this is an indication of very poor fit (Hooper, et al., 2008). This means that all of the proposed digital literacy items would need

to be removed, as would two-thirds of the media literacy items, when these two scales are considered as part of one model.

When analyzed as separate scales, both the media literacy and digital literacy models – with their full sets of items – still have poor fits as indicated by the goodness-of-fit indices. However, in comparing the separate scales with the combined scale, it’s evident that the separate scales show some improvement with increased CFI and TLI scores, and a considerable reduction in their  $\chi^2$  values and degrees of freedom. Furthermore, as a combined scale, only six items showed any promise for keeping as part of the full model (with  $R^2$  values above 0.20), and all six of these items were part of the original media literacy scale. As separate scales, media literacy alone had seven items that seemed potentially worthy of keeping (with  $R^2$  values above 0.20), and digital literacy alone also had seven items potentially worth keeping (with  $R^2$  values above 0.20). These results help show that the digital literacy items should perhaps be kept as part of a separate scale from media literacy.

**Table 9.** Comparing Media Literacy and Digital Literacy as Separate Scales

Factor Model	DF	$X^2$	CFI	TLI	RMSEA	Number of items with $R^2$ values $\geq$ 0.20.
Media & Digital	406	660.07	0.47	0.43	0.00	6 (out of 30)
All Media Items	120	268.41	0.59	0.53	0.09	7 (out of 17)
All Digital Items	66	140.89	0.56	0.48	0.09	7 (out of 13)

### **Media Literacy.**

Because the results from the separate scales (media literacy and digital literacy) showed promise as separate models, media literacy was further analyzed for the best separate model. After eliminating items with poor discrimination parameter values, eight media literacy items – which consisted of four questions from the website on melanoma cancer and four questions from the advertisement website on Gardasil – were kept in the final model, which means that nine question items were identified for elimination.

Table 10 shows the discrimination and difficulty parameters for all of the media literacy items. Nine questions (CNCER 2, 4, 6, and 7; and GARDML 2, 6, 7, 8, and 9) had poor discrimination parameter values (below 0.3). However, the question regarding authorship – on both websites (CNCER2 and GARDML2) – was kept even though the discrimination values were below 0.3 for these questions on both the melanoma cancer website and the Gardasil website. Because authorship is considered one of the key elements of media literacy for evaluating credibility and quality, as defined by the National Association for Media Literacy Education, these questions on authorship were considered important to the construct of media literacy. However, the question was changed for the final assessment to read “Who is responsible for this message?” (instead of “Who is the author of this message?”) because the author realized that actual “authorship” may be unclear (as the writer/creator may be anonymous, but the company/organization representing that message should be clear). The other six question items with poor discrimination values were eliminated.

After testing the new scale of items, all of the items except for the two authorship questions (CNCER 2 and GARDML 2) had good discrimination values (above 0.3), which can

be viewed in Table 11. Four of these items were highly discriminating (values above 0.6). Difficulty parameters ranged between -4.32 to 2.18, but most of the question items (6) were negative, indicating these questions would be relatively easy for this population.

The Chi-square and goodness-of-fit indices for the media literacy models can be seen in Table 12. Model B represents all of the items with discrimination values above 0.3 plus the two authorship questions, which is the model that was kept for the final round of assessment. This model actually has the highest CFI and TLI values, plus the lowest RMSEA value, indicating it's the best model between the three. Model C eliminates the two authorship questions, which actually results in slightly lower CFI and TLI values and an increased RMSEA value, indicating it's not as good of a fit.

**Table 10.** Item-level analysis of media literacy questions in health literacy test

<b>Question Item</b>	<b>Difficulty</b>	<b>Discrimination</b>
<b>Melanoma Skin Cancer (National Cancer Institute)</b>		
CNCER1: Purpose of the message	-2.22	0.59
CNCER2: Authorship	-4.69	0.25
CNCER3: Authorship credibility	0.51	0.35
CNCER4: Reviewed by professionals	-0.29	-0.37
CNCER5: When info last updated	-1.97	0.64
CNCER6: What point of view left out	-0.19	0.18
CNCER7: Info based on scientific evidence	-2.18	0.23
CNCER8: How credible is message	-2.94	0.64
<b>Gardasil (Advertisement for Gardasil)</b>		
GARDML1: Purpose of message	-1.06	1.37
GARDML2: Authorship	2.11	0.22
GARDML3: Authorship credibility	-0.19	1.13
GARDML4: Reviewed by professionals	-0.18	0.74
GARDML5: When info last updated	-1.33	3.70
GARDML6: What point of view left out	3.50	0.11
GARDML7: What is the author's point of view	2.97	0.18
GARDML8: Info based on scientific evidence	-3.14	-0.17
GARDML9: How credible is message	1.71	-0.29

**Table 11.** Item-level analysis of final model of media literacy items

Item	Difficulty	Discrimination
<b>Melanoma Skin Cancer (National Cancer Institute)</b>		
CNCER1: Purpose of the message	-2.22	0.59
CNCER2: Authorship	-4.32	0.28
CNCER3: Authorship credibility	0.48	0.38
CNCER5: When info last updated	-1.94	0.65
<b>Gardasil (Advertisement for Gardasil)</b>		
GARDML1: Purpose of message	-1.04	1.44
GARDML2: Authorship	2.18	0.21
GARDML3: Authorship credibility	-0.20	1.06
GARDML5: When info last updated	-1.31	4.04

**Table 12.** Chi-square and goodness-of-fit indices for media literacy models

Model	DF	X <sup>2</sup>	CFI	TLI	RMSEA
(A) All media literacy items	136	496.945	0.589	0.534	0.093
(B) Minus poor items, but including authorship Q's	28	172.784	0.880	0.841	0.076
(C) Minus all poor items	10	28.969	0.873	0.810	0.115

### Digital Literacy.

The digital literacy section ended up being divided into two separate sub-concepts: general digital literacy and health information seeking. Seven question items were kept in the general digital literacy model, and five questions were kept separate as part of a health information-seeking model. All five of the open-ended digital literacy questions were eliminated and one of the close-ended digital literacy questions was eliminated.

The discrimination and difficulty parameters for all of the original digital literacy questions are shown in Table 13. Five out of the original 13 close-ended question items had good discrimination values (above 0.30). These five items were all personal health information-seeking questions:

- Have you ever searched for health information on the Internet (Never, 1-2, times, 3-5 times, 6-10 times, 11+ times)?
- How difficult was it to find the information you needed (difficult, somewhat difficult, not very difficult, easy)?
- Have you always been able to find the answers to your health-related questions? (Never, seldom, sometimes, usually, always)?
- What are some of the main websites you have used (list of some of the major health websites, and a place to write in additional sites)?
- Have you used digital applications for any of the following (exercise routines, nutrition, health-related journaling, etc.)?

These questions obviously belonged together, and upon further inspection, it seemed that the other questions (which asked very specific right/wrong digital literacy questions) should perhaps be part of a different subscale/factor. The other eight items were combined together and evaluated again for their Item Response Theory parameter statistics. This second-phase yielded seven of the eight items as having good discrimination values (above 0.30) when grouped without the health information-seeking items (all except for SCENUSE1). The item-level analysis of these two second-phased approaches with the two subscales can be viewed in tables 14 and 15.

Table 16 provides an overview of the Chi-square and goodness-of-fit indices for these final models. The health-information seeking model (with the five questions that ask about personal use) has the best values, with CFI and TLI values at 0.80 and 0.66 respectively. And there is a considerable reduction in the  $\chi^2$  value from the original model

with a difference of 60 degrees of freedom. The general digital literacy items have very poor goodness-of-fit values; however, because they had good discrimination values in the Item Response Theory statistics, they were kept for another round of testing. But the author fully recognizes that if these items continue to perform poorly, they may need to be pulled from the assessment.

All of the open-ended questions were eliminated from the instrument for the last round of testing. The answers were varied and would be difficult to realistically code in large-scale testing with this instrument. Therefore it didn't seem practical to include them as part of the health literacy assessment. However, the author may use the open-ended textual data (from this first round of testing) in future research with digital literacy.

**Table 13.** Item-level analysis of all initial digital literacy question items

<b>Question Item</b>	<b>Difficulty</b>	<b>Discrimination</b>
DLSEARCH: Have you searched for health info	-1.91	0.59
DLDIFFCT: How difficult to find info	-0.23	0.91
DLFIND: Able to find answers to health questions	-0.06	2.11
DLSOURCE: Source of website's funding	-0.86	0.12
DLRUNWEB: Who runs a website	-3.31	0.15
DLPURPS: How can you tell website's purpose	-3.92	0.19
DLORIGNL: Original source of website's info	-0.52	0.13
DLCURRNT: How current info is on website	11.30	-0.04
SCENUSE1: Usefulness (not useful)	5.31	0.08
SCENUSE2: Usefulness (Not very useful)	23.67	0.05
SCENUSE3: Usefulness (Very useful)	-7.01	0.14
DLSCORET: Use of digital applications	-0.49	0.52
WEBDLT: Main health websites used	-1.44	0.57

**Table 14.** Item-level analysis of health-information seeking items

<b>Question Item</b>	<b>Difficulty</b>	<b>Discrimination</b>
DLSEARCH: Have you searched for health info	-1.91	0.59
DLDIFFCT: How difficult to find info	-0.24	0.91
DLFIND: Able to find answers to health questions	-0.06	7.39
DLSCORET: Use of digital applications	-0.58	0.42
WEBDLT: Main health websites used	-1.65	0.48



**Table 15.** Item-level analysis of general digital literacy question items

<b>Question Item</b>	<b>Difficulty</b>	<b>Discrimination</b>
DLSOURCE: Source of website's funding	-0.20	0.59
DLRUNWEB: Who runs a website	-1.25	0.40
DLPURPS: How can you tell website's purpose	-1.46	0.60
DLORIGNL: Original source of website's info	-0.12	0.71
DLCURRNT: How current info is on website	-0.84	0.53
SCENUSE2: Usefulness (Not very useful)	1.93	0.68
SCENUSE3: Usefulness (Very useful)	-2.78	0.36

**Table 16.** Chi-square and goodness-of-fit indices for digital literacy and health information seeking questions

<b>Model</b>	<b>DF</b>	<b>X<sup>2</sup></b>	<b>CFI</b>	<b>TLI</b>	<b>RMSEA</b>
All initial digital literacy items	66	140.89	0.56	0.48	0.09
Health-information seeking	6	31.53	0.80	0.66	0.17
General digital literacy	15	67.99	0.33	0.06	0.16

### **Study Population with Final Test**

A total of 426 students responded to the assessment survey, which consisted of 235 students from the 100-level communication course (out of 367 registered for the course, or 64%), and 191 students from the two sections of the 300-level communication course (out of 237 registered for the course, or 81%). The students in the 100-level course were mainly freshmen and sophomores and the students in the 300-level course were mainly juniors and seniors. Both courses comprised students from various majors throughout the university, as they are general communication classes that meet the writing/communication requirements for undergraduate students.

As mentioned in the methods section on data coding and eliminating outliers, 26 outlier cases were eliminated from the data set (the majority of these cases appeared to

consist of participants who randomly guessed the answers without reading or taking much thought with the questions, as was apparent from their low STOFHLA scores and concerning DFFIT, Cook's distance, and Studentized deleted residuals values). Therefore the final sample size consisted of 400 participants.

The respondents included 153 males and 243 females (with four respondents who left this question blank), who ranged in age from 17 to 36 ( $M = 20$ ), and who ranged over the undergraduate grade levels (35% freshmen, 13% sophomores, 26% juniors, 25% seniors, and 1% who left this question blank). Participants identified as 81.8% White, 3.3% Black or African American, 3.8% Asian, 6.5% Hispanic, 0.3% American Indian or Alaskan Native, 0.5% Native Hawaiian or other Pacific Islander, and 3% identified as "Other."

And as indicated in Table 17, they all had adequate literacy scores on the S-TOFHLA health literacy assessment, which is indicative of scores between 23 and the maximum, 36 ( $M = 34.9$ ,  $SD = 1.45$ ).

Most of the participants indicated they had very good or excellent health (67%), with 28.5% in good health, and 4% in fair or poor health. These college students appear to be in slightly better overall health compared with the national averages of 61% reporting excellent or very good health and 9.5% in fair or poor health (Centers for Disease Control and Prevention, 2010; HealthyPeople.gov, 2013). When asked about whether they had felt sad, nervous, fidgety, or hopeless during the past 30 days (some of the time, most of the time, or all of the time), 15.2% indicated they had felt sad, 48.5% indicated they had felt nervous, 52% indicated they had felt fidgety, and 12.3% indicated they had felt hopeless. These numbers can be compared to national averages of 12% of U.S. adults experiencing feelings of sadness, 18% experiencing feelings of nervousness, 19% experiencing feelings

of restlessness, and 7% having feelings of hopelessness (Centers for Disease Control and Prevention, 2010), indicating that this college student population may be at increased risk for these characteristics related to mental health.

Only 22 participants indicated they felt healthy and full of energy for the entire month during the last 30 days, but 329 participants (82.3%) indicated they had not felt healthy and full of energy for at least 5 days (and up to 30 days) of the past month ( $M = 19.96$ ,  $SD = 7.35$ ). Most participants (264 or 66%) had experienced pain of some kind at some point during the last 30 days (between 1-30 days) that made it hard for them to engage in their usual activities, such as self-care, work, or recreation, with 85 (21.3%) of these participants having experienced pain for 6 days or more over the past month.

Body Mass Index values were calculated for those participants who shared their height and weight values (6 participants chose not to share this information). Body Mass Index was calculated as follows:

$$\text{BMI} = \frac{\text{Weight in Pounds}}{(\text{Height in inches})^2} \times 703$$

Most of the participants (74.5%) had BMI values in the normal range, 18.5-24.9, as defined by the National Heart, Lung and Blood Institute. About 5.5% were underweight, 15.8% were overweight, and 2.8% were obese.

**Table 17.** Characteristics of study population who took final assessment

Characteristic	N=400	% of N
STOFHLA score (23-36 adequate literacy; all scores above 24)		
24-25	2	0.5
26-27	1	0.3
28-29	1	0.3
30-31	5	1.3
32-33	36	9.0
34-35	201	50.3
36	154	38.5
Self-reported health status		
Excellent	79	19.8
Very good	190	47.5
Good	114	28.5
Fair	15	3.8
Poor	1	0.3
How often participant felt sad during past 30 days		
Some of the time, most of the time, or all of the time	61	15.2
A little of the time, none of the time	339	84.8
How often participant felt nervous during the past 30 days		
Some of the time, most of the time, or all of the time	194	48.5
A little of the time, none of the time	206	51.5
How often participant felt fidgety during the past 30 days		
Some of the time, most of the time, or all of the time	208	52.0
A little of the time, none of the time	192	48.0
How often participant felt hopeless during the past 30 days		
Some of the time, most of the time, or all of the time	49	12.3
A little of the time, none of the time	351	87.7
How many days participant felt healthy and full of energy over past 30 days ( <i>M</i> =19.96; <i>SD</i> = 7.35)		
0-5 days	27	6.8
6-10 days	39	9.8
11-15 days	52	13
16-20 days	88	22
21-25 days	122	30.5
26-30 days	71	17.8
How many days pain made it hard to engage in activities over past 30 days		
0-5 days	315	78.8
6-10 days	45	11.3
11-15 days	18	4.5
16-20 days	2	0.5
21-25 days	4	1.0
26-30 days	15	3.8
Body Mass Index		
Underweight = <18.5	22	5.5
Normal weight = 18.5-24.9	298	74.5
Overweight = 25-29.9	63	15.8
Obesity = BMI of 30 or greater	11	2.8
Missing	6	1.5

As shown in Table 18, 87.2% of the students indicated they don't currently use tobacco products, but about half of them said they have used tobacco products in the past (50.7%).

Seventy students (17.5%) said they didn't consume any alcohol at all over the last 30 days, with 35.8% having consumed alcohol between 1-5 days, 30% between 6-10 days, and 16.8 percent had consumed alcohol on 11 or more days. About 60 percent of the participants indicated they had consumed three or more drinks on the days when they did consume alcohol.

**Table 18.** Use of tobacco and alcohol products

Characteristic	N=400	% of N
Currently uses tobacco products		
Yes	51	12.8
No	349	87.2
Has ever used tobacco products		
Yes	203	50.7
No	197	49.3
No of days in past month that alcohol was consumed (M=6.46, SD =6.30)		
0	70	17.5
1-5	143	35.8
6-10	120	30.0
11+	67	16.8
On the days alcohol was consumed, about how many drinks were consumed		
0	72	18
1-2	82	20.5
3-4	112	28
5-6	67	16.8
7+	66	16.5
Missing	1	0.2

Ninety-one percent of the students said they had participated in an exercise activity during the past month, with an average of three times per week and 55 minutes per session, as shown in Table 19.

Over 70% indicated they either hadn't had a flu shot or weren't sure if they had one sometime over the past year, as shown in Table 20.

**Table 19.** Exercise data of study population

Characteristic	N=400	% of N
Participation in exercise during the past month		
Yes	365	91.3
No	24	6.0
Don't know/not sure	10	2.5
Number of times per week participant exercises ( $M=3.28$ , $SD=1.97$ )		
0	30	7.5
1-2	109	27.3
3-4	151	37.8
5-7	105	26.3
8+	4	1.0
Number of average minutes spent exercising ( $M=55.11$ , $SD=33.88$ )		
0 mins	23	5.8
1-30 mins	84	21
31-60 mins	203	50.8
61+ mins	89	22.3

**Table 20.** Flu vaccine

Characteristic	N=400	% of N
Had a seasonal flu vaccine during the past year		
Yes	112	28
No	256	64
Not sure	31	7.8
Missing	1	0.3

### Reliability and Psychometric Properties of the Instrument

The new health literacy instrument demonstrated good internal consistency, with a Cronbach's alpha of 0.81 for the 51-item scale. The psychometric properties of the individual items from the final testing with the instrument – as evaluated by Item Response Theory analysis – are shown in Table 21. All of the items had discrimination values above 0.30 (good), except for one media literacy item (covering the National Cancer Institute's melanoma skin cancer website). However, since the same media literacy question covering a different section (on Gardasil) had a high discrimination value (1.21), and because this was an important question to the construct of media literacy (about authorship credibility), this item was retained. Most of the items (76%) had discrimination values above 0.60

(which are considered very good, (Wise, 2012)). Almost all of the items had negative difficulty values, indicating they were somewhat easy for this college student population, with an average difficulty value of -1.35. As the table illustrates, only a small number of items would be considered somewhat difficult items (with positive values) – two comprehension questions, two media literacy questions, and one digital literacy question (GOUT8, GOUT11, CANCER3, GARDML2, and SCENUSE2).

On average, respondents answered 70% of the items correctly. A full analysis of the final scores, including a demographic breakdown, is included in the section on “Final Scores.”

**Table 21.** IRT psychometric properties of final health literacy items

Question Item	Difficulty	Discrimination	% Correct
<b>Comprehension</b>			
Sentence Verification GOUT1	-2.73	1.00	92
Sentence Verification GOUT3	-0.22	0.88	54
Sentence Verification GOUT4	-0.35	0.87	57
Sentence Verification GOUT6	-1.31	0.52	66
Sentence Verification GOUT8	0.90	0.71	36
Sentence Verification GOUT9	-3.07	0.42	78
Sentence Verification GOUT11	0.62	0.54	42
Sentence Verification GOUT14	-4.49	0.61	93
Cloze Technique Cholesterol CLOZE7	-1.34	0.78	72
Cloze Technique Cholesterol CLOZE8	-0.09	1.27	52
Cloze Technique Cholesterol CLOZE9	-0.43	1.27	60
Cloze Technique Cholesterol CLOZE10	-1.17	1.98	81
Cloze Technique Cholesterol CLOZE11	-0.80	1.48	70
Cloze Technique Cholesterol CLOZE12	-1.13	2.59	83
Cloze Technique Cholesterol CLOZE13	-0.99	1.46	74
Cloze Technique Cholesterol CLOZE14	-0.97	1.12	70
Cloze Technique Cholesterol CLOZE15	-0.74	1.46	68
Cloze Technique Cholesterol CLOZE16	-0.88	1.71	73
Cloze Technique Cholesterol CLOZE17	-1.08	1.96	79
Cloze Technique Cholesterol CLOZE18	-0.93	1.63	74
<b>Numeracy</b>			
Basic 1: Understanding instructions	-2.08	1.00	85
Basic 2: Understanding missing info	-2.05	0.39	68
Basic 4: Understanding instructions/food	-4.60	0.46	88
Computational 4: Missing # information	-3.51	0.62	88
Computational 5: Division	-3.22	1.19	96
Analytical 1: Percent to ratio	-1.14	1.40	77
Analytical 2: Making sense of different	-2.68	0.45	76

Question Item	Difficulty	Discrimination	% Correct
units			
Analytical 3: Calculating probability	-2.28	0.62	79
Analytical 4: Calculating percent	-1.10	1.90	79
Statistical 5: Calculating risk	0.03	1.11	49
Statistical 6: Calc risk based on previous	-0.43	0.99	59
<b>Media Literacy</b>			
Melanoma Skin Cancer (NCI)			
CNCER1: Purpose of the message	-2.42	1.00	89
CNCER2: Authorship	-2.53	1.50	95
CNCER3: Authorship credibility	1.85	0.25	39
CNCER5: When info last updated	-2.42	0.89	87
Gardasil (Advertisement for Gardasil)			
GARDML1: Purpose of message	-1.39	1.21	79
GARDML2: Authorship	0.61	0.68	41
GARDML3: Authorship credibility	-0.09	1.21	52
GARDML5: When info last updated	-1.89	3.16	95
<b>Health-information Seeking</b>			
DLSEARCH: Have you searched for health info	-1.66	1.00	80 (have searched for info)
DLDIFFCT: How difficult to find info	-0.51	2.25	66 (did not find difficult)
DLFIND: Able to find answers to health questions	-0.13	3.52	54 (able to find answers)
DLSCORET: Use of digital applications	-0.78	0.32	56 (have used apps)
WEBDLT: Main health websites used	-3.41	0.33	75 (have used websites)
<b>Digital Literacy</b>			
DLSOURCE: Source of website's funding	-0.29	1.00	56
DLRUNWEB: Who runs a website	-1.66	0.99	80
DLPURPS: How can you tell website's purpose	-1.70	1.22	84
DLORIGNL: Original source of website's info	-0.51	0.57	57
DLCURRNT: How current info is on website	-0.54	0.99	61
SCENUSE2: Usefulness (Not very useful)	1.30	0.49	35
SCENUSE3: Usefulness (Very useful)	-6.30	0.36	90

## Model Fit

Similar to the pretest, the factors – comprehension, numeracy, media literacy, health-information seeking, and digital literacy – were modeled separately based on confidence that each construct (factor) included a very different set of questions that seemed to clearly belong in separate categories. However, initially four factors were considered in the pretest, but results from the pretest indicated that the questions in the



digital literacy group clearly belonged to two separate factors: digital literacy and personal health-information seeking (as one section included correct/incorrect questions and the other included personal informational questions). Therefore, five factors were again modeled with the results from testing the final version of the instrument. The goodness-of-fit indices of these final models are presented in Table 22. As illustrated, none of the final models fit well according to these indices. The comprehension and media literacy models fit the best, with the other models fitting very poorly. However, as noted above, the discrimination values of the individual items from the IRT analysis – which were assessed as part of the five separate factors – are all relatively good (with the exception of one media literacy item).

**Table 22.** Goodness-of-fit indices for five skill-set area of health literacy instrument

<b>Factor Model</b>	<b>CFI</b>	<b>TLI</b>	<b>RMSEA</b>
Comprehension	0.73	0.70	0.08
Numeracy	0.14	0.05	0.12
Media literacy	0.75	0.67	0.07
Health-information seeking	0.56	0.26	0.21
Digital literacy	0.12	0.24	0.09
Overall model	0.68	0.67	0.04

## **Validity**

### **Correlation of new instrument with S-TOFHLA.**

As hypothesized, Pearson correlations between the health literacy domains of the new instrument and the S-TOFHLA were overall fairly low, with the highest correlation with the comprehension section, which was 0.35. The remaining correlations with the S-TOFHLA were 0.22 for numeracy, 0.27 for media literacy, 0.07 for health-information seeking, and 0.25 for digital literacy (Table 23). The overall new health literacy instrument

had a correlation of 0.38 with the STOFHLA. The results of these correlations and comparisons help support the convergent validity and discriminant validity of the instrument (that the comprehension section would have the highest correlation with the S-TOFHLA, followed by media literacy, digital literacy, and numeracy, and finally health-information seeking – showing the order of expected reading skills involved).

**Table 23.** Correlations of health literacy domains and S-TOFHLA

Scale	Overall	Comprehension	Numeracy	Media literacy	Health-info seeking	Digital literacy
Comprehension	0.86**	1.00				
Numeracy	0.70**	0.44**	1.00			
Media literacy	0.66**	0.41**	0.41**	1.00		
Health-info seeking	0.24**	0.11*	0.09	0.08	1.00	
Digital literacy	0.56**	0.30**	0.29**	0.37**	0.04	1.00
S-TOFHLA	0.38**	0.35**	0.22**	0.27**	0.07	0.25**

\* p<.05; \*\* P<.01

#### **Association with other measures.**

Ten stepwise linear regressions were run with each health-related measure with both the new instrument and with the S-TOFHLA. The health-related measures were as follows:

- HEALTH: Self-reported health status.
- HRQL: Health-related quality of life score (how often participant feels sad, nervous, fidgety, and/or hopeless).
- PAIN-FREE: The number of pain-free days the participant experienced over the past month.
- ENERGY: The number of days the participant felt full-of-energy over the past month.
- TOBACCO USE: Score on participant's past and present use of tobacco products.

- **PARTICIPATION:** Whether the participant participated in any physical activities over the past month.
- **EXERCISE SCORE:** How often participant exercises per week (number of times per week X number of minutes exercised per typical workout).
- **ALCOHOL:** Amount of alcohol consumed over the past month (number of days alcohol consumed X number of drinks typically consumed per day).
- **BMI:** Amount of body fat determined through calculation based on weight and height.
- **FLU:** Whether the participant obtained a flu shot within the past 12 months.

In the analyses with the new instrument, each health-related variable was entered as the dependent variable, and then the comprehension score was entered into the first block of the independent variables, followed by numeracy score in the second block, media literacy score in the third block, digital literacy score in the fourth block, and health-information seeking in the fifth block. This order was chosen because comprehension is the most well established concept of health literacy, followed by health numeracy, and the other three are relatively new variables in the health literacy construct. In the analyses with the S-TOFHLA, each health-related variable was entered as the dependent variable, and the S-TOFHLA score was entered as the only independent variable.

The results showed that the new instrument had statistically significant  $R^2$  values for the following outcome variables: health-related quality of life, exercise score, participation in physical activities, and alcohol consumption. The S-TOFHLA had a statistically significant  $R^2$  value with just one outcome variable – participation in physical activities – but the result was not as robust as it was with the new instrument. These

results are presented in Tables 25-28. Neither instrument showed a significant  $R^2$  for health status, tobacco use, energy, flu shot, BMI, or number of pain-free days.

In terms of effect sizes, the new instrument had small-medium effect sizes with the five health-related variables mentioned above, while the S-TOFHLA only had small effect sizes with one of the variables (exercise participation). According to Cohen, an effect size of .10 - .30 is considered small to medium, and less than .10 is considered trivial (Cohen, 1992). These values can be seen in Table 24.

**Table 24.** Effect sizes (n=400)

<b>Health-related behavior</b>	<b>New Instrument <i>r</i></b>	<b>S-TOFHLA <i>r</i></b>
Health-related quality of life	.16	.02
Exercise participation	.19	.11
Exercise frequency	.20	.01
Alcohol consumption	.23	.09

Overall, the results show that there is good criterion-related validity between the new instrument and health-related quality of life, amount of alcohol consumption, participation in physical activities and amount of exercise. The new instrument shows better overall predictive validity with these health-related measures than the S-TOFHLA.

**Table 25. Hierarchical Regression Analysis on Health-Related Quality of Life (n=400)**

<b>Instrument</b>	<b><math>\beta</math></b>	<b>R<sup>2</sup></b>	<b>F</b>	<b><math>\Delta R^2</math></b>	<b>F Change</b>
<b>New Instrument</b>					
Comprehension	-.029	.001	.331	.001	.331
Comprehension Numeracy	-.104 .171**	.024**	4.956	.024	9.573**
Comprehension Numeracy Media Literacy	-.094 .181** -.035	.025*	3.430	.001	.393
Comprehension Numeracy Media Literacy Digital Literacy	-.095 .180** -.037 .006	.025*	2.569	.000	.012
Comprehension Numeracy Media Literacy Digital Literacy Health-information seeking	-.096 .179** -.038 .006 .016	.026	2.071	.000	.103
<b>STOFHLA</b>	.018	.000	.125	.000	.125

\*p &lt; .05; \*\*p &lt; .01

**Table 26. Hierarchical Regression Analysis on Participation in Exercise (n=400)**

<b>Instrument</b>	<b><math>\beta</math></b>	<b>R<sup>2</sup></b>	<b>F</b>	<b><math>\Delta R^2</math></b>	<b>F Change</b>
<b>New Instrument</b>					
Comprehension	-.144**	.021**	8.368**	.021	8.368*
Comprehension Numeracy	-.192** .111*	.030**	6.235**	.010	4.039*
Comprehension Numeracy Media Literacy	-.189** .114* -.012	.031**	4.162**	.000	.044
Comprehension Numeracy Media Literacy Digital Literacy	-.198** .105 -.031 .071	.035**	3.558**	.004	1.724
Comprehension Numeracy Media Literacy Digital Literacy Health-information seeking	-.196** .107 -.030 .071 -.028	.036*	2.905*	.001	.315
<b>STOFHLA</b>	-.110	.010*	4.900*	.010	4.900*

\*p &lt; .05; \*\*p &lt; .01

**Table 27. Hierarchical Regression Analysis on Exercise Frequency (n=400)**

Instrument	$\beta$	R <sup>2</sup>	F	$\Delta R^2$	F Change
<b>New Instrument</b>					
Comprehension	-.001	.000	.000	.000	.000
Comprehension Numeracy	-.001 .000	.000	.000	.000	.000
Comprehension Numeracy Media Literacy	-.011 -.010 .037	.001	.129	.001	.388
Comprehension Numeracy Media Literacy Digital Literacy	-.011 -.010 .037 .000	.001	.097	.000	.000
Comprehension Numeracy Media Literacy Digital Literacy Health-information seeking	-.024 -.025 .036 -.003 .196**	<b>.039*</b>	2.925*	.038	14.225**
<b>STOFHLA</b>	.015	.000	.086	.000	.086

\*p &lt; .05; \*\*p &lt; .001

**Table 28. Hierarchical Regression Analysis on Amount of Alcohol Consumed (n=400)**

Instrument	$\beta$	R <sup>2</sup>	F	$\Delta R^2$	F Change
<b>New Instrument</b>					
Comprehension	-.083	.007	2.246	.007	2.246
Comprehension Numeracy	-.034 -.114	.018	2.892	.011	3.521
Comprehension Numeracy Media Literacy	-.020 -.102 -.048	.019	2.120	.002	.585
Comprehension Numeracy Media Literacy Digital Literacy	-.012 -.091 -.020 -.089	.026	2.129	.006	2.132
Comprehension Numeracy Media Literacy Digital Literacy Health-information seeking	-.030 -.106 -.018 -.092 .161**	<b>.051*</b>	3.432	.025	8.446**
<b>STOFHLA</b>	-.099	.010	3.242	.010	.073

\*p &lt; .05; \*\*p &lt; .01

## Scoring the New Instrument

Although measures developed using Item Response Theory can be accomplished using special IRT software, this software may not be widely available in practice, making it impractical. Another option for scoring is to calculate the number of items correct, which is what was done here. The total score possible – determined by counting the number of correct items (or number of times a website or application is used in the health-information seeking section) – was 51 for the whole assessment. The skill areas can also be separately scored, with total possible scores of 20 for comprehension, 11 for numeracy, 8 for media literacy, 5 for health-information seeking, and 7 for digital literacy.

The mean score from the final test was 34.72 with a range of 15 to 47. The comprehension mean score was 13.74 with a range of 5 to 20; the numeracy mean score was 8.46 with a range of 2 to 11; the media literacy mean score was 5.76 with a range of 1 to 8; the health-information seeking mean score was 3.32 with a range of 0 to 5; and the digital literacy mean score was 4.63 with a range of 1 to 7.

Comparisons for race and school year were also evaluated by regressing race on final scores and school year on final scores with an alpha level of .05 ( $n = 400$ ). The results revealed that there were no significant differences in scores for race, except for Asian students, who scored about 3.5 points less than White students on the health literacy test,  $\beta = -3.45$ ,  $t(389) = -2.00$ ,  $p = .046$ . However, there were only 15 Asian students (3.8%) in the study population. Results by school year, however, indicated that juniors and seniors scored about 2.5 points more than freshmen students on the health literacy test, with sophomores not scoring significantly different from freshmen,  $\beta = 2.33$ ,  $t(392) = 2.78$ ,  $p = .006$  for juniors;  $\beta = 2.54$ ,  $t(392) = 2.98$ ,  $p = .003$  for seniors.

## Discussion

### Overview

This new health literacy assessment – for measuring skills in college students – is a more comprehensive instrument for measuring health literacy than the current leading health literacy assessment tools. The new instrument reflects a range of tasks and skills that are necessary for navigating the current U.S. health care system. There is an emerging consensus in the literature regarding the expanded scope of the health literacy construct, and this is now widely recognized today by organizations such as the World Health Organization and the U.S. Department of Health and Human Services. The expanded concept includes comprehension (at a more appropriately advanced level than measured by the existing tools), health numeracy, media literacy, digital literacy, and Internet health-information seeking skills.

The current leading tools – such as the TOFLHA and the REALM – mainly measure comprehension, and only do so at a very basic level akin to assessing Basic English language proficiency. More advanced reading skills are needed to understand the kinds of public health materials available from websites such as WebMD or the National Cancer Institute. And health literacy is now widely recognized as a concept that goes beyond reading comprehension. The TOFHHA includes a numeracy component, but like its comprehension measure, it's very basic and does not reflect the more advanced skills that adults are likely to face in their daily lives in the context of the U.S. health care system. There are other specialized tools for measuring health numeracy, such as the Newest Vital Sign and the Medical Data Interpretation Test, but these tools are lacking in one or more



skills-based areas of the entire concept of health numeracy. And there are no known specialized tools for measuring health media literacy, digital health literacy, Internet health-information seeking skills, or their effective combination.

The new instrument fills an existing gap and includes a comprehensive assessment of skills relevant to the new health literacy construct framework outlined in this report. In summary, the instrument includes the following: A comprehension component, which includes two measures of reading skills, unlike most known instruments that only include one. Education researchers suggest using multiple measures to assess reading comprehension to account for the different kinds of comprehension and brain processes that take place during comprehension (Marcotte & Hintze, 2009; Spear-Swerling, 2006). The two measures include more advanced evaluations of reading comprehension to reflect the kinds of skills needed for understanding materials available on public health websites, such as WebMD or the National Institutes of Health. It also includes a health numeracy component that assesses for basic, computational, analytical, and statistical skills relevant to understanding the U.S. health care system. Other known health numeracy instruments typically focus on specific components of the health numeracy construct, but do not include an assessment of all four of these numeracy skills. The media literacy assessment encompasses the main media literacy skills outlined by the National Association for Media Literacy through an evaluation of two different health website passages. No known instruments have been created specifically for measuring health media literacy. The digital health literacy component includes an assessment of Internet skills for understanding and navigating health websites. Although young adults -- especially college students -- may be impressively technologically literate in today's digitally advanced environment, some

researchers and educators today say there is increasing evidence in the classroom that shows that students are less information savvy than earlier generations because they do not use technology effectively when they conduct research (Breivik, 2005; Katz, 2007; Rockman, 2004). And many researchers believe that digital literacy skills today are as equally important to people's ability to solve problems and think critically about information as reading and writing skills (Katz, 2007; Partnership for 21st Century Skills, 2003). Since about 81% of Americans use the Internet, and 80% of those users look for health information online (Pew Internet and American Life Project, 2012), being able to navigate search engines and websites has become increasingly important and it makes sense that digital literacy is considered important to the new expanded concept of health literacy. And finally, the health-information seeking component includes an evaluation of how often personal health information is sought digitally, and the level of difficulty participants have in finding answers to their health-related questions online. The difference between these last two sections – digital health literacy and health-information seeking – is that one component measures the participant's knowledge of health website navigation and the other determines the participant's personal use of health information online.

## **Discussion of Results**

All three of the intended goals for this research were supported: the instrument has good internal consistency; its comprehension section has a modest correlation with the S-TOFHLA, but the other sections have lower correlations with the S-TOFHLA; and it is a

better predictor of some health-related behaviors over the S-TOFHLA for this college student population.

The tool demonstrated good internal consistency, with a Chronbach's alpha of 0.81 for the 51-item test. Chronbach's alpha should generally exceed a value of 0.70 for an instrument to be considered reliable (Bland & Altman, 1997; Santos, 1999). The mean score across the 51-item instrument was 70% correct. This is comparative with the National Assessment of Adult Literacy (NAAL), which was intended so that adults would have a 67% probability of answering the questions correctly (Kutner, Greenberg, Jin, & Paulsen, 2006).

There was good evidence of discriminant validity, supporting the second goal of this study. The new instrument demonstrates a modest correlation with the S-TOFHLA (0.38), with the comprehension section of the new instrument having the highest overall correlation with the S-TOFHLA (0.35) and the other sections ranging from 0.07 to 0.27. Since the S-TOFHLA only measures print reading literacy, the higher correlation with the comprehension section makes sense. It also makes sense that this correlation isn't higher, as the comprehension section in the new instrument uses real-world stimuli as opposed to solely plain language stimuli, and so therefore the readability level in the new instrument's materials is naturally higher than it is in the S-TOFHLA. The new instrument's comprehension section also uses two reading comprehension techniques – the Cloze and the Sentence Verification Technique – while the S-TOFHLA only uses the Cloze technique. The modest correlation suggests some overlap but emphasizes that there are some major differences in the skills being assessed. And the low correlations with the other four sections of the new instrument suggest that these are very different skills from the

traditional measurement of reading comprehension that is often used as a proxy for measuring “health literacy.”

Item Response Theory analysis helped confirm the best question items for the new instrument and all of the final items had good or very good discrimination values, indicating that high-ability participants answered the items correctly more frequently than lower-ability participants.

The new instrument had statistically significant  $R^2$  values for health-related quality of life, exercise frequency, overall participation in physical activities, and alcohol consumption. This is compared to the S-TOFHLA, which only had a statistically significant  $R^2$  value with overall participation in physical activities. When broken down by each individual sub-concept of the new health literacy instrument, different sub-concepts helped predict different health-related behaviors. This may help confirm that no individual sub-concept of health literacy can be used as a proxy for any of the others in predicting health-related behaviors. Each sub-concept provides different information about a person’s health literacy and can help predict different health behaviors. Numeracy provided the highest level of variance explained (among the five sub-concepts of health literacy) for participants’ health-related quality of life score. Comprehension provided the highest level of variance explained for overall participation in physical activities. And while the S-TOFHLA also predicted a significant proportion of the variance in overall participation in physical activities, the new health literacy instrument predicted a higher proportion of the variance (4% as opposed to 1%). Health-information seeking provided the highest level of variance explained for both exercise frequency and alcohol consumption.

However, these results also indicate that not all parts of the comprehensive health literacy concept – at one time – are significantly predicting any of the health measures. Only one to two sub-concepts seem to be significantly contributing to the explanation of each health behavior. And only three out of the five sub-concepts provided significant F-change statistics: comprehension, numeracy, and health-information seeking.

But overall, the new instrument shows better predictive validity in this study with these health-related measures than the S-TOFHLA, which supports the third goal of this study. Further research is needed to support the fourth goal, which was to show that health literacy (as measured by the new instrument or the gold standard) has predictive validity with risk behaviors that are often prevalent in college students. While the new tool did predict a higher level of variance than the S-TOFHLA in health-related quality of life, which included mental health characteristics like amount of sadness and restlessness experienced in the past month; as well as participation in and frequency of exercise; and amount of alcohol consumption – neither tool predicted more than 5% of the variance with any of these behaviors. More research is recommended – particularly with other young adults who represent more educationally and ethnically diverse populations – to see how health literacy is related to these and other health and risk behaviors to better establish the strength of these relationships.

### **Implications for Theory**

Additional analysis of these correlations with health behaviors may help ground this more comprehensive concept of health literacy in behavioral theory. For example, in the

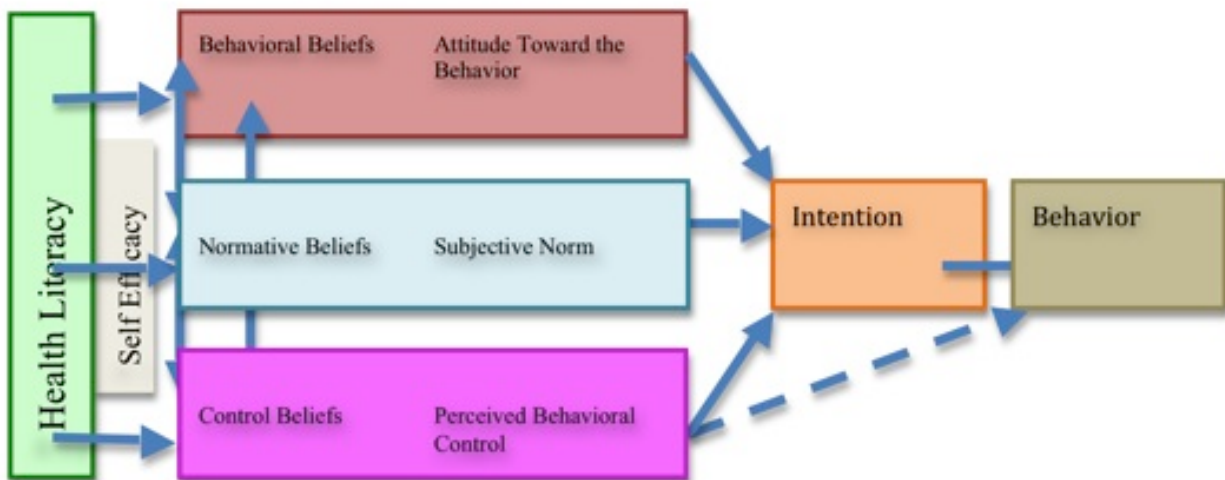
Theory of Planned Behavior – which posits that specific attitudes toward a behavior in question help predict that behavior, and includes the influences of what they think other people’s beliefs will be about the behavior in question, as well as a person’s perceptions on his/her ability to perform a given behavior (Ajzen, 1991) – health literacy may have an impact on a person’s overall beliefs that then lead to their intentions, which may then lead to specific behaviors.

See Figure 1 for a visual of the Theory of Planned Behavior (Ajzen, 2013; Ajzen, 1991). Health literacy could potentially affect behavioral beliefs, normative beliefs, and control beliefs separately or simultaneously. A behavioral belief is the subjective probability that the behavior will produce a specific outcome. I would argue that a belief might only be accessible if the person has the self-efficacy to believe that he/she can effectively and successfully carry out that behavior. And increased self-efficacy may come from an increase in health literacy. For example, if a person feels confident in their ability to search for credible information about different treatment options on the Internet, comprehend that information, analyze the relative risks and benefits associated with each treatment (high self-efficacy in health literacy), then they may feel more comfortable bringing their informed thoughts and concerns about these treatment options to discussion with their health care provider (behavioral intention and behavior).

Health literacy could also affect how realistic a person’s normative beliefs are about carrying out a health behavior. Higher health literacy may result in more rational perceived behavioral expectations of important referent individuals or groups – such as health care professionals, in addition to friends and family. For example, if a person is better able to interpret their test results (part of health literacy), then they might have a

better idea about their doctor’s expectations (normative belief) for the next appropriate steps for their health (intention and behavior).

Control beliefs could also be affected by health literacy. The more a person feels they can successfully find the health information they need to make a decision, or make appropriate comparisons, or use appropriate digital tools to assist them with their diet or exercise regimen (perceived behavioral control) – for example – the more likely they may feel as if they really can lose that weight, or stop smoking, or find a treatment option that works well for their specific needs, etc.



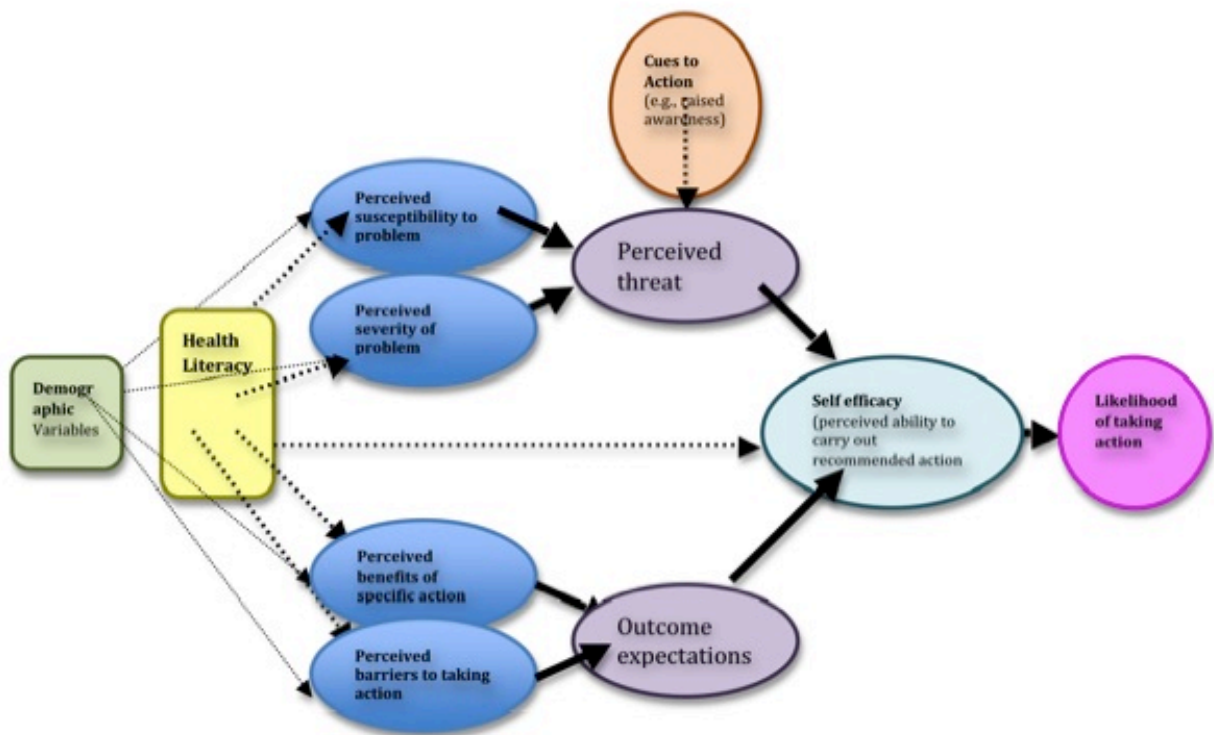
**Figure 1.** Theory of Planned Behavior and Health Literacy.

Or this more advanced concept of health literacy may show some effects on/within the Health Belief Model. The Health Belief Model is based on the understanding that a person will perform a health-related action if he/she 1) feels that a negative health condition can be avoided; 2) has a positive expectation that by taking that health-related

action, he/she will avoid a negative health outcome; 3) and believes that he/she can successfully perform that health-related action (Glanz, Rimer, & Lewis, 2002). The model is based on a person's perceived susceptibility, perceived severity, perceived benefits, and perceived barriers – which represent the perceived threat and net benefits for performing a specific health-related action. It also sometimes includes two concepts that are often added to the model -- cues to action and self-efficacy (University of Twente, 2012). It seems reasonable that health literacy might be a potential predictor or modifying factor of perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. Much like the discussion above about the Theory of Planned Behavior, health literacy might affect how much a person understands about their chances of getting a certain condition (perceived susceptibility), for example; and how serious that condition might be (perceived severity); how effective the proposed treatment might be based on their analysis of risks and benefits (perceived benefits); and an accurate notion of how much diagnostic tests or treatment might cost (perceived barriers). See Figure 2 for a visual on how health literacy might fit into (or effect) the Health Belief Model.

Further analysis of these correlations are needed, but again, may help ground health literacy – with it's five sub-concepts as outlined in this report – in behavioral theory, as the initial results of this study show that there seems to be a link between health literacy and some health behaviors.





**Figure 2.** Health Belief Model and Health Literacy.

### Implications for Practice

Adequate comprehension, health numeracy, media literacy, digital literacy, and health-information seeking skills are fundamental requirements for individual decision making about health care, disease prevention, screening, diagnosis, and treatment. The research reported here on the development of this new instrument for college students highlights the need for continued assessment of health literacy with other groups of young adults who represent diverse populations.

Identifying young adults' strengths and weaknesses with regard to all of these components of health literacy may lead to the development of focused health literacy interventions and potentially could contribute to increasing self-efficacy in health literacy. The new tool could be used to identify both individual as well as whole-population deficiencies. Individuals will be able to see specifically what kinds of questions they missed (e.g., statistical, understanding web page credibility, etc.), and researchers can also use the tool to obtain information about how well particular groups perform (e.g., low-income and underrepresented young adults).

The instrument might be helpful for health literacy initiatives in university settings. The assessment could be administered to freshmen students during their first semester to help students learn which skills they may want to try and improve upon during their academic study. Then the assessment – or a different version of it – could be administered again during the students' final semester to see if they were able to successfully improve upon those skills.

### **Limitations**

This study definitely has some limitations. Purposeful sampling was conducted for both the pretest and final test on young adult college students enrolled in communication courses at only one university. However, the students represented a variety of majors, as these communication courses were for non-communication majors. The pretest also mainly included junior- and senior-level students, but the final test population comprised students almost equally from all four undergraduate grade levels. The study population also only included 18.2% ethnic minorities, but this is fairly close to the Colorado State

University student population of 14% ethnic minorities. Future research is recommended on other young adult populations, both college-educated and not – which may also provide more information on whether the results from this instrument are related to education level. Although according to the Institute of Medicine, patient health literacy can potentially provide more information about a person’s health status than their education level (Institute of Medicine, 2004). Second, none of the study participants demonstrated inadequate or marginal print literacy as measured by the S-TOFHLA, which may raise questions regarding the generalizability of the findings. However, as mentioned in the literature review, the S-TOFHLA only measures elementary reading skills akin to measuring Basic English proficiency. More advanced skills are needed for navigating the current U.S. health care system than what the S-TOFHLA measures. And the college student population tested in this study was expected to have high scores on the S-TOFHLA, but not necessarily have all of the more advanced skills – as measured by the new instrument – that are needed for successful navigation of the U.S. health care system.

The goodness-of-fit indices were also not robust for any of the five skill sets of health literacy. Pretest values were overall higher than the final test values, which may be due to the sample size difference (pretest sample size of 144 and final test sample size of 400). The media literacy section had the highest CFI and TLI values from the pretest (CFI 0.880, TLI 0.841). The comprehension section had the second highest values from the pretest (CFI 0.80, TLI 0.78), and would have been even higher if the SVT technique questions had been eliminated (CFI 0.95, TLI 0.94). However, I chose to leave in the SVT technique questions so that two measuring techniques were included for evaluating comprehension. This decision was made based on recommendations from the education

literature on including more than one measuring technique for assessing comprehension in testing. Future research on other possible comprehension measuring techniques may be beneficial for improving this measurement tool. The health-information seeking pretest values were fair (CFI 0.80, TLI 0.67), but the other two sections – digital literacy and numeracy – had fairly poor goodness-of-fit indices. And as mentioned above, the fit values for all five sections of the final test were lower than they were for the pretest, with the highest values remaining in the comprehension and media literacy sections. This could be a result of the well-established techniques that were used in formulating the questions in these two particular sections. The comprehension section consisted of two well-established techniques from the reading comprehension literature – the Cloze technique and the Sentence Verification Technique – and the media literacy section consisted of questions that were formulated based on the National Association of Media Literacy Education’s framework for evaluating media literacy. The other three sections included questions based on the extensive literature review and explication provided in this report, but because they are relatively new areas of measurement, they were not based on specific, well-established measurement techniques. Instead they include new types of questions. Future research and analysis on question types and measurement techniques in these three areas – numeracy, digital literacy, and health-information seeking – is recommended.

The finding that the new instrument discriminates best at a lower-than-average level for all five sub-concepts of health literacy limits the ability to distinguish skill level at the higher end of health literacy, which might be desirable for identifying those who understand more conceptually complex concepts from those who only understand the basic concepts needed for effective navigation of the health care system. However, it

reinforces the instrument's ability to identify those who may be particularly at risk due to low health literacy.

Finally, only four health education experts – all from Colorado State University – reviewed the questions created for this instrument. Additional experts, and perhaps from other institutions and health care clinics, may have provided more or different analyses of the questions that were chosen for inclusion in the instrument. Nevertheless, these four reviewers were all well-qualified health education experts with doctoral degrees related to medicine, public health, or health education.

### **Opportunities for Future Work**

There are several opportunities for future work with this new instrument. Next steps might include creating a shorter form of the assessment that takes less time. Or it's also possible to create a computer-adapted version of the tool since IRT methods were used to develop the instrument. A CAT version would use a computer-generated algorithm to determine which subsequent question items should be given to each participant, based on whether he/she answers the previous item correctly (much like the SAT or GRE). This approach can greatly decrease the overall time burden on participants, as they wouldn't need to necessarily answer every question, but rather answer a few initial items in each section (and subsection) to estimate their ability level to help identify which remaining items should be administered. This could be particularly helpful in the comprehension and numeracy sections. However, the media literacy, digital literacy, and health-information seeking sections all include a limited amount of specific questions that may not necessarily

make sense to eliminate because answering one question correctly may not be indicative of potentially answering another question in that section correctly.

The instrument should also be tested on other young adult populations located around the country (and perhaps around the world) to assess the differences between college students and young adults who have not attended university. The more data that is gathered using the comprehensive instrument will also help identify the demographic differences in functional health literacy among groups.

Other health and risk behaviors – such as drug use, reckless driving, and safe sex – should also be examined among different young adult groups for their correlation with health literacy. The more that is understood about health literacy’s potential influence or connection with health behaviors, the more likely we can see whether health literacy is rooted in – or influences – behavior theories. And health literacy desperately needs more of a theoretical base for future research.

**Patient health literacy is just one component.**

Health literacy is also not just about the patients. That is, it’s not just about a patient’s skills and knowledge, but should include the entire health system involved in a patient’s care (Rudd, 2010). This means that health care professionals and the activities of health systems are also important for closing the gap on literacy-related barriers to health. Patient health literacy is definitely a major portion of the health literacy problem, but to ensure access to accurate and usable health information, health professionals should also be involved and take action.

A recent case study with 199 patients evaluated the effects of improved communication by physicians with patients and showed that better physician-patient communication resulted in shorter hospital stays (by 1 day), a reduction in post-surgery heart problems (by 15%), a faster transfer rate to less-intensive care levels, and an overall higher rating of quality health care by the patients (Trummer, Mueller, Nowak, Stidl, & Pelikan, 2006). However, research shows that doctor-patient communication and relationship skills could use some improvement. In a qualitative interview study conducted with 33 medical students and 15 medical faculty members, the students reported that the instruction of physician-patient relationship and communication skills was highly variable, rarely explicit, and primarily dependent on role modeling. The faculty also noted that the teaching of these skills could be improved (Egnew & Wilson, 2010).

Therefore, future research in health literacy should also involve an examination of the other components that can help patients improve their understanding of health, such as the written materials in use, the guidelines and procedures currently in place, and health professionals' communication skills.

## **Conclusion**

In conclusion, the new instrument consists of five sub-concepts of health literacy which have been identified as important for understanding health information and making appropriate health care decisions, and it contains question items that have been reviewed by health education experts and selected based on good Item Response Theory discrimination parameters. It's recommended for research use in measuring health literacy in young adult populations, especially college students, to help identify deficiencies and strengths in the sub-concepts of health literacy.

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## Appendix A: Advantages and disadvantages of existing health literacy assessment tools

NAME	Brief description	Reliability and Validity	Advantages	Disadvantages and missing health literacy concepts
REALM	<p>Word recognition test that consists of common medical words. Patients read the words aloud and are scored on how well they pronounce each word.</p>	<ul style="list-style-type: none"> <li>• Creators obtained a Chronbach's alpha of 0.96 for test-retest reliability.</li> <li>• REALM correlates well reading assessments from education field: Peabody Individual Achievement Test-Revised (0.97); the Slossan Oral Reading Test (0.96); and the Wide Range Achievement Test-Revised (0.88).</li> <li>• Content validity and face validity were established by authors, and were reportedly based on the selected of health-related words.</li> </ul>	<ul style="list-style-type: none"> <li>• Quick and easy to administer and score (takes 3-5 minutes)</li> <li>• Uses health-related words, so useful in health care settings</li> <li>• Has been used widely in health communication literature</li> <li>• Criterion validity is well established (see correlations with other tests).</li> </ul>	<ul style="list-style-type: none"> <li>• Test is not based on an underlying conceptual framework.</li> <li>• Test does not measure patient's understanding of the words, but merely their sight-reading ability.</li> <li>• The variations of the REALM assign only grade-range equivalents as scores, but do not point out specific areas of deficit.</li> <li>• The revised version of the REALM (an eight-word recognition test) only identifies those "at risk for poor health literacy" and has not been tested beyond an initial pilot study.</li> <li>• The testing materials focus on material found in medical settings, but do not represent the broad spectrum of health materials that occur outside of the clinical setting.</li> <li>• The test does not measure numeracy, media literacy, or computer literacy.</li> </ul>
TOFHLA	<p>The "gold standard" of health literacy testing. Consists of two sections: a 50-item reading comprehension test and a 17-item numeracy test.</p> <p>Reading test consists of three health-related passages with every 5<sup>th</sup>-7<sup>th</sup> word deleted.</p> <p>Numeracy section involves participants' reading numbers on prescription bottles and appointment slips, and then being asked orally by the administrator about the information they just read.</p>	<ul style="list-style-type: none"> <li>• Criterion validity of the TOFHLA was shown by demonstrating correlations with the REALM and WRAT-R – they were 0.84 and 0.74, respectively (p&lt;.0001).</li> <li>• Creators obtained a Chronbach's alpha of 0.96 for test-retest reliability.</li> </ul>	<ul style="list-style-type: none"> <li>• Available in both English and Spanish.</li> <li>• Has strong reliability and validity data available for the English version.</li> <li>• Measures both comprehension and numeracy skills (although both are limited).</li> <li>• Reading passages are at different reading levels.</li> </ul>	<ul style="list-style-type: none"> <li>• Test is not based on an underlying conceptual framework.</li> <li>• The test is timed, which therefore may be testing more on reading speed than just comprehension.</li> <li>• There is no reliability or validity data available for the shortened versions of the TOFHLA (which seem to be used most often in the literature).</li> <li>• There is no validity data for the Spanish version.</li> <li>• The testing materials focus on material found in medical settings, but do not represent the broad spectrum of health materials that occur outside of the clinical setting.</li> <li>• The test only uses one assessment of comprehension, yet education scholars recommend using more than one method.</li> <li>• The test does not thoroughly measure numeracy (only tests very basic math</li> </ul>

NAME	Brief description	Reliability and Validity	Advantages	Disadvantages and missing health literacy concepts
				skills). <ul style="list-style-type: none"> <li>Does not assess media literacy or computer literacy.</li> </ul>
WRAT	WRAT is a literacy test, but not specific to health literacy; however, the test is often referred to as a possible literacy measurement in health care contexts.  Consists of three subtests: reading recognition, spelling, and arithmetic.	<ul style="list-style-type: none"> <li>The test correlates well with the Peabody Individual Achievement Test (0.98), another educational test for measuring general literacy.</li> <li>The revised version (WRAT-R) has test-retest reliability coefficients that range from 0.79 to 0.97, with high correlations (between 0.91 and 0.99) between the WRAT and WRAT-R.</li> </ul>	<ul style="list-style-type: none"> <li>Reading section uses two methods to assess comprehension (letter reading and oral word reading). Although this test is essentially substituting oral word recognition (verbal fluency) for reading comprehension.</li> <li>Includes a math component.</li> <li>Test is easy to administer and score.</li> </ul>	<ul style="list-style-type: none"> <li>Besides comprehension, this test does not take most of the health literacy concepts into account.</li> <li>The comprehension section is mainly assessed through verbal fluency, but not actual reading comprehension.</li> <li>The numeracy section only assesses basic arithmetic skills, and not in a health context.</li> <li>The test does not contain any health-related context.</li> </ul>
OHLI	Oral health literacy assessment based on TOFHLA for measuring dental knowledge.  Tests reading comprehension based on cloze technique Tests numeracy through questions about taking common prescriptions associated with dental treatment (same format as TOFHLA).	<ul style="list-style-type: none"> <li>Internal reliability Chronbach's alpha &gt;.07.</li> <li>Test-retest reliability Chronbach's alpha &gt;.06 (retest 3-6 months later).</li> <li>Construct validity tested by correlating with TOFHLA. OHLI and TOFHLA = 0.613 (p&lt;.001).</li> </ul>	<ul style="list-style-type: none"> <li>Specific to dental knowledge for use in dentists office</li> </ul>	<ul style="list-style-type: none"> <li>Test is not based on an underlying conceptual framework.</li> <li>Does not assess media literacy or computer literacy.</li> <li>And very limited measurement of numeracy.</li> <li>Comprehension section only uses one assessment method (based on TOFHLA).</li> </ul>
Newest Vital Sign	Six-question numeracy test	<ul style="list-style-type: none"> <li>Reliability Chronbach's alpha = 0.76 for English version and 0.69 for Spanish version</li> <li>Criterion validity was assessed by calculating the correlation between the TOFHLA and the NVS (r = 0.69, p &lt; .001 for English version; r = .49 for Spanish version).</li> </ul>	<ul style="list-style-type: none"> <li>Quick to administer and score (takes 3 minutes).</li> </ul>	<ul style="list-style-type: none"> <li>Test is not based on an underlying conceptual framework.</li> <li>Their test measures reading and numeracy interpretation skills, but does not measure media or computer literacy.</li> <li>Does not test all aspects of numeracy.</li> </ul>
Korean Health Literacy Scale	Test specifically developed for testing health literacy in Korean adults, based on the TOFHLA.	<ul style="list-style-type: none"> <li>Reliability Chronbach's alpha = 0.833 (0.844 for comprehension of the graphic and numeracy sections and 0.816 for identification of health-related terms in the cloze technique).</li> <li>Construct validity was assessed by categorizing question items into a two-factor solution. Internal</li> </ul>	<ul style="list-style-type: none"> <li>Provides additional assessment of interpretation of graphics. And provides a Korean-specific health literacy measure for Korean adults.</li> </ul>	<ul style="list-style-type: none"> <li>Test is not based on an underlying conceptual framework.</li> <li>Does not measure media literacy, or computer literacy.</li> <li>Reading and numeracy sections have the same problems as the traditional TOFHLA (comprehension section uses only one method of assessment and numeracy section only assesses very</li> </ul>

NAME	Brief description	Reliability and Validity	Advantages	Disadvantages and missing health literacy concepts
		<p>consistency for the total two-factor structure was 0.891.</p> <ul style="list-style-type: none"> <li>No concurrent validities were established for this test.</li> </ul>		<p>basic math).</p>
Bilingual Multimedia Talking Touchscreen	<p>A computer assessment tool based on the TOFHLA, NALS, and NAAL that tests three areas of health literacy: comprehension via a cloze technique, ability to make sense of images, and numeracy.</p>	<ul style="list-style-type: none"> <li>No quantitative data was reported on validity or reliability. However, the authors claim the tool has good content validity because it covers a wide range of topics that are relevant to primary care patients.</li> <li>The authors also found that the overall questions included in the assessment tool showed a wide range of item difficulties (proportion correct from their pilot testing), ranging from 22 percent to 96 percent.</li> </ul>	<ul style="list-style-type: none"> <li>Available in both English and Spanish.</li> <li>Tests users' knowledge of health-related images in addition to prose and numeracy.</li> </ul>	<ul style="list-style-type: none"> <li>Does not measure media literacy.</li> <li>Only uses one assessment method to measure comprehension.</li> <li>Limited measurement of computer literacy.</li> </ul>
Brief screening questions for identifying inadequate health literacy	<p>Three questions that can identify about 80 percent of adult patients with inadequate health literacy (as would be found by using the STOFHLA).</p>	<ul style="list-style-type: none"> <li>Unknown</li> </ul>	<ul style="list-style-type: none"> <li>Screening questions can be asked quickly and allow clinical staff to get an idea of a patient's health literacy needs almost immediately. This may be helpful as an initial assessment before going into more in-depth health literacy assessments.</li> </ul>	<ul style="list-style-type: none"> <li>Does not comprehensively assess health literacy at all.</li> </ul>
SIRACT	<p>Cancer-specific health literacy tool that tests patients' comprehension at the passage level (rather than sentence level).</p>	<ul style="list-style-type: none"> <li>Tool has not been tested for reliability and validity yet.</li> </ul>	<ul style="list-style-type: none"> <li>Cancer-specific for cancer patients. Also provides more descriptive information about patients' level of literacy (independent, needs instruction, or at a level of frustration).</li> <li>Takes 10 minutes to administer.</li> </ul>	<ul style="list-style-type: none"> <li>Does not test numeracy, media literacy, or computer literacy.</li> </ul>
REALD-99	<p>Dentistry-specific word recognition test based on the REALM.</p>	<ul style="list-style-type: none"> <li>REALD-99 has a high correlation with the REALM, with a Pearson's correlation coefficient of 0.80, showing high convergent validity.</li> <li>Reliability was 0.86 (Chronbach's alpha).</li> </ul>	<ul style="list-style-type: none"> <li>Dental-specific test on verbal fluency.</li> <li>Takes 5 minutes to administer.</li> </ul>	<ul style="list-style-type: none"> <li>Does not test comprehension, numeracy, media literacy, or computer literacy,</li> </ul>

NAME	Brief description	Reliability and Validity	Advantages	Disadvantages and missing health literacy concepts
Medical Data Interpretation Test	Assessment tool that specifically tests participants' ability to interpret medical statistical information that often appears in public material.	<ul style="list-style-type: none"> <li>• The test demonstrated good repeatability with test and retest scores' correlation of 0.67. The test also had good internal reliability with a Chronbach's alpha of 0.71.</li> <li>• Construct validity was supported through pilot study results (the authors compared participants' scores on a subset of questions from the NALS and a previously created 3-item numeracy scale and found that people with high scores on the Medical Data Interpretation Test had high scores on the other tests, and those with low scores on their test had low scores on the other tests); and through 15 physicians' ratings of the test (60 percent thought the test did an excellent or very good job covering the important concepts in reading skills; 73 percent rated the clarity of the test highly; and 86 percent believed that a person getting most of the questions wrong would have very limited ability to interpret medical data).</li> </ul>	<ul style="list-style-type: none"> <li>• Comprehensive examination of participants' ability to interpret medical statistics that might appear in healthcare materials.</li> </ul>	<ul style="list-style-type: none"> <li>• Does not measure comprehension, media literacy or computer literacy.</li> </ul>

## Appendix B: Initial Item Pool of Health Literacy Assessment Questions

### COMPREHENSION SECTION

#### Sentence Verification Technique

##### **DIRECTIONS:**

Read the following passage about gout and uric acid. After reading the passage, you will read another document about gout and uric acid and will be asked to indicate whether each sentence is a “YES” or “NO” sentence. “YES” sentences are defined as sentences that are the same as or mean the same as the original passage sentences. “NO” sentences have a different meaning than the original passage sentences.

##### **GOUT: Original**

##### **GOUT**

*Source: National Institute of Arthritis and Musculoskeletal and Skin Diseases(National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2011)*

Gout is a painful condition that occurs when the bodily waste product uric acid is deposited as needle-like crystals in the joints and/or soft tissues. In the joints, these uric acid crystals cause inflammatory arthritis, which in turn leads to intermittent swelling, redness, heat, pain, and stiffness in the joints.

In many people, gout initially affects the joints of the big toe (a condition called podagra). But many other joints and areas around the joints can be affected in addition to or instead of the big toe. These include the insteps, ankles, heels, knees, wrists, fingers, and elbows. Chalky deposits of uric acid, also known as tophi, can appear as lumps under the skin that surrounds the joints and covers the rim of the ear. Uric acid crystals can also collect in the kidneys and cause kidney stones.

##### **URIC ACID**

Uric acid is a substance that results from the breakdown of purines. A normal part of all human tissue, purines are found in many foods. Normally, uric acid is dissolved in the blood and passed through the kidneys into the urine, where it is eliminated.

If there is an increase in the production of uric acid or if the kidneys do not eliminate enough uric acid from the body, levels of it build up in the blood (a condition called hyperuricemia). Hyperuricemia also may result when a person eats too many high-purine foods, such as liver, dried beans and peas, anchovies, and gravies. Hyperuricemia is not a disease, and by itself it is not dangerous. However, if excess uric acid crystals form as a result of hyperuricemia, gout can develop. The crystals form and accumulate in the joint, causing inflammation.

## **GOUT: Test Sentences**

**DIRECTIONS:** Read each sentence and indicate whether that sentence is a “YES” sentence or a “NO” sentence. “YES” sentences are defined as sentences that are the same as or mean the same as the original passage sentences. “NO” sentences have a different meaning than the original passage sentences.

### **KEY**

O/Y: Original sentence (YES)

P/Y: Paraphrase sentence (YES)

M/N: Meaning change (NO)

D/N: Distracter (NO)

### **GOUT**

1. Gout occurs if too much uric acid builds up in the fluid around the joints and/or soft tissues, resulting in the formation of uric acid crystals in the joints – which is very painful (P/Y). 2. These crystals make the joint swell up and become inflamed causing the joint to appear warm and red and feel very tender and stiff (P/Y).

3. Although rare, sometimes gout affects the joints of the big toe (a condition called podagra) (M/N). 4. But usually other joints and areas around the big toe and other parts of the body are mainly affected (M/N). 5. These include the insteps, ankles, heels, knees, wrists, fingers, and elbows (O/Y). 6. It is more common in men, in women after menopause, and those who drink alcohol (D/N). 7. People who take certain medicines may have higher levels of uric acid in the blood (D/N).

### **URIC ACID**

8. Uric acid is a substance that causes the buildup of purines (M/N). 9. A normal part of all human tissue, purines are found in many foods (O/Y). 10. A relatively small number of foods, however, contain concentrated amounts of purines (D/N). 11. If there is a change in the production of uric acid or if the kidneys eliminate too much uric acid, the body builds up too much uric acid in the blood to compensate (a condition called hyperuricemia) (M/N).

12. Hyperuricemia also may result when a person eats too many high-purine foods, such as liver, dried beans and peas, anchovies, and gravies (O/Y). 13. Hyperuricemia is a disease, but it is hard to spread and not considered dangerous (M/N). 14. When the excess uric acid crystals accumulate in the joints as a result of hyperuricemia they can set the stage for a painful attack of gout (P/Y). 15. The crystals form and accumulate in the joint, causing inflammation (O/Y).



## Metastatic Cancer

DIRECTIONS: Read the following passage about metastatic cancer. After reading the passage, you will read another document about metastatic cancer and will be asked to indicate whether each sentence is a “YES” or “NO” sentence. “YES” sentences are defined as sentences that are the same as or mean the same as the original passage sentences. “NO” sentences have a different meaning than the original passage sentences.

### Metastatic Cancer

Source: American Cancer Society (American Cancer Society, 2011)

Metastatic cancer is a cancer that has spread from the part of the body where it started (the primary site) to other parts of the body. When cancer cells break away from a tumor, they can travel to other areas of the body through either the bloodstream or the lymph system (a collection of vessels that carry fluid and immune system cells).

### The Lymph System

If the cells travel through the lymph system, they may end up in the lymph nodes (small, bean-sized collections of immune cells) or spread to other organs. If the cells travel through the bloodstream they can go to any part of the body. Most often, the cancer cells break off and travel in the bloodstream. Many of these cells die, but some settle in a new area, begin to grow, and form new tumors. This spread of cancer to a new part of the body is called *metastasis*.

In order for cancer cells to spread to new parts of the body, they have to go through several changes. They have to be able to break away from the original tumor and enter the bloodstream or lymph system, which can carry them to another part of the body. At some point they need to attach to the wall of a blood or lymph vessel and move through it into a new organ. They then need to be able to grow and thrive in their new location. All the while, they need to be able to avoid attacks from the body's immune system. Going through all these steps means the cells that start new tumors may no longer be exactly the same as the ones in the tumor they started in. This may make treatment more difficult.

Even when cancer has spread to a new area, it is still named after the part of the body where it started. For example, if prostate cancer spreads to the bones, it is still called prostate cancer (not bone cancer). Likewise, breast cancer that has spread to the lungs it is still called breast cancer, not lung cancer.

Sometimes the metastatic tumors have already begun to grow when the cancer is first found and diagnosed. And in some cases, a metastasis may be found before the original (primary) tumor is found. If a cancer has already spread to many places before it is found, it may be hard to figure out where it started. If this happens the cancer is called *cancer of unknown primary*.

## Metastatic Cancer: Test Sentences

DIRECTIONS: Read each sentence and indicate whether that sentence is a “YES” sentence or a “NO” sentence. “YES” sentences are defined as sentences that are the same as or mean the same as the original passage sentences. “NO” sentences have a different meaning than the original passage sentences.

KEY

O/Y: Original sentence (YES)

P/Y: Paraphrase sentence (YES)

M/N: Meaning change (NO)

D/N: Distracter (NO)

### Metastatic Cancer

Metastatic cancer is the spread of cancer from one organ or part to another non-adjacent organ or part (P/Y). The cells have the ability to break free from the original tumor site and enter the bloodstream or lymph system (a collection of vessels that carry fluid and immune system cells), which spreads the disease to other organs (P/Y).

### The Lymph System

If the cells are suppressed in the lymph system, they may end up in the lymph nodes (small cells that lack a membrane-bound nucleus) or spread to other tissues (M/N). If the cells travel through the bloodstream they can go to about 30 percent of the rest of the body (M/N). Most often, the cancer cells break off and travel in the bloodstream (O/Y). About half of these cells die, and the other half settle in a new area, begin to grow, and form new tumors (M/N). This spread of cancer to a new part of the body is called *metastasis* (O/Y).

When the cancer does spread to other organs it is because of certain genetic changes in the cells that scientists are beginning to recognize (D/N). They have to be able to break away from the original tumor and enter the bloodstream or lymph system, which can carry them to another part of the body (O/Y). At some point, the cancer cells affix themselves to the walls of lymphatic or blood vessels and penetrate through the wall into a new organ (P/Y).

They then need to be able to bind to each other in their new location (M/N). This “homing” pattern may be caused by substances on the cancer cell surfaces that stick to cells in certain organs (D/N). Going through all these steps means the cells that start new tumors may no longer be exactly the same as the ones in the tumor they started in (O/Y). This will make treatment less difficult (M/N).

Even when cancer has spread to a new area, it is still named after the part of the body where it started (O/Y). For example, if breast cancer spreads to the lungs, it is still called breast cancer (not lung cancer) (P/Y). The most common site for colon cancer to spread to is the liver (D/N).

Most people don't realize that cancer is preventable in many cases (D/N). And in some cases, a metastasis may be found before the original (primary) tumor is found (O/Y). Diagnosing where a cancer has started can be difficult if the cancer has already spread to several parts of the body before it is found (P/Y). Learning what causes cancer and what the risk factors are is the first step in cancer prevention (D/N).

## **Chlamydia: Original**

**DIRECTIONS:** Read the following passage about chlamydia. After reading the passage, you will read another document about chlamydia and will be asked to indicate whether each sentence is a "YES" or "NO" sentence. "YES" sentences are defined as sentences that are the same as or mean the same as the original passage sentences. "NO" sentences have a different meaning than the original passage sentences.

### **CHLAMYDIA**

*Source: World Health Organization (World Health Organization, 2011)*

More cases of STD are caused by Chlamydia trachomatis than by any other bacterial pathogen, making *C. trachomatis* infections an enormous public health problem throughout the world. In both men and women, silent, asymptomatic infection is common. The bacterium is transmitted from one partner to another by sexual intercourse. In men, *C. trachomatis* is the commonest cause of non-gonococcal (non-specific) urethritis. Conjunctivitis (that does not progress to blindness) and joint inflammation may occur. Men with asymptomatic infection serve as carriers of the disease, spreading the infection while only rarely suffering long-term health problems. Women, in contrast, are at high risk of severe complications of infection. Acute infection with Chlamydia can result in acute salpingitis and PID, whose long-term consequences include chronic pain, ectopic pregnancy and infertility. Contamination of the hands with genital discharge may lead to a conjunctival infection following contact with the eyes. Babies born to mothers with infection of their genital tract frequently present with chlamydial eye infection within a week of birth (chlamydial "ophthalmia neonatorum"), and may subsequently develop pneumonia. Various studies have estimated that there are four to five million new cases of chlamydial infection each year in the USA alone. Among urban adolescent females, the incidence rate can be as high as 30%. The annual costs of treating and caring for patients with PID might be as high as US\$10 billion.

## Chlamydia: Test Sentences

DIRECTIONS: Read each sentence and indicate whether that sentence is a “YES” sentence or a “NO” sentence. “YES” sentences are defined as sentences that are the same as or mean the same as the original passage sentences. “NO” sentences have a different meaning than the original passage sentences.

### KEY

O/Y: Original sentence (YES)

P/Y: Paraphrase sentence (YES)

M/N: Meaning change (NO)

D/N: Distracter (NO)

More cases of STD are caused by Chlamydia trachomatis than by any other bacterial pathogen, making C. trachomatis infections an enormous public health problem throughout the world (O). In men, but not women, silent, symptomatic infection is common (M). Sexual intercourse can spread the bacterium from one person to another (P). Non-specific urethritis in men is most often caused by Chlamydia trachomatis (P). If you have Chlamydia, your doctor will prescribe oral antibiotics, usually azithromycin or doxycycline (D). Conjunctivitis (which usually progresses to blindness) and inflammation of the colon may occur (M). Men who show no symptoms of infection can still serve as carriers of Chlamydia, even though they may not suffer any long-term health problems themselves (P). Women, in contrast, are at high risk of severe complications of infection (O). Acute infection with genital herpes can result in short-term effects that include painful urination, lesions in the genital region, and inflammation of the anus and rectum (M). After taking antibiotics, people should be retested to be sure the infection is cured (D). Hands can become contaminated by coming in contact with genital discharge, which can lead to conjunctivitis through direct hand-to-eye contact (P). Babies born to mothers with infection of their genital tract frequently present with chlamydial eye infection within a week of birth (chlamydial “ophthalmia neonatorum”), and may subsequently develop pneumonia (O). One study estimated that there are about half a million new cases of sexually transmitted diseases each year in the USA alone (M).

Among urban adolescent females, the incidence rate can be as high as 30% (O). Symptoms for Chlamydia are usually noticeable within one to three weeks of contact (D).

## CLOZE TECHNIQUE

Directions: Fill in the blank in the following sentences from the multiple choice options.

### Sleep Apnea: Cloze Technique

Source: National Heart, Lung, and Blood Institute (National Heart Lung and Blood Institute, 2011)

#### What Is Sleep Apnea?

Sleep apnea (AP-ne-ah) is a common (1) \_\_\_\_\_ in which you have one (2) \_\_\_\_\_ more pauses in breathing or shallow (3) \_\_\_\_\_ while you sleep.

- |                    |              |                   |
|--------------------|--------------|-------------------|
| 1.                 | 2.           | 3.                |
| a. <b>disorder</b> | a. <b>or</b> | a. bleeding       |
| b. treatment       | b. and       | <b>b. breaths</b> |
| c. attack          | c. each      | c. pain           |
| d. remedy          | d. several   | d. nausea         |

Breathing pauses can (4) \_\_\_\_\_ from a few seconds to minutes.

- 4.
- a. begin
  - b. start
  - c. close
  - d. **last**

They often (5) \_\_\_\_\_ 5 to 30 times or more (6) \_\_\_\_\_ hour.

- |                 |              |
|-----------------|--------------|
| 5.              | 6.           |
| <b>a. occur</b> | a. in        |
| b. watch        | b. on        |
| c. feel         | <b>c. an</b> |
| d. quit         | d. at        |

Typically, normal breathing then (7) \_\_\_\_\_ again, sometimes with a loud snort (8) \_\_\_\_\_ choking sound.

- |                  |              |
|------------------|--------------|
| 7.               | 8.           |
| a. beats         | <b>a. or</b> |
| b. closes        | b. in        |
| <b>c. starts</b> | c. around    |
| d. raises        | d. under     |

Sleep apnea (9) \_\_\_\_\_ is a chronic (ongoing) condition that (10) \_\_\_\_\_ your sleep.

- |            |                    |
|------------|--------------------|
| 9.         | 10.                |
| a. never   | a. causes          |
| b. history | <b>b. disrupts</b> |
| c. control | c. pushes          |

**d. usually**

d. collapses

You often move out of deep (11)\_\_\_\_\_ and into light sleep when your (12)\_\_\_\_\_ pauses or becomes shallow.

11.

**a. sleep**

b. reflux

c. history

d. obstruction

12.

a. mouth

**b. breathing**

c. allergy

d. problem

This results in (13)\_\_\_\_\_ sleep quality that makes you tired (14)\_\_\_\_\_ the day. Sleep apnea is one of the (15)\_\_\_\_\_ causes of excessive daytime sleepiness.

13.

a. comfortable

b. stealthy

c. duplicitous

**d. poor**

14.

a. inside

b. outside

c. before

**d. during**

15.

a. tricky

b. sincere

**c. leading**

d. subtle

## HPV: Cloze Technique

Source: Medline Plus (Medline Plus, 2011b)

### HPV

Human papillomaviruses (HPV) are common (1) \_\_\_\_\_ that can cause warts. There are more (2) \_\_\_\_\_ 100 types of HPV.

- |                   |                 |
|-------------------|-----------------|
| 1.                | 2.              |
| a. bacteria       | a. or less than |
| b. <b>viruses</b> | b. virus        |
| c. bugs           | <b>c. than</b>  |
| d. diseases       | d. infectious   |

Most are harmless, but (3) \_\_\_\_\_ 30 types put you at risk for \_\_\_\_\_. These types affect the (5) \_\_\_\_\_ and you get them (6) \_\_\_\_\_ sexual contact with an infected partner.

- |                 |                  |                    |                   |
|-----------------|------------------|--------------------|-------------------|
| 3.              | 4.               | 5.                 | 6.                |
| a. another      | a. <b>cancer</b> | a. <b>genitals</b> | a. under          |
| b. several      | b. treatment     | b. abdomen         | <b>b. through</b> |
| c. instead      | c. an allergy    | c. auxiliary area  | c. over           |
| d. <b>about</b> | d. reflux        | d. dermatitis      | d. despite        |

They are classified as either low-risk or (7) \_\_\_\_\_. Low-risk HPV can cause (8) \_\_\_\_\_.

- |                     |                         |
|---------------------|-------------------------|
| 7.                  | 8.                      |
| a. <b>high-risk</b> | a. breast cancer        |
| b. malignant        | b. <b>genital warts</b> |
| c. dangerous        | c. terminal disease     |
| d. benign           | d. upset stomach        |

(9) \_\_\_\_\_ HPV can lead to cancers of the cervix, vulva, vagina, and anus in (10) \_\_\_\_\_. In men, it can lead to (11) \_\_\_\_\_ of the anus and penis.

- |                     |                 |                   |
|---------------------|-----------------|-------------------|
| 9.                  | 10.             | 11.               |
| a. Benign           | a. the skin     | a. treatment      |
| b. Dangerous        | b. the stomach  | b. <b>cancers</b> |
| c. <b>High-risk</b> | c. people       | c. remedies       |
| d. Malignant        | d. <b>women</b> | d. disorders      |

Although some people develop (12) \_\_\_\_\_ warts from HPV infection, others have (13) \_\_\_\_\_ symptoms. Your health care provider can (14) \_\_\_\_\_ or remove the warts.

- |                |         |                 |
|----------------|---------|-----------------|
| 12.            | 13.     | 14.             |
| a. respiratory | a. some | a. <b>treat</b> |

- b. colorectal
- c. breast
- d. **genital**

- b. regular
- c. special
- d. **no**

- b. watch
- c. stress
- d. infect

In women, (15)\_\_\_\_\_ smears can detect changes in the (16)\_\_\_\_\_ that might lead to cancer.

- 15.
- a. cytologic
  - b. **Pap**
  - c. blood
  - d. skin

- 16.
- a. **cervix**
  - b. larynx
  - c. hepatitis
  - d. patella

Correct usage of (17)\_\_\_\_\_ condoms greatly reduces, but does not (18)\_\_\_\_\_, the risk of catching or spreading (19) \_\_\_\_\_. A vaccine can protect against several (20)\_\_\_\_\_ of HPV, including some that can cause cancer.

- 17.
- a. spandex
  - b. colloidal
  - c. **latex**
  - d. concentrated

- 18.
- a. discourage
  - b. underestimate
  - c. define
  - d. **eliminate**

- 19.
- a. **HPV**
  - b. cancer
  - c. malignancy
  - d. benign tumors

- 20.
- a. **types**
  - b. rolls
  - c. plans
  - d. cells



## High Cholesterol: Cloze Technique

Source: Johns Hopkins Medicine (Johns Hopkins Medicine, 2011)

### High Cholesterol and Triglyceride Levels

While fats (lipids) play a vital role in the body's metabolic processes, high blood levels of fats—a condition known as hyperlipidemia—increase the risk of coronary heart disease.

Two common lipid abnormalities are characterized either by high blood cholesterol levels (hypercholesterolemia) or high blood levels of triglycerides (hypertriglyceridemia). Cholesterol is manufactured primarily in the liver and then carried in the bloodstream by low density lipoprotein (LDL).

(Because cholesterol and other fats do not dissolve in (1)\_\_\_\_\_, they cannot travel through the blood unaided. Lipoproteins are (2)\_\_\_\_\_ formed in the liver to transport cholesterol and other (3)\_\_\_\_\_ through the bloodstream.)

1.	2.	3.
a. alcohol	a. food	a. plaques
<b>b. water</b>	b. a disorder	b. diseases
c. lipids	c. triglycerides	<b>c. fats</b>
d. sugar	<b>d. particles</b>	d. acids

Cholesterol is returned to the liver from other body (4)\_\_\_\_\_ by another lipoprotein, high density lipoprotein (HDL). From there, cholesterol is (5)\_\_\_\_\_ into the bile, either unchanged or after (6)\_\_\_\_\_ to bile acids.

4.	5.	6.
a. limbs	a. revealed	<b>a. conversion</b>
b. quadrants	<b>b. secreted</b>	b. functionalization
<b>c. cells</b>	c. fused	c. fusion
d. organs	d. controlled	d. translocation

Cholesterol is essential for the formation of cell (7)\_\_\_\_\_ and the manufacture of several hormones, but it is not (8)\_\_\_\_\_ from the diet because the liver produces all the (9)\_\_\_\_\_ the body needs.

7.	8.	9.
a. <b>membranes</b>	a. modified	a. cells
b. secretion	b. included	<b>b. cholesterol</b>
c. biochemicals	c. synthesized	c. cytosol
d. sebum	<b>d. required</b>	d. proteins

If blood cholesterol levels are (10)\_\_\_\_\_, large amounts of LDL (so-called “bad”) cholesterol can (11)\_\_\_\_\_ in the arterial walls. These deposits represent the first (12)\_\_\_\_\_ in the narrowing of arteries, termed atherosclerosis.

10.	11.	12.
a. purified	a. evolve	a. membrane
<b>b. elevated</b>	b. fuse	b. gradient
c. produced	<b>c. deposit</b>	<b>c. stage</b>
d. synthesized	d. modify	d. example

Because high (13)\_\_\_\_\_ levels cause no symptoms, preventive measures and regular measurement of (14)\_\_\_\_\_ levels are important for people in high-risk categories. High (15)\_\_\_\_\_ levels are especially dangerous when HDL (“good”) cholesterol levels are low.

13.	14.	15.
<b>a. cholesterol</b>	<b>a. cholesterol</b>	<b>a. cholesterol</b>
b. protein	b. protein	b. protein
c. secretion	c. secretion	c. secretion
d. bacteria	d. bacteria	d. bacteria

Left (16)\_\_\_\_\_, high cholesterol can eventually lead to a heart attack due to (17)\_\_\_\_\_ heart disease or a stroke due to narrowed (18)\_\_\_\_\_ supplying the brain.

16.	17.	18.
a. solidified	a. genetic	a. membranes
b. liquefied	<b>b. coronary</b>	b. systems
c. encoded	c. vertebrate	c. lipoproteins
<b>d. untreated</b>	d. circulatory	<b>d. arteries</b>

## NUMERACY QUESTIONS

### BASIC

Imagine you have just come home from surgery, and have been given the following at-home care instructions. Read the instructions and then answer the questions below.

*Your incision, or scar, has both stitches and steri-strips, which are small white strips of tape, and is covered by a gauze dressing and tape or a plastic dressing.*

*Do not remove the dressing, steri-strips or stitches. We will remove the dressing in seven to 10 days. We will also remove the sutures in one to two weeks unless they absorb on their own. If the dressing or ster-strips fall off, do not attempt to replace them. (At-home care instructions adapted from (University of California San Francisco Medical Center, 2011)*

1. If you haven't had a follow-up appointment yet, but it has been 10 days, should you remove the dressing yourself and replace it?
  - a. YES
  - b. NO**
  - c. Not enough information available to answer this question.
2. Should you remove any gauze or paper tape two days after the surgery?
  - a. YES
  - b. NO
  - c. Not enough information available to answer this question.**

You have also been provided with the following instructions for taking your pain medication. Read the instructions and then answer the questions below.

*Your medication may be taken with or without food. Take two chewable tablets every 12 hours. Make sure you take it around the same time every day. The tablets should be crushed or chewed thoroughly before they are swallowed. (Adapted instructions from Medline Plus, (Medline Plus, 2011a)).*

3. How many times per day should you take your medication?
  - a. ONCE
  - b. TWICE**
  - c. THREE TIMES
  - d. Not enough information available to answer this question.
4. Can you take your medication with food in the morning, but without food at night?
  - a. YES**
  - b. NO
  - c. Not enough information available to answer this question.

## COMPUTATIONAL

1. Triglycerides are a type of fat found in your blood and a high amount can raise your risk of heart disease. A normal level is less than 150. Borderline-high is 150-199, High is 200 to 499, and very high is 500 or higher. You just discovered you have a triglyceride level of 135. Should you be concerned? (WebMD, 2011)
  - a. YES
  - b. NO**
  - c. Not enough information available to answer this question
2. You just discovered that you have a triglyceride level of 150. Should you take medication?
  - a. YES
  - b. NO
  - c. Not enough information to answer this question.**
3. Having a body mass index at or above 30 puts you at a greater risk for having high cholesterol. If you weigh 145 pounds, are you at a greater risk for having high cholesterol? (Mayo Clinic, 2011)
  - a. YES
  - b. NO
  - c. Not enough information to answer this question.**
4. If you have high cholesterol and if you have a parent or sibling who developed heart disease before age 55, you are at a greater than average risk of developing heart disease. If your mother had good cholesterol, but developed heart disease when she was 50, are you at a greater than average risk of developing heart disease? (Mayo Clinic, 2011)
  - a. YES**
  - b. NO
  - c. Not enough information to answer this question
5. About 90 percent of lung cancer deaths in men are due to smoking. Are women more or less likely to develop lung cancer? (Centers for Disease Control and Prevention (CDC), 2011b)
  - a. More
  - b. Less
  - c. Not enough information to answer this question**
6. In 2009, the estimated number of diagnoses of HIV infection was 42,959. Of these, about half were reported as Black/African American. How many is that?(Department of Health and Human Services: Centers for Disease Control and Prevention, 2011)
  - a. 21,480**
  - b. 21,450
  - c. 21,500
  - d. 22,000

## ANALYTICAL

5. The National Cancer Institute estimates that about 12.2 percent of women born today will be diagnosed with breast cancer at some point in their lives. This is the same as which of the following: (National Cancer Institute, 2011)
  - a. **1 in 8 women**
  - b. 1 in 9 women
  - c. 1 in 7 women
  - d. 1 in 6 women
6. In the 1970s, the lifetime risk of being diagnosed with breast cancer was 1 in 10. Has the average increased or decreased today (see question above)? (National Cancer Institute, 2011)
  - a. **Increased**
  - b. Decreased
  - c. Stayed the same
  - d. Not enough information to answer this question
7. A woman's chance of being diagnosed with breast cancer between age 30 and 39 is 0.43 percent and her chance of being diagnosed between age 40 and 49 is 1.45 percent. Therefore: (National Cancer Institute, 2011)
  - a. **A woman's chance of breast cancer diagnosis increases three-fold between her 30s and 40s.**
  - b. A woman's chance of breast cancer diagnosis doubles between her 30s and 40s.
  - c. A woman's chance of breast cancer diagnosis decreases three-fold between her 30s and 40s.
  - d. A woman's chance of breast cancer diagnosis stays the same in her 30s and 40s.
8. The average lifetime risk of being diagnosed with breast cancer is higher than a woman's chance of being diagnosed when she is in her 30s. (National Cancer Institute, 2011)
  - a. True
  - b. **False**
  - c. Not enough information to answer this question
9. At the end of 2008, an estimated 1,178,350 persons aged 13 and older were living with HIV infection in the United States. Of those, 20% had undiagnosed HIV infections, which is about how many people? (Department of Health and Human Services: Centers for Disease Control and Prevention, 2011)
  - a. 230,000
  - b. 235,000
  - c. **236,000**
  - d. 240,000

## STATISTICAL

1. About one out of six people between 14 and 49 years of age in the United States has genital herpes. About what percentage of the U.S. population is this? (Centers for Disease Control and Prevention (CDC), 2011c)
  - a. 14%
  - b. 15%
  - c. 16%**
  - d. Not enough information to answer this question
2. About 1 in five women have genital herpes. About what percentage of the U.S. population is this? (Centers for Disease Control and Prevention (CDC), 2011c)
  - a. 20%**
  - b. 25%
  - c. 30%
  - d. Not enough information to answer this question
3. Smokers are 10 to 20 times more likely to get lung cancer than people who do not smoke. This is the same as: (Centers for Disease Control and Prevention (CDC), 2011b)
  - a. 20 to 30 out of 200 people
  - b. 10 to 40 out of 200 people
  - c. 20 to 40 out of 200 people**
  - d. 10 to 30 out of 200 people
4. A person affected by an autosomal dominant disorder has a 50 percent chance of passing the mutated gene to each child ((U.S. National Library of Medicine, 2011). If you have an autosomal dominant disorder, what is the chance that your child will NOT inherit the mutated gene? [easy]
  - a. 25 percent
  - b. 50 percent**
  - c. 100 percent
  - d. Not enough information to answer the question
5. Two unaffected people who each carry one copy of a mutated gene for an autosomal recessive disorder have a 25 percent chance with each pregnancy of having the child affected by the disorder. If you and your partner carry the mutated gene, but are not affected, and you become pregnant, what is the chance your child will NOT be affected by the disorder? (U.S. National Library of Medicine, 2011) [easy-medium]
  - a. 50 percent
  - b. 75 percent**
  - c. 100 percent
  - d. Not enough information to answer the question

6. The chance of passing on a genetic condition applies equally to each pregnancy. If a couple has a child with an autosomal recessive disorder (see question above), the chance of having another child with the disorder is \_\_\_\_\_. (U.S. National Library of Medicine, 2011)
- a. **25 percent**
  - b. 50 percent
  - c. 75 percent
  - d. Not enough information to answer this question

## MEDIA LITERACY

### Carbohydrates: Media Literacy

DIRECTIONS: Take a look at the webpage below. Answer the following questions based on what you see in the webpage.

Total HEALTH: Carbohydrates! The Truth! (\*Note: This is a fake webpage)

1. What is the purpose of this message?
  - a. Explain how to lose weight with eating the right ratio of proteins, fats, and carbohydrates.
  - b. Explain that carbohydrates are not necessarily bad for you and should be a key component of a balanced diet.**
  - c. Explain that there are many carbohydrates that are bad for you.
  - d. Explain that carbohydrates are more important than protein.
  
2. Who is the author of this message?
  - a. Anonymous
  - b. Jigsaw health carbohydrates
  - c. Total Health
  - d. D.J. Frank, total HEALTH**
  
3. What makes this author credible?
  - a. Information in article reflects what is now well known.
  - b. Information has been published in a public domain
  - c. Credibility cannot be identified or verified**
  - d. Information written by well-established company
  
4. Has the information on this page been reviewed by a health professional?
  - a. Clearly YES
  - b. Clearly NO
  - c. Not clear from information available**
  
5. When was the information last reviewed or updated?
  - a. December 12, 2011
  - b. January 3, 2012
  - c. Current date
  - d. Unknown**



6. What point of view do you think is LEFT OUT of this message?
- Over the long term, low-carbohydrate diets can result in a healthy gradual weight loss because they contain fewer calories.** *(which is actually the position WebMD reports)*
  - It's unhealthy to severely restrict carbohydrates from the diet.
  - Carbohydrates are used as fuel for the body before other nutrients are used.
  - Low-glycemic carbohydrate foods are essential for the body to function.
7. Which statement most closely resembles the author/sender's view of this topic?
- The healthiest diet is one that is balanced with carbohydrates, proteins, and fats.**
  - The healthiest diet is one that has a higher proportion of proteins and fats, with a small amount of carbohydrates.
  - The healthiest diet is one that has significantly more calories from low-glycemic carbohydrates than fats or proteins.
  - The healthiest diet is one that is high protein, low fat, and little or no carbohydrates.
8. Which statement most closely resembles your own perspective on this topic?
- The healthiest diet is one that is balanced with carbohydrates, proteins, and fats.
  - The healthiest diet is one that has a higher proportion of proteins and fats, with a small amount of carbohydrates.
  - The healthiest diet is one that has significantly more calories from low-glycemic carbohydrates than fats or proteins.
  - The healthiest diet is one that is high protein, low fat, and little or no carbohydrates.
  - I don't think this is important to health
  - I'm not sure
9. Is all of the information in this message based on scientific fact?
- YES
  - Some parts
  - Missing evidence**
10. How credible do you think this message is?
- Very credible
  - Fairly credible
  - Not sure
  - Not credible

## Pro-Ana: Media Literacy

DIRECTIONS: Take a look at the webpage below. Answer the following questions based on what you see in the webpage (Webpage:

<http://theskinnyoncelebs.wordpress.com/2009/02/04/pro-ana-tips-and-tricks/>)

1. What do you think is the purpose of this website, based on the content provided here?
  - a. To convert people to become anorexic and have eating disorders.
  - b. To encourage people who are already skinny, or obsessed with being skinny, to maintain a skinny lifestyle.**
  - c. To promote a healthier, leaner lifestyle.
  - d. To provide links to advertisements for drugs, laxatives, diuretics, and other dieting tools.
2. Who is the author of this message?
  - a. Anonymous**
  - b. Nicole Richie
  - c. Pro-ana
  - d. Wordpress
3. What makes this author credible?
  - a. Information on website reflects what is now well known.
  - b. Information has been published in a public domain
  - c. Credibility cannot be identified or verified**
  - d. Information written by well-established company
4. Has the information on this page been reviewed by a health professional?
  - a. Clearly YES
  - b. Clearly NO**
  - c. Not clear from information available
5. When was the information last reviewed or updated?
  - a. February 4, 2009
  - b. January 3, 2012
  - c. Current date
  - d. Unknown**
6. What point of view do you think is LEFT OUT of this message?
  - a. Anorexia is a sustainable life choice.
  - b. Anorexia is a serious eating disorder and can damage your health and threaten your life.
  - c. Staying skinny will make your life better.
  - d. It's okay to lose weight as quickly as possible.

7. Which statement most closely resembles the author/sender's view of this topic?
- a. **Anorexia is a sustainable lifestyle choice and I am here to provide tips on how to maintain that lifestyle.**
  - b. Anorexia is not healthy, but it is essential if we want to be beautiful.
  - c. Eat less so that you don't have to exercise more.
  - d. Anorexia is a disease, but it can't be cured, so I am here to provide tips on how to do it in a healthy way.
8. Is all of the information in this message based on scientific fact?
- a. YES
  - b. Some parts
  - c. **Missing evidence**
9. How credible do you think this message is?
- a. Very credible
  - b. Fairly credible
  - c. Not sure
  - d. Not credible

## MELANOMA: Media Literacy

*National Cancer Institute's General Information about Melanoma*

DIRECTIONS: Take a look at the webpage below. Answer the following questions based on what you see in the webpage.

Webpage: <http://www.cancer.gov/cancertopics/pdq/treatment/melanoma/Patient>

1. What is the purpose of the message on this webpage?
  - a. Provide treatment information about melanoma skin cancer.
  - b. Explain the different stages of melanoma skin cancer.
  - c. Provide general, introductory information about melanoma skin cancer.**
  - d. Explain that melanoma skin cancer is dangerous and common for all adults.
2. Who is the author of this message?
  - a. Anonymous
  - b. National Cancer Institute
  - c. 1-800-4-Cancer
  - d. American Cancer Society
3. What makes this author credible?
  - a. Government site, authorship is clear, resources for information are cited, webpage states when this resource was last updated.
  - b. Government site, authorship is clear, purpose of site is clear, webpage states when this resource was last updated.**
  - c. Government site, webpage states when this resources was last updated, tilde ~ in the URL.
  - d. Credibility cannot be identified or verified.
4. Has the information on this page been reviewed or created by health professional/s?
  - a. Clearly YES**
  - b. Clearly NO
  - c. Not clear from the information available
5. When was the information last reviewed or updated?
  - a. January 11, 2011
  - b. November 1, 2011**
  - c. Current date
  - d. Unknown

6. What point of view or information do you think is LEFT OUT of this message?
  - a. It is important to understand the signs of possible melanoma, since it is an aggressive skin cancer.
  - b. It is important to understand the risk factors associated with developing melanoma.
  - c. **Melanoma skin cancer is the most underfunded of all cancers by federal and private agencies and yet it is one of the most common cancers and needs more funding.**
  - d. Suspicious-looking areas that develop on the skin should be examined by a health professional as soon as possible.
7. Which statement most closely resembles the author/sender's view of the topic (based on the information provided on the webpage)?
  - a. Fortunately, melanoma skin cancer is rarely fatal.
  - b. **It is important to understand the signs and risk factors of melanoma skin cancer and how it can be diagnosed and treated.**
  - c. UV rays may not have anything to do with developing melanoma skin cancer (as many medical experts suggest), but it's still important to understand the possible risks associated with getting the cancer.
  - d. Both exposed and unexposed areas of the body can get melanoma skin cancer and therefore it's important to be aware of all the possible causes and risk factors associated with developing the cancer.
8. Which statement most closely resembles your own perspective on this topic?
  - a. Fortunately, melanoma skin cancer is rarely fatal.
  - b. It is important to understand the signs and risk factors of melanoma skin cancer and how it can be diagnosed and treated.
  - c. UV rays may not have anything to do with developing melanoma skin cancer (as many medical experts suggest), but it's still important to understand the possible risks associated with getting the cancer.
  - d. Both exposed and unexposed areas of the body can get melanoma skin cancer and therefore it's important to be aware of all the possible causes and risk factors associated with developing the cancer.
9. Is all of the information in this message likely based on scientific evidence?
  - a. **Yes**
  - b. Some parts
  - c. Missing evidence
10. How credible do you think this message is?
  - a. Very credible
  - b. Fairly credible
  - c. Not sure
  - d. Not credible

## Digestion and Depression: Media Literacy

DIRECTIONS: Please take a look at the webpage below. Answer the following questions about the webpage.

Worldwide Health Center

Webpage: <http://www.worldwidehealthcenter.net/articles-449.html>

1. What is the purpose of the message on this webpage?
  - a. Provide information about an alternate treatment for depression.
  - b. To explain the relationship between digestive health and depression.**
  - c. To persuade readers to buy BioPRO and GI Cell Support capsules.
  - d. To demonstrate how traditional Western medicine doesn't always provide enough information about the links between what you eat and your physical and mental health.
2. Who is the author of this message?
  - a. Worldwide Health Center
  - b. Health News
  - c. Anonymous
  - d. Specific author not clear**
3. What makes this author credible?
  - a. Government site, authorship is clear, resources for information are cited, webpage states when this resource was last updated.
  - b. Information published on a credible website, content of message is rich and contains valid research, website is not trying to generate revenue.
  - c. Health care website, webpage states when this resources was last updated.
  - d. Credibility of author is not clear.**
4. Has the information on this page been reviewed or created by health professional/s?
  - a. Clearly YES
  - b. Clearly NO
  - c. Not clear from the information available**
5. When was the information last reviewed or updated?
  - a. September 22, 2009**
  - b. November 1, 2011
  - c. Current date
  - d. Unknown
6. What point of view or information do you think is LEFT OUT of this message?
  - a. Depression may cause digestive problems.**
  - b. There is a clear link between digestive health and cognitive health.
  - c. Digestive health can be improved by consuming healthy intestinal bacteria.
  - d. By improving your digestive health, you may be able to improve your cognitive health.

7. Which statement most closely resembles the author/sender's view of the topic (based on the information provided on the webpage)?
  - a. Don't assume your doctor knows everything about the relationship between what you eat and your cognitive health.
  - b. It is important to take care of your physical health, including consuming the right foods and products, to maintain good cognitive health.**
  - c. Since digestive health and depression can sometimes go together, taking special digestive capsules may help with your depression as well.
  - d. None of the above.
8. Which statement most closely resembles your own perspective on this topic?
  - a. Don't assume your doctor knows everything about the relationship between what you eat and your cognitive health.
  - b. It is important to take care of your physical health, including consuming the right foods and products, to maintain good cognitive health.
  - c. Since digestive health and depression can sometimes go together, taking special digestive capsules may help with your depression as well.
  - d. None of the above.
9. Is all of the information in this message likely based on scientific evidence?
  - a. Yes
  - b. Some parts**
  - c. Missing evidence
10. How credible do you think this message is?
  - a. Very credible
  - b. Fairly credible
  - c. Not sure
  - d. Not credible

**\*\*POSSIBLE ADDITIONAL QUESTIONS (if participants will actually go to live sites):**

***(Note: Probably won't keep these questions – need to keep viewing experience as close to “the same” as possible for everyone)***

11. If you don't think this message is credible, or you are unsure of its credibility, which of the following reasons makes you doubt the message's credibility?
  - a. Advertisements on the page
  - b. Name of the institution or organization hosting or funding this information is not clear
  - c. Sources/references are not provided or cited, or they do not look like credible sources
  - d. Not clear when this message was created or last updated
  - e. None of the above
12. Is there information on the site that describes the organization, agency, or company's identity and why the information is being published?
13. Is the purpose of the website to generate revenue in some way?

## GARDASIL: MEDIA LITERACY

DIRECTIONS: Please view the following webpage and answer the following questions about the webpage.

Webpage: <http://www.gardasil.com/>

1. What is the main purpose of the message on this webpage?
  - a. To educate people about the human papillomavirus.
  - b. To explain why human papillomavirus vaccination is important for young women.
  - c. To promote the vaccine *Gardasil*.**
  - d. To provide information about a cure for cervical cancer.
2. Who is the author of this message?
  - a. Gardasil
  - b. FDA Staff
  - c. Group of physicians
  - d. Specific author not clear**
3. What makes this author credible?
  - a. Government website, authorship is clear, resources for information are cited, webpage states when this resource was last updated.
  - b. Information published on a credible website, content of message is rich and contains valid research, website is not trying to generate revenue.
  - c. Information has been published in a public domain.
  - d. Credibility should be verified with additional information from other sources.**
4. Has the information on this page been reviewed or created by physicians or other health care professionals?
  - a. Clearly YES
  - b. Clearly NO
  - c. Not clear from information available on this webpage**
5. When was this information last reviewed or updated?
  - a. February 6, 2012 (today)**
  - b. Yesterday
  - c. December 2011
  - d. Unknown
6. What point of view or information do you think is LEFT OUT of this message?
  - a. The Gardasil vaccine may help prevent young men and women from developing or spreading HPV.
  - b. Gardasil does not protect against all forms of HPV.
  - c. Young men and women should get vaccinated before they become sexually active.
  - d. There is a common misconception that the HPV vaccine protects against all types of HPV.**



7. Which statement most closely resembles the author/sender's view of the topic (based on the information provided on the webpage)?
  - a. HPV is more common than many people think and vaccination is one way to prevent the virus from spreading.
  - b. We encourage young men and women to get the Gardasil vaccination before its too late.**
  - c. It is especially important for boys to receive Gardasil as part of their routine vaccinations.
  - d. It is important for young men and women to understand the effects and side effects of taking (and not taking) any optional vaccinations.
8. Which statement most closely resembles your own perspective on this topic?
  - a. HPV is more common than many people think and vaccination is one way to prevent the virus from spreading.
  - b. We encourage young men and women to get the Gardasil vaccination before its too late.
  - c. It is especially important for boys to receive Gardasil as part of their routine vaccinations.
  - d. It is important for young men and women to understand the effects and side effects of taking (and not taking) any optional vaccinations.
  - e. None of the above.
9. Is all of the information in this message likely based on scientific evidence?
  - a. YES**
  - b. Some parts
  - c. Missing evidence
10. How credible do you think this message is?
  - a. Very credible
  - b. Fairly credible
  - c. Not sure
  - d. Not credible

## DIGITAL LITERACY QUESTIONS

### Personal Digital Health Literacy Questions

1. Have you searched for health information on the Internet?

NEVER      1-2 times      3-5 times      6-10 times      11+ times

2. How difficult was it to find the information you needed?

Difficult      Somewhat difficult      Not very difficult      Easy

3. Have you always been able to find the answers to your health-related questions?

NEVER      SELDOM      SOMETIMES      USUALLY      ALWAYS

4. What are some of the main websites you have used?

- a. Wikipedia
- b. WebMD
- c. National Institutes of Health
- d. Local hospital's website
- e. Large National hospital's website (such as Mayo Clinic)
- f. Other \_\_\_\_\_

5. Have you used digital applications (on your computer or smart phone device) for any of the following?

- g. Figuring out health-related scores, such as BMI (Body Mass Index)
- h. Food journaling, exercise journaling, or other health-related journaling
- i. Exercise routines
- j. Nutrition applications, such as calorie trackers, weight loss plans, or nutrition plans
- k. Other \_\_\_\_\_

## General digital literacy questions

6. You open the home page for [www.webmd.com](http://www.webmd.com). On the home page, you see a link for “Cold or Flu: How to tell which symptoms you have.” You want to view the link in a separate window, but you do not want to close the home page. What will you do to view the “Cold or Flu” link in a separate window?
  - a. Type the keywords “cold or flu” in the address bar and then click New Page.
  - b. Right-click the link for “Cold or Flu” and then click Open in New Window.**
  - c. Type the keywords “Cold or Flu” in the Search box.
  - d. Click the link for “Cold or Flu: How to tell which symptoms you have.”
7. Which online community can help you create an online nutrition and exercise journal?
  - a. Newsgroup
  - b. Blog**
  - c. Bulletin board
  - d. Chat group
8. You use your computer to chat with a health educator about some health concerns you have. Which network transfers the messages between your computer and the health educator’s computer?
  - a. Internet**
  - b. Intranet
  - c. Local area network (LAN)
  - d. Ethernet
9. It costs money to run a website. Which of the following helps you figure out the source of a website’s funding?
  - a. Right-click on website homepage and then click on View Source.
  - b. Scrolling to the bottom of a website’s homepage and viewing disclosure statement.
  - c. Checking the address of the website, such as addresses ending in “.gov,” “.edu,” “.org,” or “.com.”**
  - d. Right-click on the URL in the address bar and click Open URL.
10. How can you tell who runs a website? Which of the following indicates one way you can tell?
  - a. Open the website’s Javascript.
  - b. The organization/institution/company is clearly noted on every major page, along with a link to the site’s homepage.**
  - c. Right-click on the website homepage and then click on View Source.
  - d. Right-click on the URL in the address bar and then click “Search in Google.”

11. How can you tell what a health website's purpose is? Which of the following indicates one way you can tell?
- Use a search engine to find reviews of that website to see if you can find that website's true purpose.
  - Right-click on the website homepage and click on View Source.
  - Many websites have a link to information about the site, often called "About this Site." With a credible site, this page should clearly state the purpose of the site and help you evaluate the trustworthiness of the information displayed on that website.**
  - Check the address of the website and if the address is long, the website is most likely trying to sell you something.
12. How can you figure out what the original source of the website's information is?
- All websites put this information somewhere on their website. If the website contains a search box, try typing in "references" in the search box.
  - Good health and medical websites post this information at the end of material that was not originally created by the authors of that site.**
  - Do a crosscheck by copying part of the text of a website and pasting it into a search engine to see where else that same information appears.
  - Check the fact sheets listed at the bottom of a website's home page.
13. How can you tell how current the health information is on a website?
- Health experts should update the material on a regular basis. Good websites should clearly post the most recent update, but there if they don't - there is no way to figure out when that information was last reviewed and updated.**
  - Right-click on the home page and click View Source.
  - All website creators are required to list this information somewhere on their website. Sometimes you have to search through the website to find this information.
  - Scroll to the bottom of the website's homepage to find the most recent date listed.

## Scenario Digital Literacy Questions

Questions 1-6: Assessment

Questions 7- 12: Evaluate

### SCENARIO 1

*You just discovered that your father has Stage 1 prostate cancer. His doctor told him he has a Gleason score of 6 and a PSA of 4.1. He is now faced with making a decision about several different treatment options. But he wants to make sure he understands what they all are and their corresponding side effects. You agree to help him research and understand all his options.*

1. How would you go about searching for information on the Internet? Please be as specific as possible. (Might be better to keep as open-ended).
2. What key words would you type into a search engine (regarding this topic)?
3. Which search engine would you use?
4. What websites (if any) would you most likely go to for information?
5. Of the following sources, which do you think would provide you with the most useful, accurate, diverse, and up-to-date information for answering your question about this topic?
  - a. Wikipedia
  - b. Medical Encyclopedia
  - c. National Cancer Institute
  - d. Your local hospital's website
6. Why do you think the source you indicated above would provide you with the most useful, accurate, diverse, and up-to-date information for answering your question about this topic?





13. Now imagine you begin to receive a lot of e-mail traffic about prostate cancer and treatment options from friends, family, medical personnel, and several of the automatic information updates you signed up for from various websites. How would you manage all these emails with various pieces of information so that it's most useful to you and your father?

(Keep as an open answer, but looking for answers like the following: categorize emails to appropriate folders based on critical view of e-mail's contents; arrange information into an organizational chart, etc.).

## SCENARIO 2

*You are concerned that one of your close friends drinks heavily on a regular basis and seems to be lacking in his/her schoolwork and other responsibilities and daily activities. However, you are not sure what to do and if there is anything you can do to help your friend. You decide to conduct a little Internet research on the resources that might be available to you and to your friend.*

1. How would you go about searching for information on the Internet? Please be as specific as possible.
2. What key words would you type into a search engine when researching this topic?
3. Which search engine would you use?
4. What websites (if any) would you most likely go to for information?
5. Of the following sources, which do you think would provide you with the most useful, accurate, diverse, and up-to-date information for answering your question about this topic?
  - a. The Psychology Department's website at your university
  - b. Wikipedia
  - c. Medical Encyclopedia
  - d. Your local hospital's website
  - e. The health clinic's website at your university
  - f. Other \_\_\_\_\_
6. Why do you think the source you indicated above would provide you with the most useful, accurate, diverse, and up-to-date information for answering your question about this topic?





### SCENARIO 3

*There have been several changes in your life recently. Someone close to you has just died. Your family isn't getting along right now. Your workload at school feels unbearable. You don't feel like you have a good friend nearby that you can talk to at the moment. You find you're having trouble sleeping lately and you don't have much energy during the day. You think you may be a little depressed and decide to seek help, but first you would like to find out more about depression from information available on the Internet, and whether it's necessary for you to seek professional help.*

1. How would you go about searching for information on the Internet? Please be as specific as possible.
2. What key words would you type into a search engine when researching this topic?
3. Which search engine would you use?
4. What websites (if any) would you most likely go to for information?
5. Of the following sources, which do you think would provide you with the most useful, accurate, diverse, and up-to-date information for answering your question about this topic?
  - a. The Psychology Department's website at your university
  - b. Wikipedia
  - c. National Institute of Health's website
  - d. Your local hospital's website
  - e. The health clinic's website at your university
  - f. Other \_\_\_\_\_
6. Why do you think the source you indicated above would provide you with the most useful, accurate, diverse, and up-to-date information for answering your question about this topic?



## Appendix C: Expert Recruitment E-mail

Dear \_\_\_\_\_:

I am writing to you because of your expertise in health education. I am a Ph.D. student in public communication and technology at Colorado State University, and am in the process of creating a new health literacy assessment tool for young adults (specifically young adult college students). My research is being conducted under the guidance of Dr. Craig Trumbo, Journalism and Technical Communication, [ctrumbo@colostate.edu](mailto:ctrumbo@colostate.edu). I am requesting your expertise to help decipher which question items – from a pool of possible questions – are best suited to address four areas of health literacy that will be included in a final assessment tool.

The health literacy assessment will consist of questions measuring comprehension of health materials, health numeracy, media literacy, and digital literacy. The tool will comprehensively assess each area, including more advanced questions than the standard health literacy assessments contain. The existing tools only measure very basic skills, but this new tool will provide a more thorough and advanced assessment that is targeted to young adult college students.

I would be grateful for your help in deciphering which question items work best among a large pool of questions in each of the health literacy areas identified for this tool (comprehension, numeracy, media literacy, and digital health literacy). Your participation would consist of reading over each question and ranking how well it works/doesn't work for measuring each identified area of health literacy (you would rank the question – or set of combined questions – on a Likert scale of “Not a good question” to “Excellent question”). The highest-scoring questions among all the experts will be included in a pre-test assessment.

The pre-test assessment will then be given to a group of CSU students. After statistical analysis of the first round of testing with students, a final version of the assessment will be tested again on another sample of CSU students.

I would send you the list of possible questions and ask that you please respond with your ranked question items within a couple of weeks. I estimate that ranking the questions will likely take around 2 hours of your time.

I understand that your schedule is very busy, and I would be grateful for your participation. In recognition of your help, I will provide you with a \$15 gift card to a restaurant in Fort Collins (regardless of whether you finish the questionnaire or not).

If you are willing and able to participate, please let me know by \_\_\_\_\_. The attached letter provides a complete description of the study's protocol.

Feel free to contact me ([Raquel.Harper@colostate.edu](mailto:Raquel.Harper@colostate.edu)) if you have any questions or concerns.

Thank you for your time and consideration.

Best,  
Raquel Harper and Craig Trumbo

Raquel Harper, MS  
Craig Trumbo, PhD  
Journalism & Technical Communication  
1785 Campus Delivery, Colorado State University  
Fort Collins, CO 80523-1785  
[970-491-2077](tel:970-491-2077)

## Appendix D: Expert Evaluation of Health Literacy Assessment Questions

### Expert Consent Form



Department of Journalism and Technical Communication  
Colorado State University  
Fort Collins, CO 80523-1785  
Telephone 970-491-2077  
email: [ctrumbo@colostate.edu](mailto:ctrumbo@colostate.edu)

Dear «FirstName»,

We would like to invite you to participate in a part of our research on creating a new health literacy assessment tool for young adults (specifically young adult college students). Your help is requested because of your expertise in health education and/or health communication. We are requesting your expertise to help decipher which question items – from a pool of possible questions – are best suited to address four areas of health literacy that will be included in the final assessment tool.

All of the details about this part of the research project are provided below. Please take a few minutes to look this information over and give consideration to participating in this part of the project.

**TITLE OF STUDY:** “Comprehensive Health Literacy Assessment for Young Adults”

**DISSERTATOR AND ADVISOR:** Raquel Harper, PhD Candidate, Department of Journalism and Technical Communication, MS 1785 Colorado State University, Fort Collins, CO 80526. Phone: 303-589-0083. Email [Raquel.Harper@colostate.edu](mailto:Raquel.Harper@colostate.edu). Craig Trumbo, PhD, Associate professor, Department of Journalism and Technical Communication, MS 1785 Colorado State University, Fort Collins, CO 80526. Phone 970-491-2077 Email [ctrumbo@colostate.edu](mailto:ctrumbo@colostate.edu).

**WHY AM I BEING INVITED TO TAKE PART IN THIS RESEARCH?** We are seeking participation from you to help choose which question items work best among a large pool of questions in each of four health literacy areas (comprehension, numeracy, media literacy, and digital health literacy).

**WHO IS DOING THE STUDY?** The study is being conducted by researchers in the Journalism and Technical Communication Department at Colorado State University.

**WHAT IS THE PURPOSE OF THIS STUDY?** This part of the study is designed to help create an updated health literacy assessment tool – specifically for young adults – by choosing the best question items among a pool of possible health literacy questions.

**WHERE IS THE STUDY GOING TO TAKE PLACE, HOW LONG WILL IT LAST?**

You will be given a document containing a large pool of questions in each of the health literacy areas. You will also be given an evaluation questionnaire for choosing the best question items. We estimate that choosing the best items will likely take around 2 hours of your time. You will have two weeks to complete the evaluation questionnaire.

**WHAT WILL I BE ASKED TO DO?** Your participation would consist of reading over each question (or set of questions) and deciding whether that question (or set of questions) works well or doesn't work well for inclusion in the final assessment. You will also rank some items (in terms of which ones you like best to the ones you like the least). And there are spaces for optional additional feedback, if you choose to provide additional comments (such as suggestions on questions that you think need more work).

**ARE THERE REASONS WHY I SHOULD NOT TAKE PART IN THIS STUDY?** You should be a professional with some health-related background (e.g., health education, health communication, or medicine). If you do not have some background in health, you should not participate.

**WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?** There are no foreseeable risks or discomforts to you from participating in this research study.

**ARE THERE ANY BENEFITS FROM TAKING PART IN THIS STUDY?** There are no direct benefits to you from participating in this research study. We hope that the results of this study will help us create an appropriate tool for measuring health literacy in young adult college students. The highest-scoring questions among all the experts will hopefully be included in a pre-test assessment with a group of CSU students.

**DO I HAVE TO TAKE PART IN THE STUDY?** Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

**WHAT WILL IT COST ME TO PARTICIPATE?** There are no costs to you for joining this study.

**WHO WILL SEE THE INFORMATION THAT I GIVE?** Your information will be combined with information from the other experts taking part in this study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered from experts at Colorado State University. You will not be identified in these written materials. We may publish the results of this study; however, we will keep your name and other identifying information private (except your affiliation with Colorado State University).

**WILL I RECEIVE ANY COMPENSATION FOR TAKING PART IN THIS STUDY?** In recognition of your help, we will provide you with a \$15 restaurant gift card.

**WHAT IF I HAVE QUESTIONS?** Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind. You can contact the DISSERTATOR, Raquel Harper (303-589-0083 or Raquel.Harper@colostate.edu) or the ADVISOR, Craig Trumbo (970-491-2077 or ctrumbo@colostate.edu). If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655.

We hope you will join us in this research effort. Please respond to this email indicating whether you agree to participate. If you agree, you acknowledge that you have read the information stated in this letter.

Sincerely,

Dr. Craig Trumbo  
Department of Journalism and Technical Communication  
Colorado State University  
Fort Collins, CO 80523-1785  
PH: 970-491-2077  
Email: [ctrumbo@colostate.edu](mailto:ctrumbo@colostate.edu)



## Expert Evaluation Questionnaire

# EVALUATION OF HEALTH LITERACY ASSESSMENT QUESTIONS

## BACKGROUND ON COMPREHENSION SECTION

Two different measurements for comprehension have been selected for measuring the comprehension section of the health literacy assessment: the Cloze Technique and the Sentence Verification Technique. The Cloze technique has already long been used in previous health literacy assessment tools and has been recognized as a valid tool for measuring comprehension of health materials. However, education experts suggest using more than one technique to measure comprehension to give a more accurate indicator of comprehension performance (in the past, only one form has been included in the standard health literacy measurement tools). Therefore, this instrument will also include the Sentence Verification Technique, which is considered to be a valid means of measuring reading comprehension among many education experts.

### Sentence Verification Technique

**Brief description:** The Sentence Verification Technique is based on the idea that when people read passages, they form a memory representation of that passage (meaning, people should be preserving the meaning of each sentence in the passage). Therefore, the test measures whether participants have comprehended a passage by checking their accuracy for determining if sentences mean or do not mean the same things as the sentences in the original passage. The test always consists of four different types of test sentences: 1) *Original*: an exact duplication of the sentence in the original passage; 2) *paraphrase*: some or all of the words in the sentence have been changed from the original, but without altering meaning; 3) *meaning change*: one or two words have been changed in the passage sentence in order to change the meaning of the sentence; 4) *distractor*: consistent with the theme of the passage, but unrelated in meaning to any sentence in the passage.

Therefore, participants would read through a passage and then, without looking back at the original passage, would respond to the test questions with either "YES" or "NO." "YES" sentences are defined as sentences that are the same or mean the same as the original passages (original and paraphrase). "NO" sentences have a different meaning than the original passage sentences (meaning change or distractor).

**The goal for the comprehension section is to include one passage using the Sentence Verification Technique and one using the Cloze technique (so your evaluation will help decipher which passages work best).**

**Please review the passage on GOUT and corresponding test sentences. Then answer the questions below.**

1. Do you think this passage could work well as part of the comprehension section in the health literacy assessment? (Circle your answer on the scale of 1-5 below).

1	2	3	4	5
Definitely not a good passage				Passage works very well

2. Overall, do you think the test sentences that go with the Gout passage are clearly “YES” or “NO” sentences (that is, they either clearly mean the same thing as the original passage, or they clearly don’t)?

1	2	3	4	5
Test sentences definitely don’t work				Test sentences work very well

3. Overall, do you think the Gout passage and corresponding test questions could work well as part of the comprehension section of the health literacy assessment?

1	2	3	4	5
Gout passage and test questions definitely DON’T work				Gout passage and test questions seem like they could work very well

4. This passage on Gout would work well as a potential topic that most college students are **unfamiliar** with.

1	2	3	4	5
Strongly disagree				Strongly agree

5. I think it might be important to include some information that college students are **unfamiliar** with in a health literacy assessment.

1	2	3	4	5
Strongly disagree				Strongly agree

6. Any additional comments?

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**Please review the passage on METASTATIC CANCER and corresponding test sentences. Then answer the questions below.**

7. Do you think this passage could work well as part of the comprehension section in the health literacy assessment?

1	2	3	4	5
Definitely not a good passage				Passage works very well

8. Overall, do you think the test sentences that go with the Metastatic Cancer passage are clearly “YES” or “NO” sentences (that is, they either clearly mean the same thing as the original passage, or they clearly don’t)?

1	2	3	4	5
Test sentences definitely don’t work				Test sentences work very well

9. Overall, do you think the Metastatic Cancer passage and corresponding test questions could work well as part of the comprehension section of the health literacy assessment?

1	2	3	4	5
Metastatic Cancer passage and test questions definitely DON’T work				Metastatic Cancer passage and test questions seem like they could work very well

10. This passage on Metastatic Cancer would work well as a potential topic that most college students are unfamiliar with.

1	2	3	4	5
Strongly disagree				Strongly agree

11. Any additional comments?

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**Please review the passage on Chlamydia and corresponding test sentences. Then answer the questions below.**

12. Do you think this passage could work well as part of the comprehension section in the health literacy assessment?

1	2	3	4	5
Definitely not a good passage				Passage works very well

13. Overall, do you think the test sentences that go with the Chlamydia passage are clearly “YES” or “NO” sentences (that is, they either clearly mean the same thing as the original passage, or they clearly don’t)?

1	2	3	4	5
Test sentences definitely don’t work				Test sentences work very well

14. Overall, do you think the Chlamydia passage and corresponding test questions could work well as part of the comprehension section of the health literacy assessment?

1	2	3	4	5
Chlamydia passage and test questions definitely DON’T work				Chlamydia passage and test questions seem like they could work very well

15. This passage on Chlamydia would work well as a potential topic that most college students **are familiar** with.

1	2	3	4	5
Strongly disagree				Strongly agree

16. Please rank which passage and corresponding test questions you think would work best as part of the comprehension section of the health literacy assessment (with 1 being your first choice and 3 being your last choice).

Gout	
Metastatic Cancer	
Chlamydia	

17. Any additional comments?

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## Cloze Technique

**Brief description:** The Cloze technique is already widely used in standard health literacy assessments, including the Test of Functional Health Literacy in Adults. The technique involves including a passage with every X<sup>th</sup> word deleted (typically spanning a range, such as every 5<sup>th</sup> to 7<sup>th</sup> word deleted). The participant then fills in the blank based on a multiple choice set of answers.

**What's different about the technique included in this assessment:** The existing standard health literacy assessments only test for a very basic level of comprehension (such as being able to identify the difference between the need for an adjective versus a noun in a Cloze assessment question).

For example: Before supper you should only have a \_\_\_\_\_ snack.

A) small; B) broth; C) attack; or D) nausea.

However, in this health literacy assessment intended for young adults, more advanced skills will be tested to reflect the reading skills needed to understand various kinds of health materials available from websites such as WebMD or the National Cancer Institute.

**Please review the passage on Sleep Apnea with included Cloze assessment questions. Then answer the questions below.**

18. Do you think this passage (including Cloze questions) could work well as part of the comprehension section in the health literacy assessment?

1	2	3	4	5
Definitely not a good passage				Passage works very well

19. Overall, the Cloze questions included in this passage are appropriate and seem to include only one true answer.

1	2	3	4	5
Strongly disagree				Strongly agree

20. Are there any Cloze questions that you think don't work well in this passage? If so, please identify them here.

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**Please review the passage on HPV with included Cloze assessment questions. Then answer the questions below.**

21. Do you think this passage (including Cloze questions) could work well as part of the comprehension section in the health literacy assessment?

1	2	3	4	5
Definitely not a good passage				Passage works very well

22. Overall, the Cloze questions included in this passage are appropriate and seem to include only one true answer.

1	2	3	4	5
Strongly disagree				Strongly agree

23. Are there any Cloze questions that you think don't work well in this passage? If so, please identify them here.

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**Please review the passage on High Cholesterol and Triglyceride Levels with included Cloze assessment questions. Then answer the questions below.**

24. Do you think this passage (including Cloze questions) could work well as part of the comprehension section in the health literacy assessment?

1	2	3	4	5
Definitely not a good passage				Passage works very well

25. Overall, the Cloze questions included in this passage are appropriate and seem to include only one true answer.

1	2	3	4	5
Strongly disagree				Strongly agree

26. Are there any Cloze questions that you think don't work well in this passage? If so, please identify them here.

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27. Please rank which passage and corresponding Cloze test questions you think would work best as part of the comprehension section of the health literacy assessment (with 1 being your first choice and 3 being your last choice).

Sleep Apnea	
HPV	
High Cholesterol	

## NUMERACY SECTION

**Brief description:** Based on research on numeracy, there are four main areas that should be tested when assessing for numeracy skills: basic, computational, analytical, and statistical. Therefore, all of these question types are included in this assessment. For the final assessment, about 12-15 questions will be chosen from this draft (approximately three from each area).

Please take a look at the questions in the Numeracy section and follow along with your evaluations here:

### **BASIC**

1. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

2. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

3. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

4. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

### **COMPUTATIONAL**

1. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

2. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree



3. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

4. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

5. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

6. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

**ANALYTICAL**

1. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

2. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

3. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

4. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

5. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

**STATISTICAL**

1. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

2. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

3. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

4. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

5. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

6. This seems like a good numeracy question.

1	2	3	4	5
Strongly disagree				Strongly agree

# MEDIA LITERACY

**Brief description:** There are five potential website pages included in this assessment draft with essentially the same 10 media literacy questions included with each (just tailored to that website). One or two of these five will be included in the final health literacy assessment.

Please take a look at the 10 main questions included after the Carbohydrates website. Keep these in mind, and then just browse over the other four websites included in this draft assessment (Pro-Ana, Melanoma, Digestion and Depression, and Gardasil). Because the 10 main questions are essentially the same for each website (just tailored to that website), you do not need to re-read these questions after each website.

1. Please rank order which websites you think work best for assessing media literacy (with 1 as your top choice and 5 as your last choice).

Carbohydrates	
Pro-Ana	
Melanoma	
Digestion and Depression	
Gardasil	

Based on the 10 questions listed with the Carbohydrates section, please indicate whether you think these are good questions (these 10 questions are essentially the same for each topic):

1. This seems like a good media literacy question.

1	2	3	4	5
Strongly disagree				Strongly agree

2. This seems like a good media literacy question.

1	2	3	4	5
Strongly disagree				Strongly agree

3. This seems like a good media literacy question.

1	2	3	4	5
Strongly disagree				Strongly agree

4. This seems like a good media literacy question.

1	2	3	4	5
Strongly disagree				Strongly agree

5. This seems like a good media literacy question.

1	2	3	4	5
Strongly disagree				Strongly agree

6. This seems like a good media literacy question.

1	2	3	4	5
Strongly disagree				Strongly agree

7. This seems like a good media literacy question.

1	2	3	4	5
Strongly disagree				Strongly agree

8. This seems like a good media literacy question.

1	2	3	4	5
Strongly disagree				Strongly agree

9. This seems like a good media literacy question.

1	2	3	4	5
Strongly disagree				Strongly agree

10. This seems like a good media literacy question.

1	2	3	4	5
Strongly disagree				Strongly agree

# DIGITAL LITERACY

**Brief Description:** There are three sections for the digital literacy section: Personal digital health literacy questions, general digital literacy questions, and a set of questions based on a scenario. There are three possible scenarios included in this section, but only one of them will be used in the final assessment. Please review the questions in the personal and general digital literacy sections first, and indicate below whether you think these questions will work (or if any don't work). Then briefly review the three scenarios and indicate which one you think will work best. Then take a look at the questions included with the first scenario (the questions for all three scenarios are similar) and indicate whether you think these questions work/don't work.

## PERSONAL DIGITAL HEALTH LITERACY QUESTIONS

1. Questions 1-5 (in the personal digital health literacy section) seem like good questions to be included in the digital health literacy section of the assessment.

1	2	3	4	5
Strongly disagree				Strongly agree

2. If any of the questions do not seem like they would work well, please indicate which ones here:

QUESTION	BRIEF EXPLANATION

3. Questions 6-13 (in the general digital literacy section) seem like appropriate questions to include in the digital literacy section of the assessment.

1	2	3	4	5
Strongly disagree				Strongly agree

4. Among questions 6-13, were there a couple that stood out to you as particularly good questions for inclusion in the assessment?

QUESTION	QUESTION

5. Among questions 6-13, were there any questions that you think should definitely NOT be included in the digital literacy section of the assessment?

QUESTION	QUESTION

6. Please rank the three scenarios in order of which scenario you think works best to include to which one you think doesn't work as well (SCENARIO 1 = Prostate cancer; SCENARIO 2 = friend who is a heavy drinker; SCENARIO 3 = depression).

	SCENARIO
BEST (FIRST CHOICE)	
SECOND	
LAST	

**Take a look at the first six questions in SCENARIO 1 (these questions are similar for all three scenarios). Then answer the following question.**

7. Including these open-ended questions (1-6) seems like a good idea, even if they can't be included as part of an overall "health literacy score." (These questions would not be part of a quantitative health literacy score, but may provide some useful information).

1	2	3	4	5
Strongly disagree				Strongly agree

**Now take a look at questions 7-12 (repeat question, just with different website images). Then answer the following question.**

8. Including a few of these types of questions on evaluation of "usefulness" of web pages seems like a good idea as part of the digital literacy assessment.

1	2	3	4	5
Strongly disagree				Strongly agree

Thank you very much for your time and effort with helping me choose the best questions for inclusion in the first version of the health literacy assessment. Please feel free to provide any additional comments or suggestions.

## Appendix E: Health Literacy Assessment Pre-Test

### Demographics

1. How old are you? \_\_\_\_\_
2. Sex?
  - Male
  - Female
3. Ethnicity: Which do you consider yourself to be?
  - White
  - Black or African American
  - Asian
  - Hispanic
  - American Indian or Alaskan Native
  - Native Hawaiian or Other Pacific Islander
  - Other
4. Year in school?
  - Freshman
  - Sophomore
  - Junior
  - Senior
  - Graduate student

### Comprehension Section

#### Sentence Verification Technique

#### **DIRECTIONS:**

Read the following passage about gout and uric acid. After reading the passage, you will read another document about gout and uric acid and will be asked to indicate whether each sentence is a "YES" or "NO" sentence. "YES" sentences are defined as sentences that are the same as or mean the same as the original passage sentences. "NO" sentences have a different meaning than the original passage sentences.

## ***GOUT: Original***

### **GOUT**

*Source: National Institute of Arthritis and Musculoskeletal and Skin Diseases (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2011)*

Gout is a painful condition that occurs when the bodily waste product uric acid is deposited as needle-like crystals in the joints and/or soft tissues. In the joints, these uric acid crystals cause inflammatory arthritis, which in turn leads to intermittent swelling, redness, heat, pain, and stiffness in the joints.

In many people, gout initially affects the joints of the big toe (a condition called podagra). But many other joints and areas around the joints can be affected in addition to or instead of the big toe. These include the insteps, ankles, heels, knees, wrists, fingers, and elbows. Chalky deposits of uric acid, also known as tophi, can appear as lumps under the skin that surrounds the joints and covers the rim of the ear. Uric acid crystals can also collect in the kidneys and cause kidney stones.

### **URIC ACID**

Uric acid is a substance that results from the breakdown of purines. A normal part of all human tissue, purines are found in many foods. Normally, uric acid is dissolved in the blood and passed through the kidneys into the urine, where it is eliminated.

If there is an increase in the production of uric acid or if the kidneys do not eliminate enough uric acid from the body, levels of it build up in the blood (a condition called hyperuricemia). Hyperuricemia also may result when a person eats too many high-purine foods, such as liver, dried beans and peas, anchovies, and gravies. Hyperuricemia is not a disease, and by itself it is not dangerous. However, if excess uric acid crystals form as a result of hyperuricemia, gout can develop. The crystals form and accumulate in the joint, causing inflammation.

## ***GOUT: Test Sentences***

**DIRECTIONS:** Read each sentence and indicate whether that sentence is a “YES” sentence or a “NO” sentence. “YES” sentences are defined as sentences that are the same as or mean the same as the original passage sentences. “NO” sentences have a different meaning than the original passage sentences.

### **KEY**

O/Y: Original sentence (YES)

P/Y: Paraphrase sentence (YES)

M/N: Meaning change (NO)

D/N: Distracter (NO)



## GOUT

1. Gout occurs if too much uric acid builds up in the fluid around the joints and/or soft tissues, resulting in the formation of uric acid crystals in the joints – which is very painful (P/Y). 2. These crystals make the joint swell up and become inflamed causing the joint to appear warm and red and feel very tender and stiff (P/Y).

3. Although rare, sometimes gout affects the joints of the big toe (a condition called podagra) (M/N). 4. But usually other joints and areas around the big toe and other parts of the body are mainly affected (M/N). 5. These include the insteps, ankles, heels, knees, wrists, fingers, and elbows (O/Y). 6. It is more common in men, in women after menopause, and those who drink alcohol (D/N). 7. People who take certain medicines may have higher levels of uric acid in the blood (D/N).

## URIC ACID

8. Uric acid is a substance that causes the buildup of purines (M/N). 9. A normal part of all human tissue, purines are found in many foods (O/Y). 10. A relatively small number of foods, however, contain concentrated amounts of purines (D/N). 11. If there is a change in the production of uric acid or if the kidneys eliminate too much uric acid, the body builds up too much uric acid in the blood to compensate (a condition called hyperuricemia) (M/N).

12. Hyperuricemia also may result when a person eats too many high-purine foods, such as liver, dried beans and peas, anchovies, and gravies (O/Y). 13. Hyperuricemia is a disease, but it is hard to spread and not considered dangerous (M/N). 14. When the excess uric acid crystals accumulate in the joints as a result of hyperuricemia they can set the stage for a painful attack of gout (P/Y). 15. The crystals form and accumulate in the joint, causing inflammation (O/Y).

## Cloze Technique

Directions: Fill in the blank in the following sentences from the multiple-choice options.

### High Cholesterol: Cloze Technique

Source: Johns Hopkins Medicine (Johns Hopkins Medicine, 2011)

#### High Cholesterol and Triglyceride Levels

While fats (lipids) play a vital role in the body's metabolic processes, high blood levels of fats—a condition known as hyperlipidemia—increase the risk of coronary heart disease.

Two common lipid abnormalities are characterized either by high blood cholesterol levels (hypercholesterolemia) or high blood levels of triglycerides (hypertriglyceridemia). Cholesterol is manufactured primarily in the liver and then carried in the bloodstream by low density lipoprotein (LDL).

(Because cholesterol and other fats do not dissolve in (1)\_\_\_\_\_, they cannot travel through the blood unaided. Lipoproteins are (2)\_\_\_\_\_ formed in the liver to transport cholesterol and other (3)\_\_\_\_\_ through the bloodstream.)

1.	2.	3.
a. alcohol	a. food	a. plaques
<b>b. water</b>	b. a disorder	b. diseases
c. lipids	c. triglycerides	<b>c. fats</b>
d. sugar	<b>d. particles</b>	d. acids

Cholesterol is returned to the liver from other body (4)\_\_\_\_\_ by another lipoprotein, high density lipoprotein (HDL). From there, cholesterol is (5)\_\_\_\_\_ into the bile, either unchanged or after (6)\_\_\_\_\_ to bile acids.

4.	5.	6.
a. limbs	a. revealed	<b>a. conversion</b>
b. quadrants	<b>b. secreted</b>	b. functionalization
<b>c. cells</b>	c. fused	c. fusion
d. organs	d. controlled	d. translocation

Cholesterol is essential for the formation of cell (7)\_\_\_\_\_ and the manufacture of several hormones, but it is not (8)\_\_\_\_\_ from the diet because the liver produces all the (9)\_\_\_\_\_ the body needs.

7.	8.	9.
a. <b>membranes</b>	a. modified	a. cells
b. secretion	b. included	<b>b. cholesterol</b>
c. biochemicals	c. synthesized	c. cytosol
d. sebum	<b>d. required</b>	d. proteins

If blood cholesterol levels are (10)\_\_\_\_\_, large amounts of LDL (so-called “bad”) cholesterol can (11)\_\_\_\_\_ in the arterial walls. These deposits represent the first (12)\_\_\_\_\_ in the narrowing of arteries, termed atherosclerosis.

10.	11.	12.
a. purified	a. evolve	a. membrane
<b>b. elevated</b>	b. fuse	b. gradient
c. produced	<b>c. deposit</b>	<b>c. stage</b>
d. synthesized	d. modify	d. example

Because high (13)\_\_\_\_\_ levels cause no symptoms, preventive measures and regular measurement of (14)\_\_\_\_\_ levels are important for people in high-risk categories. High (15)\_\_\_\_\_ levels are especially dangerous when HDL (“good”) cholesterol levels are low.

13.	14.	15.
<b>a. cholesterol</b>	<b>a. cholesterol</b>	<b>a. cholesterol</b>
b. protein	b. protein	b. protein
c. secretion	c. secretion	c. secretion
d. bacteria	d. bacteria	d. bacteria

Left (16)\_\_\_\_\_, high cholesterol can eventually lead to a heart attack due to (17)\_\_\_\_\_ heart disease or a stroke due to narrowed (18)\_\_\_\_\_ supplying the brain.

16.	17.	18.
a. solidified	a. genetic	a. membranes
b. liquefied	<b>b. coronary</b>	b. systems
c. encoded	c. vertebrate	c. lipoproteins
<b>d. untreated</b>	d. circulatory	<b>d. arteries</b>

## Numeracy Questions

### Basic

Imagine you have just come home from surgery, and have been given the following at-home care instructions. Read the instructions and then answer the questions below.

*Your incision, or scar, has both stitches and steri-strips, which are small white strips of tape, and is covered by a gauze dressing and tape or a plastic dressing.*

*Do not remove the dressing, steri-strips or stiches. We will remove the dressing in seven to 10 days. We will also remove the sutures in one to two weeks unless they absorb on their own. If the dressing or steri-strips fall off, do not attempt to replace them. (At-home care instructions adapted from (University of California San Francisco Medical Center, 2011)*

5. If you haven't had a follow-up appointment yet, but it has been 10 days, should you remove the dressing yourself and replace it?
  - a. YES
  - b. NO**
  - c. Not enough information available to answer this question.
6. Can you get the affected area (which is covered with dressing) wet?
  - a. YES
  - b. NO
  - c. Not enough information available to answer this question.**

You have also been provided with the following instructions for taking your pain medication. Read the instructions and then answer the questions below.

*Your medication may be taken with or without food. Take two chewable tablets every 12 hours. Make sure you take it around the same time every day. The tablets should be crushed or chewed thoroughly before they are swallowed. (Adapted instructions from Medline Plus, (Medline Plus, 2011a)).*

7. How many times per day should you take your medication?
  - a. ONCE
  - b. TWICE**
  - c. THREE TIMES
  - d. Not enough information available to answer this question.

8. Can you take your medication with food in the morning, but take it without food at night?
- a. **YES**
  - b. NO
  - c. Not enough information available to answer this question.

### Computational

7. Triglycerides are a type of fat found in your blood and a high amount can raise your risk of heart disease. A normal level is less than 150. Borderline-high is 150-199, High is 200 to 499, and very high is 500 or higher. You just discovered you have a triglyceride level of 135. Should you be concerned? (WebMD, 2011)
- a. YES
  - b. **NO**
  - c. Not enough information available to answer this question
8. You just discovered that you have a triglyceride level of 150. Should you take medication?
- a. YES
  - b. NO
  - c. **Not enough information to answer this question.**
9. If you have high cholesterol and if you have a parent or sibling who developed heart disease before age 55, you are at a greater than average risk of developing heart disease. If your mother had good cholesterol, but developed heart disease when she was 50, are you at a greater than average risk of developing heart disease? (Mayo Clinic, 2011)
- a. **YES**
  - b. NO
  - c. Not enough information to answer this question
10. About 90 percent of lung cancer deaths in men are due to smoking. Are women more or less likely to develop lung cancer? (Centers for Disease Control and Prevention (CDC), 2011b)
- a. More
  - b. Less
  - c. **Not enough information to answer this question**
11. In 2009, the estimated number of diagnoses of HIV infection was 42,959. Of these, about half were reported as Black/African American. How many is that? (Department of Health and Human Services: Centers for Disease Control and Prevention, 2011)
- a. 20,480
  - b. **21,480**
  - c. 22,480
  - d. 23,480

## Analytical

10. The National Cancer Institute estimates that about 12.2 percent of women born today will be diagnosed with breast cancer at some point in their lives. This is the same as which of the following (National Cancer Institute, 2011):
- 2 in 5 women
  - 2 in 7 women
  - 1 in 8 women**
  - 1 in 12 women
11. In the 1970s, the lifetime risk of being diagnosed with breast cancer was 1 in 10. Has the average increased or decreased today (see question above)? (National Cancer Institute, 2011)
- Increased**
  - Decreased
  - Stayed the same
  - Not enough information to answer this question
12. A woman's chance of being diagnosed with breast cancer between age 30 and 39 is 0.43 percent and her chance of being diagnosed between age 40 and 49 is 1.45 percent (National Cancer Institute, 2011). Therefore:
- A woman's chance of breast cancer diagnosis increases three-fold between her 30s and 40s.**
  - A woman's chance of breast cancer diagnosis doubles between her 30s and 40s.
  - A woman's chance of breast cancer diagnosis decreases three-fold between her 30s and 40s.
  - A woman's chance of breast cancer diagnosis stays the same in her 30s and 40s.
13. At the end of 2008, an estimated 1,178,350 persons aged 13 and older were living with HIV infection in the United States. Of those, 20% had undiagnosed HIV infections, which is about how many people (Department of Health and Human Services: Centers for Disease Control and Prevention, 2011)?
- 78,000
  - 154,000
  - 236,000**
  - 365,000

## Statistical

7. About one out of six people between 14 and 49 years of age in the United States has genital herpes (Centers for Disease Control and Prevention (CDC), 2011c) About what percentage of the U.S. population is this ?
  - a. 9%
  - b. 16%**
  - c. 26%
  - d. Not enough information to answer this question
8. About 1 in five women have genital herpes (Centers for Disease Control and Prevention (CDC), 2011c. About what percentage of the U.S. population is this?
  - a. 20%**
  - b. 25%
  - c. 30%
  - d. Not enough information to answer this question
9. Smokers are 10 to 20 times more likely to get lung cancer than people who do not smoke. This is the same as:
  - a. 20 to 30 out of 200 people
  - b. 10 to 40 out of 200 people
  - c. 20 to 40 out of 200 people**
  - d. 10 to 30 out of 200 people
10. A person affected by an autosomal dominant disorder has a 50 percent chance of passing the mutated gene to each child (U.S. National Library of Medicine, 2011). If you have an autosomal dominant disorder, what is the chance that your child will NOT inherit the mutated gene?
  - a. 25 percent
  - b. 50 percent**
  - c. 100 percent
  - d. Not enough information to answer the question
11. Two unaffected people who each carry one copy of a mutated gene for an autosomal recessive disorder have a 25 percent chance with each pregnancy of having the child affected by the disorder. If you and your partner carry the mutated gene, but are not affected, and you become pregnant, what is the chance your child will NOT be affected by the disorder?
  - a. 25 percent
  - b. 50 percent
  - c. 75 percent**
  - d. Not enough information to answer the question
12. The chance of passing on a genetic condition applies equally to each pregnancy. If a couple has a child with an autosomal recessive disorder (see question above), the chance of having another child with the disorder is \_\_\_\_\_.
  - a. 25 percent**
  - b. 50 percent
  - c. 75 percent
  - d. Not enough information to answer this question

## Media Literacy

### MELANOMA

*National Cancer Institute's General Information about Melanoma*

DIRECTIONS: Take a look at the webpage below (\*Note to Reviewers: Survey website will provide a link to this webpage or have it embedded within the survey page:

<http://www.cancer.gov/cancertopics/pdq/treatment/melanoma/Patient>). Answer the following questions based on what you see in the webpage.

11. What is the purpose of the message on this webpage?
  - a. Provide treatment information about melanoma skin cancer.
  - b. Explain the different stages of melanoma skin cancer.
  - c. **Provide general, introductory information about melanoma skin cancer.**
  - d. Explain that melanoma skin cancer is dangerous and common for all adults.
12. Who is the author of this message?
  - a. Anonymous
  - b. National Cancer Institute
  - c. 1-800-4-Cancer
  - d. American Cancer Society
13. What makes this author credible?
  - a. Government site, authorship is clear, resources for information are cited, webpage states when this resource was last updated.
  - b. **Government site, authorship is clear, purpose of site is clear, webpage states when this resource was last updated.**
  - c. Government site, webpage states when this resources was last updated, tilde ~ in the URL.
  - d. Credibility cannot be identified or verified.
14. Has the information on this page been reviewed or created by health professional/s?
  - a. **Clearly YES**
  - b. Clearly NO
  - c. Not clear from the information available
15. When was the information last reviewed or updated?
  - a. January 11, 2011
  - b. **May 18, 2012**
  - c. Current date
  - d. Unknown



16. What point of view or information do you think is LEFT OUT of this message?
- It is important to understand the signs of possible melanoma, since it is an aggressive skin cancer.
  - It is important to understand the risk factors associated with developing melanoma.
  - Melanoma skin cancer is the most underfunded of all cancers by federal and private agencies and yet it is one of the most common cancers and needs more funding.**
  - Suspicious-looking areas that develop on the skin should be examined by a health professional as soon as possible.
17. Which statement most closely resembles the author/sender's view of the topic (based on the information provided on the webpage)?
- Fortunately, melanoma skin cancer is rarely fatal.
  - It is important to understand the signs and risk factors of melanoma skin cancer and how it can be diagnosed and treated.**
  - UV rays may not have anything to do with developing melanoma skin cancer (as many medical experts suggest), but it's still important to understand the possible risks associated with getting the cancer.
  - Both exposed and unexposed areas of the body can get melanoma skin cancer and therefore it's important to be aware of all the possible causes and risk factors associated with developing the cancer.
18. Is all of the information in this message likely based on scientific evidence?
- Yes**
  - Some parts
  - Missing evidence
19. How credible do you think this message is?
- Very credible
  - Fairly credible
  - Not credible
  - Not sure

## Gardasil: Media Literacy

DIRECTIONS: Please view the following webpage (\*Note to Reviewers: Survey website will provide a link to this webpage or have it embedded within the survey page: <http://www.gardasil.com/>). And answer the following questions about the webpage.

11. What is the main purpose of the message on this webpage?
  - a. To educate people about the human papillomavirus.
  - b. To explain why human papillomavirus vaccination is important for young women.
  - c. To promote the vaccine *Gardasil*.**
  - d. To provide information about a cure for cervical cancer.
12. Who is the author of this message?
  - a. Gardasil
  - b. FDA Staff
  - c. Merck**
  - d. Specific author not clear
13. What makes this author credible?
  - a. Government website, authorship is clear, resources for information are cited, webpage states when this resource was last updated.
  - b. Information published on a credible website, content of message is rich and contains valid research, website is not trying to generate revenue.
  - c. Information has been published in a public domain.
  - d. Credibility should be verified with additional information from other sources.**
14. Has the information on this page been reviewed or created by physicians or other health care professionals?
  - a. Clearly YES
  - b. Clearly NO
  - c. Not clear from information available on this webpage**
15. When was this information last reviewed or updated?
  - a. February 6, 2012
  - b. Today
  - c. December 2011
  - d. Unknown**

16. What point of view or information do you think is LEFT OUT of this message?
- a. The Gardasil vaccine may help prevent young men and women from developing or spreading HPV.
  - b. Gardasil does not protect against all forms of HPV.
  - c. Young men and women should get vaccinated before they become sexually active.
  - d. **There is a common misconception that the HPV vaccine protects against all types of HPV.**
17. Which statement most closely resembles the author/sender's view of the topic (based on the information provided on the webpage)?
- a. HPV is more common than many people think and vaccination is one way to prevent the virus from spreading.
  - b. **We encourage young men and women to get the Gardasil vaccination before its too late.**
  - c. It is especially important for boys to receive Gardasil as part of their routine vaccinations.
  - d. It is important for young men and women to understand the effects and side effects of taking (and not taking) any optional vaccinations.
18. Is all of the information in this message likely based on scientific evidence?
- a. **YES**
  - b. Some parts
  - c. Missing evidence
19. How credible do you think this message is?
- a. Very credible
  - b. Fairly credible
  - c. Not credible
  - d. Not sure

## Digital Literacy Questions

### Personal Digital Health Literacy Questions.

14. Have you searched for health information on the Internet?

NEVER      1-2 times      3-5 times      6-10 times      11+ times

15. How difficult was it to find the information you needed?

Difficult      Somewhat difficult      Not very difficult      Easy

16. Have you always been able to find the answers to your health-related questions?

NEVER      SELDOM      SOMETIMES      USUALLY      ALWAYS

17. What are some of the main websites you have used?

- l. Wikipedia
- m. WebMD
- n. National Institutes of Health
- o. Local hospital's website
- p. Large National hospital's website (such as Mayo Clinic)
- q. Other \_\_\_\_\_

18. Have you used digital applications (on your computer or smart phone device) for any of the following?

- a. Figuring out health-related scores, such as BMI (Body Mass Index)
- b. Food journaling, exercise journaling, or other health-related journaling
- c. Exercise routines
- d. Nutrition applications, such as calorie trackers, weight loss plans, or nutrition plans
- e. Other \_\_\_\_\_

### General digital literacy questions.

19. It costs money to run a website. Which of the following helps you figure out the source of a website's funding?
- Right-click on website homepage and then click on View Source.
  - Scrolling to the bottom of a website's homepage and viewing disclosure statement.
  - Checking the address of the website, such as addresses ending in ".gov," ".edu," ".org," or ".com."**
  - Right-click on the URL in the address bar and click Open URL.
20. How can you tell who runs a website? Which of the following indicates one way you can tell?
- Open the website's Javascript.
  - The organization/institution/company is clearly noted on every major page, along with a link to the site's homepage.**
  - Right-click on the website homepage and then click on View Source.
  - Right-click on the URL in the address bar and then click "Search in Google."
21. How can you tell what a health website's purpose is? Which of the following indicates one way you can tell?
- Use a search engine to find reviews of that website to see if you can find that website's true purpose.
  - Right-click on the website homepage and click on View Source.
  - Many websites have a link to information about the site, often called "About this Site." With a credible site, this page should clearly state the purpose of the site and help you evaluate the trustworthiness of the information displayed on that website.**
  - Check the address of the website and if the address is long, the website is most likely trying to sell you something.
22. How can you figure out what the original source of the website's information is?
- All websites put this information somewhere on their website. If the website contains a search box, try typing in "references" in the search box.
  - Good health and medical websites post this information at the end of material that was not originally created by the authors of that site.**
  - Do a crosscheck by copying part of the text of a website and pasting it into a search engine to see where else that same information appears.
  - Check the fact sheets listed at the bottom of a website's home page.
23. How can you tell how current the health information is on a website?
- Health experts should update the material on a regular basis. Good websites should clearly post the most recent update, but there if they**

**don't – there is no way to figure out when that information was last reviewed and updated.**

- b. Right-click on the home page and click View Source.
- c. All website creators are required to list this information somewhere on their website. Sometimes you have to search through the website to find this information.
- d. Scroll to the bottom of the website's homepage to find the most recent date listed.

***Scenario Digital Literacy Questions.***

Questions 1-6: Assessment

Questions 7- 12: Evaluate

**SCENARIO 1**

*You just discovered that your father has Stage 1 prostate cancer. His doctor told him he has a Gleason score of 6 and a PSA of 4.1. He is now faced with making a decision about several different treatment options. But he wants to make sure he understands what they all are and their corresponding side effects. You agree to help him research and understand all his options.*

- 10. How would you go about searching for information on the Internet? Please be as specific as possible.
- 11. What key words would you type into a search engine (regarding this topic)?
- 12. Which search engine would you use?
- 13. What websites (if any) would you most likely go to for information?
- 14. Of the following sources, which do you think would provide you with the most useful, accurate, diverse, and up-to-date information for answering your question about this topic?
  - a. Wikipedia
  - b. Medical Encyclopedia
  - c. National Cancer Institute
  - d. Your local hospital's website
- 15. Why do you think the source you indicated above would provide you with the most useful, accurate, diverse, and up-to-date information for answering your question about this topic?







## **Appendix F: Pre-test Invitation to Participate and Consent Form**

### ***Invitation to participate in research, extra credit in JTC \_\_\_\_***

We would like to invite you to participate in a research study to help us develop an assessment tool for measuring health literacy. By participating in this study, you will receive \_\_extra credit points in JTC \_\_\_\_\_. Information on the study and how to participate is below. If you cannot or would prefer not to participate in this study you may still earn \_\_\_\_extra credit points. Instructions for that extra credit opportunity are on the back of this sheet.

**To participate in this study, log into the survey website at this address \_\_\_\_\_ before X date.**

All of the details about the research project are provided below. Please take a few moments to look this information over and give consideration to participating in this project.

TITLE OF STUDY: "Comprehensive Health Literacy Assessment for Young Adults."

INVESTIGATORS: This is a research project being conducted by Raquel Harper, doctoral student, Department of Journalism and Technical Communication, and Craig Trumbo, Associate Professor, Department of Journalism and Technical Communication.

WHAT IS THE PURPOSE OF THIS STUDY? The purpose of this project is to develop a more comprehensive assessment of health literacy for young adults.

WHO WILL SEE THE INFORMATION THAT I GIVE? Your identity in this study is kept confidential. Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You will not be identified in these written materials. We may publish the results of this study; however, we will keep your name and other identifying information private.

WHY AM I BEING INVITED TO TAKE PART IN THIS RESEARCH? We are seeking participation from a random selection of college students.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST? The survey assessment is being conducted online and takes approximately 45 minutes to complete.

WHAT WILL I BE ASKED TO DO? The assessment contains questions about your health literacy pertaining to comprehension, numeracy, media literacy, and digital literacy. There are no potentially embarrassing or sensitive questions. After completing the assessment, you will be directed to a different screen to enter your email address to receive the extra credit. Your data and name will not be connected.

ARE THERE REASONS WHY I SHOULD NOT TAKE PART IN THE STUDY? If you are not prepared to answer assessment questions on reading comprehension, numeracy, media literacy, or digital literacy, you may not want to participate.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS? There are no foreseeable risks or discomforts to you from participating in this research study.

ARE THERE ANY BENEFITS FROM TAKING PART IN THIS STUDY? Aside from the extra credit, there are no direct benefits to you from participating in this research study. In a broader sense there may be benefits to public health researchers from an improved understanding of how to measure health literacy.

DO I HAVE TO TAKE PART IN THE STUDY? Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time. If you choose not to participate in the assessment you may still earn \_\_\_extra credit through a writing assignment that takes about the same amount of time and effort as completing the assessment.

WHAT WILL IT COST ME TO PARTICIPATE? There are no costs to you for joining this study.

WILL I RECEIVE ANY COMPENSATION FOR THIS STUDY? Xpoints of extra credit in JTC \_\_\_\_.

WHAT IF I HAVE QUESTIONS? Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind. You can contact the faculty supervisor, Craig Trumbo at 970-491-2077 or [ctrumbo@colostate.edu](mailto:ctrumbo@colostate.edu). If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655.

**Alternate Extra Credit Opportunity:**

If you cannot or would prefer not to participate in the health literacy assessment study you may still earn \_\_\_ points of extra credit in JTC \_\_\_\_\_. This alternate extra credit opportunity will take about as much time as it takes to participate in the research study. To use this option follow the instructions below:

Write a 400-word review essay comparing two views on a technical communication topic of your choice. This will entail finding two pieces of writing (i.e. journal articles) that express varying, perhaps even contradictory views, on a technical communication topic. You as the writer will then explain the two views that are expressed about this topic in your 400-word review essay. Include a bibliography for the two journal articles that you reviewed.

## Appendix G: Final Version of Health Literacy Assessment

### DEMOGRAPHICS

1. How old are you? \_\_\_\_\_
2. Sex?
  - Male
  - Female
3. Ethnicity: Which do you consider yourself to be?
  - White
  - Black or African American
  - Asian
  - Hispanic
  - American Indian or Alaskan Native
  - Native Hawaiian or Other Pacific Islander
  - Other
4. Year in school?
  - Freshman
  - Sophomore
  - Junior
  - Senior
  - Graduate student

### COMPREHENSION QUESTIONS

#### Sentence Verification Technique

#### **DIRECTIONS:**

Read the following passage about gout and uric acid. After reading the passage, you will read another document about gout and uric acid and will be asked to indicate whether each sentence is a “YES” or “NO” sentence. “YES” sentences are defined as sentences that are the same as or mean the same as the original passage sentences. “NO” sentences have a different meaning than the original passage sentences.

## **GOUT: Original**

### **GOUT**

*Source: National Institute of Arthritis and Musculoskeletal and Skin Diseases(National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2011)*

Gout is a painful condition that occurs when the bodily waste product uric acid is deposited as needle-like crystals in the joints and/or soft tissues. In the joints, these uric acid crystals cause inflammatory arthritis, which in turn leads to intermittent swelling, redness, heat, pain, and stiffness in the joints.

In many people, gout initially affects the joints of the big toe (a condition called podagra). But many other joints and areas around the joints can be affected in addition to or instead of the big toe. These include the insteps, ankles, heels, knees, wrists, fingers, and elbows. Chalky deposits of uric acid, also known as tophi, can appear as lumps under the skin that surrounds the joints and covers the rim of the ear. Uric acid crystals can also collect in the kidneys and cause kidney stones.

### **URIC ACID**

Uric acid is a substance that results from the breakdown of purines. A normal part of all human tissue, purines are found in many foods. Normally, uric acid is dissolved in the blood and passed through the kidneys into the urine, where it is eliminated.

If there is an increase in the production of uric acid or if the kidneys do not eliminate enough uric acid from the body, levels of it build up in the blood (a condition called hyperuricemia). Hyperuricemia also may result when a person eats too many high-purine foods, such as liver, dried beans and peas, anchovies, and gravies. If excess uric acid crystals form as a result of hyperuricemia, gout can develop. The crystals form and accumulate in the joint, causing inflammation.

## **GOUT: Test Sentences**

**DIRECTIONS:** Read each sentence and indicate whether that sentence is a “YES” sentence or a “NO” sentence. “YES” sentences are defined as sentences that are the same as or mean the same as the original passage sentences. “NO” sentences have a different meaning than the original passage sentences.

1. Gout occurs if too much uric acid builds up in the fluid around the joints and/or soft tissues, resulting in the formation of uric acid crystals in the joints – which is very painful.
  1. YES
  2. NO

2. Although rare, sometimes gout affects the joints of the big toe (a condition called podagra).
1. YES
  2. **NO**
3. But usually other joints and areas around the big toe and other parts of the body are mainly affected.
1. YES
  2. **NO**
4. It is more common in men, in women after menopause, and those who drink alcohol.
1. YES
  2. **NO**
5. Uric acid is a substance that causes the buildup of purines.
1. YES
  2. **NO**
6. A normal part of all human tissue, purines are found in many foods.
1. **YES**
  2. NO
7. If there is a change in the production of uric acid or if the kidneys eliminate too much uric acid, the body builds up too much uric acid in the blood to compensate (a condition called hyperuricemia).
1. YES
  2. **NO**
8. The crystals form and accumulate in the joint, causing inflammation.
1. **YES**
  2. NO

## High Cholesterol: Cloze Technique

Source: Johns Hopkins Medicine (Johns Hopkins Medicine, 2011)

### High Cholesterol and Triglyceride Levels

While fats (lipids) play a vital role in the body's metabolic processes, high blood levels of fats—a condition known as hyperlipidemia—increase the risk of coronary heart disease.

Two common lipid abnormalities are characterized either by high blood cholesterol levels (hypercholesterolemia) or high blood levels of triglycerides (hypertriglyceridemia). Cholesterol is manufactured primarily in the liver and then carried in the bloodstream by low density lipoprotein (LDL).

(Because cholesterol and other fats do not dissolve in water, they cannot travel through the blood unaided. Lipoproteins are particles formed in the liver to transport cholesterol and other fats through the bloodstream.)

Cholesterol is returned to the liver from other body cells by another lipoprotein, high density lipoprotein (HDL). From there, cholesterol is secreted into the bile, either unchanged or after conversion to bile acids.

Cholesterol is essential for the formation of cell (1) \_\_\_\_\_ and the manufacture of several hormones, but it is not (2) \_\_\_\_\_ from the diet because the liver produces all the (3) \_\_\_\_\_ the body needs.

1.	2.	3.
a. <b>membranes</b>	a. modified	a. cells
b. secretion	b. included	<b>b. cholesterol</b>
c. biochemicals	c. synthesized	c. cytosol
d. sebum	<b>d. required</b>	d. proteins

If blood cholesterol levels are (4) \_\_\_\_\_, large amounts of LDL (so-called “bad”) cholesterol can (5) \_\_\_\_\_ in the arterial walls. These deposits represent the first (6) \_\_\_\_\_ in the narrowing of arteries, termed atherosclerosis.

4.	5.	6.
a. purified	a. evolve	a. membrane
b. <b>elevated</b>	b. fuse	b. gradient
c. produced	<b>c. deposit</b>	<b>c. stage</b>
d. synthesized	d. modify	d. example

Because high (7)\_\_\_\_\_ levels cause no symptoms, preventive measures and regular measurement of (8)\_\_\_\_\_ levels are important for people in high-risk categories. High (9)\_\_\_\_\_ levels are especially dangerous when HDL (“good”) cholesterol levels are low.

7.	8.	9.
<b>a. cholesterol</b>	<b>a. cholesterol</b>	<b>a. cholesterol</b>
b. protein	b. protein	b. protein
c. secretion	c. secretion	c. secretion
d. bacteria	d. bacteria	d. bacteria

Left (10)\_\_\_\_\_, high cholesterol can eventually lead to a heart attack due to (11)\_\_\_\_\_ heart disease or a stroke due to narrowed (12)\_\_\_\_\_ supplying the brain.

10.	11.	12.
a. solidified	a. genetic	a. membranes
b. liquefied	<b>b. coronary</b>	b. systems
c. encoded	c. vertebrate	c. lipoproteins
<b>d. untreated</b>	d. circulatory	<b>d. arteries</b>

## NUMERACY QUESTIONS

### BASIC

Imagine you have just come home from surgery, and have been given the following at-home care instructions. Read the instructions and then answer the questions below.

*Your incision, or scar, has both stitches and steri-strips, which are small white strips of tape, and is covered by a gauze dressing and tape or a plastic dressing.*

*Do not remove the dressing, steri-strips or stiches. We will remove the dressing in seven to 10 days. We will also remove the sutures in one to two weeks unless they absorb on their own. If the dressing or steri-strips fall off, do not attempt to replace them. (At-home care instructions adapted from (University of California San Francisco Medical Center, 2011)*

1. If you haven't had a follow-up appointment yet, but it has been 10 days, should you remove the dressing yourself and replace it?
  - a. YES
  - b. NO**
  - c. Not enough information available to answer this question.
2. Can you get the affected area (which is covered with dressing) wet?
  - a. YES
  - b. NO
  - c. Not enough information available to answer this question.**

You have also been provided with the following instructions for taking your pain medication. Read the instructions and then answer the questions below.

*Your medication may be taken with or without food. Take two chewable tablets every 12 hours. Make sure you take it around the same time every day. The tablets should be crushed or chewed thoroughly before they are swallowed. (Adapted instructions from Medline Plus, (Medline Plus, 2011a)).*

3. Can you take your medication with food in the morning, but take it without food at night?
  - a. YES**
  - b. NO
  - c. Not enough information available to answer this question.



## COMPUTATIONAL

4. About 90 percent of lung cancer deaths in men are due to smoking. Are women more or less likely to develop lung cancer?
  - a. More
  - b. Less
  - c. **Not enough information to answer this question**
5. In 2009, the estimated number of diagnoses of HIV infection was 42,959. Of these, about half were reported as Black/African American. How many is that?
  - a. 20,480
  - b. **21,480**
  - c. 22,480
  - d. 23,480

## ANALYTICAL

6. The National Cancer Institute estimates that about 12.2 percent of women born today will be diagnosed with breast cancer at some point in their lives. This is the same as which of the following:
  - a. 2 in 5 women
  - b. 2 in 7 women
  - c. **1 in 8 women**
  - d. 1 in 12 women
7. In the 1970s, the lifetime risk of being diagnosed with breast cancer was 1 in 10. Has the average increased or decreased today (see question above)?
  - a. **Increased**
  - b. Decreased
  - c. Stayed the same
  - d. Not enough information to answer this question
8. A woman's chance of being diagnosed with breast cancer between age 30 and 39 is 0.43 percent and her chance of being diagnosed between age 40 and 49 is 1.45 percent. Therefore:
  - a. **A woman's chance of breast cancer diagnosis increases three-fold between her 30s and 40s.**
  - b. A woman's chance of breast cancer diagnosis doubles between her 30s and 40s.
  - c. A woman's chance of breast cancer diagnosis decreases three-fold between her 30s and 40s.
  - d. A woman's chance of breast cancer diagnosis stays the same in her 30s and 40s.

9. At the end of 2008, an estimated 1,178,350 persons aged 13 and older were living with HIV infection in the United States. Of those, 20% had undiagnosed HIV infections, which is about how many people?
- a. 78,000
  - b. 154,000
  - c. 236,000**
  - d. 365,000

## STATISTICAL

10. Smokers are 10 to 20 times more likely to get lung cancer than people who do not smoke. This is the same as:
- a. 20 to 30 out of 200 people
  - b. 10 to 40 out of 200 people
  - c. 20 to 40 out of 200 people**
  - d. 10 to 30 out of 200 people
11. Two unaffected people who each carry one copy of a mutated gene for an autosomal recessive disorder have a 25 percent chance with each pregnancy of having the child affected by the disorder. If you and your partner carry the mutated gene, but are not affected, and you become pregnant, what is the chance your child will NOT be affected by the disorder?
- a. 25 percent
  - b. 50 percent
  - c. 75 percent**
  - d. Not enough information to answer the question
12. The chance of passing on a genetic condition applies equally to each pregnancy. If a couple has a child with an autosomal recessive disorder (see question above), the chance of having another child with the disorder is \_\_\_\_\_.
- a. 25 percent**
  - b. 50 percent
  - c. 75 percent
  - d. Not enough information to answer this question

## MEDIA LITERACY QUESTIONS

### MELANOMA

*National Cancer Institute's General Information about Melanoma*

DIRECTIONS: Take a look at the webpage below. Answer the following questions based on what you see in the webpage.

Webpage: <http://www.cancer.gov/cancertopics/pdq/treatment/melanoma/Patient>

1. What is the purpose of the message on this webpage?
  - a. Provide treatment information about melanoma skin cancer.
  - b. Explain the different stages of melanoma skin cancer.
  - c. Provide general, introductory information about melanoma skin cancer.**
  - d. Explain that melanoma skin cancer is dangerous and common for all adults.
2. Who is responsible for this message?
  - a. Anonymous
  - b. National Cancer Institute
  - c. 1-800-4-Cancer
  - d. American Cancer Society
3. What makes this author credible?
  - a. Government site, authorship is clear, resources for information are cited, webpage states when this resource was last updated.
  - b. Government site, authorship is clear, purpose of site is clear, webpage states when this resource was last updated.**
  - c. Government site, webpage states when this resources was last updated, tilde ~ in the URL.
  - d. Credibility cannot be identified or verified.
4. When was the information last reviewed or updated?
  - a. January 11, 2011
  - b. May 18, 2012**
  - c. Current date
  - d. Unknown

## GARDASIL: MEDIA LITERACY

DIRECTIONS: Please view the following webpage and answer the following questions about the webpage.

Webpage: <http://www.gardasil.com/>

1. What is the main purpose of the message on this webpage?
  - a. To educate people about the human papillomavirus.
  - b. To explain why human papillomavirus vaccination is important for young women.
  - c. To promote the vaccine *Gardasil*.**
  - d. To provide information about a cure for cervical cancer.
2. Who is responsible for this message?
  - a. Gardasil
  - b. FDA Staff
  - c. Merck**
  - d. Specific author not clear
3. What makes this author credible?
  - a. Government website, authorship is clear, resources for information are cited, webpage states when this resource was last updated.
  - b. Information published on a credible website, content of message is rich and contains valid research, website is not trying to generate revenue.
  - c. Information has been published in a public domain.
  - d. Credibility should be verified with additional information from other sources.**
4. When was this information last reviewed or updated?
  - a. February 6, 2012
  - b. Today
  - c. December 2011
  - d. Unknown**

## HEALTH INFORMATION-SEEKING QUESTIONS

### Personal Digital Health Literacy Questions

1. Have you searched for health information on the Internet?

NEVER      1-2 times      3-5 times      6-10 times      11+ times

2. How difficult was it to find the information you needed?

Difficult      Somewhat difficult      Not very difficult      Easy

3. Have you always been able to find the answers to your health-related questions?

NEVER      SELDOM      SOMETIMES      USUALLY      ALWAYS

4. What are some of the main websites you have used?

- r. Wikipedia
- s. WebMD
- t. National Institutes of Health
- u. Local hospital's website
- v. Large National hospital's website (such as Mayo Clinic)
- w. Other \_\_\_\_\_

5. Have you used digital applications (on your computer or smart phone device) for any of the following?

- f. Figuring out health-related scores, such as BMI (Body Mass Index)
- g. Food journaling, exercise journaling, or other health-related journaling
- h. Exercise routines
- i. Nutrition applications, such as calorie trackers, weight loss plans, or nutrition plans
- j. Other \_\_\_\_\_

## DIGITAL LITERACY QUESTIONS

1. It costs money to run a website. Which of the following helps you figure out the source of a website's funding?
  - a. Right-click on website homepage and then click on View Source.
  - b. Scrolling to the bottom of a website's homepage and viewing disclosure statement.
  - c. Checking the address of the website, such as addresses ending in ".gov," ".edu," ".org," or ".com."**
  - d. Right-click on the URL in the address bar and click Open URL.
2. How can you tell who runs a website? Which of the following indicates one way you can tell?
  - a. Open the website's Javascript.
  - b. The organization/institution/company is clearly noted on every major page, along with a link to the site's homepage.**
  - c. Right-click on the website homepage and then click on View Source.
  - d. Right-click on the URL in the address bar and then click "Search in Google."
3. How can you tell what a health website's purpose is? Which of the following indicates one way you can tell?
  - a. Use a search engine to find reviews of that website to see if you can find that website's true purpose.
  - b. Right-click on the website homepage and click on View Source.
  - c. Many websites have a link to information about the site, often called "About this Site." With a credible site, this page should clearly state the purpose of the site and help you evaluate the trustworthiness of the information displayed on that website.**
  - d. Check the address of the website and if the address is long, the website is most likely trying to sell you something.
4. How can you figure out what the original source of the website's information is?
  - a. All websites put this information somewhere on their website. If the website contains a search box, try typing in "references" in the search box.
  - b. Good health and medical websites post this information at the end of material that was not originally created by the authors of that site.**
  - c. Do a crosscheck by copying part of the text of a website and pasting it into a search engine to see where else that same information appears.
  - d. Check the fact sheets listed at the bottom of a website's home page.

5. How can you tell how current the health information is on a website?
  - a. **Health experts should update the material on a regular basis. Good websites should clearly post the most recent update, but there if they don't - there is no way to figure out when that information was last reviewed and updated.**
  - b. Right-click on the home page and click View Source.
  - c. All website creators are required to list this information somewhere on their website. Sometimes you have to search through the website to find this information.
  - d. Scroll to the bottom of the website's homepage to find the most recent date listed.





## Appendix H: Codebook for Health Literacy Assessment Questions

### **DEMOGRAPHICS**

**AGE** How old are you?

1=18	2=19	3=20	4=21	5=22
6=23	7=24	8=25	9=26	10=27
11=28	12=29	13=30	14=31	15=32
16=33	17=34	18=35	19=36	20=37
21=38	22=39	23=40+		

**SEX** What is your sex?

1. Male
2. Female

**ETHNICITY** Which do you consider yourself to be?

1. White
2. Black or African American
3. Asian
4. Hispanic
5. American Indian or Alaskan Native
6. Native Hawaiian or Other Pacific Islander
7. Other

**SCHYEAR** Year in school?

1. Freshman
2. Sophomore
3. Junior
4. Senior
5. Graduate student

### **COMPREHENSION SECTION ONE: SENTENCE VERIFICATION TECHNIQUE**

**GOUT 1**

Gout occurs if too much uric acid builds up in the fluid around the joints and/or soft tissues, resulting in the formation of uric acid crystals in the joints – which is very painful.

- 3. YES**
4. NO

GOUT 2

These crystals make the joint swell up and become inflamed causing the joint to appear warm and red and feel very tender and stiff.

1. **YES**
2. **NO**

GOUT 3

Although rare, sometimes gout affects the joints of the big toe (a condition called podagra).

3. **YES**
4. **NO**

GOUT 4

But usually other joints and areas around the big toe and other parts of the body are mainly affected.

3. **YES**
4. **NO**

GOUT 5

These include the insteps, ankles, heels, knees, wrists, fingers, and elbows.

1. **YES**
2. **NO**

GOUT 6

It is more common in men, in women after menopause, and those who drink alcohol.

3. **YES**
4. **NO**

GOUT 7

People who take certain medicines may have higher levels of uric acid in the blood.

1. **YES**
2. **NO**

GOUT 8

Uric acid is a substance that causes the buildup of purines.

3. **YES**
4. **NO**

GOUT 9

A normal part of all human tissue, purines are found in many foods.

3. **YES**
4. **NO**

GOUT 10

A relatively small number of foods, however, contain concentrated amounts of purines.

1. **YES**
2. NO

GOUT 11

If there is a change in the production of uric acid or if the kidneys eliminate too much uric acid, the body builds up too much uric acid in the blood to compensate (a condition called hyperuricemia).

3. YES
4. **NO**

GOUT 12

Hyperuricemia also may result when a person eats too many high-purine foods, such as liver, dried beans and peas, anchovies, and gravies.

1. **YES**
2. NO

GOUT 13

When excess uric acid crystals accumulate in the joints as a result of hyperuricemia they can set the stage for a painful attack of gout.

1. **YES**
2. NO

GOUT 14

The crystals form and accumulate in the joint, causing inflammation.

3. **YES**
4. NO

**COMPREHENSION SECTION TWO: CLOZE TECHNIQUE**

CLOZE1

(Because cholesterol and other fats do not dissolve in (**CHOOSE ANSWER**) \_\_\_\_\_, they cannot travel through the blood unaided. Lipoproteins are \_\_\_\_\_ formed in the liver to transport cholesterol and other \_\_\_\_\_ through the bloodstream.)

1. Alcohol
2. **Water**
3. Lipids
4. sugar

CLOZE2

(Because cholesterol and other fats do not dissolve in \_\_\_\_\_, they cannot travel through the blood unaided. Lipoproteins are (**CHOOSE ANSWER**)\_\_\_\_\_ formed in the liver to transport cholesterol and other \_\_\_\_\_ through the bloodstream.)

1. food
2. a disorder
3. triglycerides
4. **particles**

CLOZE3

(Because cholesterol and other fats do not dissolve in \_\_\_\_\_, they cannot travel through the blood unaided. Lipoproteins are \_\_\_\_\_ formed in the liver to transport cholesterol and other (**CHOOSE ANSWER**)\_\_\_\_\_ through the bloodstream.)

1. plaques
2. diseases
3. **fats**
4. acids

CLOZE4

Cholesterol is returned to the liver from other body (**CHOOSE ANSWER**)\_\_\_\_\_ by another lipoprotein, high density lipoprotein (HDL). From there, cholesterol is \_\_\_\_\_ into the bile, either unchanged or after \_\_\_\_\_ to bile acids.

1. limbs
2. quadrants
3. **cells**
4. organs

CLOZE5

Cholesterol is returned to the liver from other body \_\_\_\_\_ by another lipoprotein, high density lipoprotein (HDL). From there, cholesterol is (**CHOOSE ANSWER**)\_\_\_\_\_ into the bile, either unchanged or after \_\_\_\_\_ to bile acids.

1. revealed
2. **secreted**
3. fused
4. controlled

CLOZE6

Cholesterol is returned to the liver from other body \_\_\_\_\_ by another lipoprotein, high density lipoprotein (HDL). From there, cholesterol is \_\_\_\_\_ into the bile, either unchanged or after (**CHOOSE ANSWER**) \_\_\_\_\_ to bile acids.

1. **conversion**
2. functionalization
3. fusion
4. translocation

CLOZE7

Cholesterol is essential for the formation of cell (**CHOOSE ANSWER**) \_\_\_\_\_ and the manufacture of several hormones, but it is not (8) \_\_\_\_\_ from the diet because the liver produces all the (9) \_\_\_\_\_ the body needs.

1. **membranes**
2. secretion
3. biochemicals
4. sebum

CLOZE8

Cholesterol is essential for the formation of cell \_\_\_\_\_ and the manufacture of several hormones, but it is not (**CHOOSE ANSWER**) \_\_\_\_\_ from the diet because the liver produces all the \_\_\_\_\_ the body needs.

1. modified
2. included
3. synthesized
4. **required**

CLOZE9

Cholesterol is essential for the formation of cell \_\_\_\_\_ and the manufacture of several hormones, but it is not \_\_\_\_\_ from the diet because the liver produces all the (**CHOOSE ANSWER**) \_\_\_\_\_ the body needs.

1. cells
2. **cholesterol**
3. cytosol
4. proteins

CLOZE10

If blood cholesterol levels are (**CHOOSE ANSWER**) \_\_\_\_\_, large amounts of LDL (so-called “bad”) cholesterol can \_\_\_\_\_ in the arterial walls. These deposits represent the first \_\_\_\_\_ in the narrowing of arteries, termed atherosclerosis.

1. purified
2. **elevated**
3. produced
4. synthesized

CLOZE11

If blood cholesterol levels are \_\_\_\_\_, large amounts of LDL (so-called “bad”) cholesterol can (**CHOOSE ANSWER**) \_\_\_\_\_ in the arterial walls. These deposits represent the first \_\_\_\_\_ in the narrowing of arteries, termed atherosclerosis.

1. evolve
2. fuse
3. **deposit**
4. modify

CLOZE12

If blood cholesterol levels are \_\_\_\_\_, large amounts of LDL (so-called “bad”) cholesterol can \_\_\_\_\_ in the arterial walls. These deposits represent the first (**CHOOSE ANSWER**) \_\_\_\_\_ in the narrowing of arteries, termed atherosclerosis.

1. membrane
2. gradient
3. **stage**
4. example

CLOZE13

Because high (**CHOOSE ANSWER**) \_\_\_\_\_ levels cause no symptoms, preventive measures and regular measurement of \_\_\_\_\_ levels are important for people in high-risk categories. High (\_\_\_\_\_ levels are especially dangerous when HDL (“good”) cholesterol levels are low.

1. **cholesterol**
2. protein
3. secretion
4. bacteria

CLOZE14

Because high \_\_\_\_\_ levels cause no symptoms, preventive measures and regular measurement of (**CHOOSE ANSWER**) \_\_\_\_\_ levels are important for people in high-risk categories. High \_\_\_\_\_ levels are especially dangerous when HDL (“good”) cholesterol levels are low.

1. **cholesterol**
2. protein
3. secretion
4. bacteria

CLOZE15

Because high \_\_\_\_\_ levels cause no symptoms, preventive measures and regular measurement of \_\_\_\_\_ levels are important for people in high-risk categories. High (**CHOOSE ANSWER**) \_\_\_\_\_ levels are especially dangerous when HDL (“good”) cholesterol levels are low.

1. **cholesterol**
2. protein
3. secretion
4. bacteria

CLOZE16

Left (**CHOOSE ANSWER**) \_\_\_\_\_, high cholesterol can eventually lead to a heart attack due to \_\_\_\_\_ heart disease or a stroke due to narrowed \_\_\_\_\_ supplying the brain.

1. solidified
2. liquefied
3. encoded
4. **untreated**

CLOZE17

Left \_\_\_\_\_, high cholesterol can eventually lead to a heart attack due to (**CHOOSE ANSWER**) \_\_\_\_\_ heart disease or a stroke due to narrowed \_\_\_\_\_ supplying the brain.

1. genetic
2. **coronary**
3. vertebrate
4. circulatory

### CLOZE18

Left \_\_\_\_\_, high cholesterol can eventually lead to a heart attack due to \_\_\_\_\_ heart disease or a stroke due to narrowed (**CHOOSE ANSWER**) \_\_\_\_\_ supplying the brain.

1. membranes
2. systems
3. lipoproteins
4. **arteries**

## NUMERACY

### **BASIC**

#### BASNUM1

If you haven't had a follow-up appointment yet, but it has been 10 days, should you remove the dressing yourself and replace it?

1. YES
2. **NO**
3. Not enough information to answer this question.

#### BASNUM2

Can you get the infected area (which is covered with dressing) wet?

1. YES
2. NO
3. **Not enough information to answer this question**

#### BASNUM3

How many times per day should you take your medication?

1. ONCE
2. **TWICE**
3. THREE TIMES
4. Not enough information to answer this question.



## BASNUM4

Can you take your medication with food in the morning, but take it without food at night?

1. **YES**
2. NO
3. Not enough information to answer this question.

## COMPUTATIONAL

### COMP1

Triglycerides are a type of fat found in your blood and a high amount can raise your risk of heart disease. A normal level is less than 150. Borderline-high is 150-199, High is 200 to 499, and very high is 500 or higher. You just discovered you have a triglyceride level of 135. Should you be concerned?

1. YES
2. **NO**
3. Not enough information available to answer this question

### COMP2

You just discovered that you have a triglyceride level of 150. Should you take medication?

1. YES
2. NO
3. **Not enough information to answer this question.**

### COMP3

If you have high cholesterol and if you have a parent or sibling who developed heart disease before age 55, you are at a greater than average risk of developing heart disease. If your mother had good cholesterol, but developed heart disease when she was 50, are you at a greater than average risk of developing heart disease?

1. **YES**
2. NO
3. Not enough information to answer this question

### COMP4

About 90 percent of lung cancer deaths in men are due to smoking. Are women more or less likely to develop lung cancer?

1. More
2. Less
3. **Not enough information to answer this question**

## COMPNS5

In 2009, the estimated number of diagnoses of HIV infection was 42,959. Of these, about half were reported as Black/African American. How many is that?

1. 20,480
- 2. 21,480**
3. 22,480
4. 23,480

## ANALYTICAL

### ANALY1

The National Cancer Institute estimates that about 12.2 percent of women born today will be diagnosed with breast cancer at some point in their lives. This is the same as which of the following:

1. 2 in 5 women
2. 2 in 7 women
- 3. 1 in 8 women**
4. 1 in 12 women

### ANALY2

In the 1970s, the lifetime risk of being diagnosed with breast cancer was 1 in 10. Has the average increased or decreased today (see question above)?

- 1. Increased**
2. Decreased
3. Stayed the same
4. Not enough information to answer this question

### ANALY3

A woman's chance of being diagnosed with breast cancer between age 30 and 39 is 0.43 percent and her chance of being diagnosed between age 40 and 49 is 1.45 percent. Therefore:

- 1. A woman's chance of breast cancer diagnosis increases three-fold between her 30s and 40s.**
2. A woman's chance of breast cancer diagnosis doubles between her 30s and 40s.
3. A woman's chance of breast cancer diagnosis decreases three-fold between her 30s and 40s.
4. A woman's chance of breast cancer diagnosis stays the same in her 30s and 40s.

#### ANALY4

At the end of 2008, an estimated 1,178,350 persons aged 13 and older were living with HIV infection in the United States. Of those, 20% had undiagnosed HIV infections, which is about how many people?

1. 78,000
2. 154,000
- 3. 236,000**
4. 365,000

#### STATISTICAL

##### STATS1

About one out of six people between 14 and 49 years of age in the United States has genital herpes. About what percentage of the U.S. population is this?

1. 9%
- 2. 16%**
3. 26%
4. Not enough information to answer this question

##### STATS2

About 1 in five women have genital herpes. About what percentage of the U.S. population is this?

- 1. 20%**
2. 25%
3. 30%
4. Not enough information to answer this question

##### STATS3

Smokers are 10 to 20 times more likely to get lung cancer than people who do not smoke. This is the same as:

1. 20 to 30 out of 200 people
2. 10 to 40 out of 200 people
- 3. 20 to 40 out of 200 people**
4. 10 to 30 out of 200 people

##### STATS4

A person affected by an autosomal dominant disorder has a 50 percent chance of passing the mutated gene to each child. If you have an autosomal dominant disorder, what is the chance that your child will NOT inherit the mutated gene?

1. 25 percent
- 2. 50 percent**
3. 100 percent
4. Not enough information to answer the question

#### STATS5

Two unaffected people who each carry one copy of a mutated gene for an autosomal recessive disorder have a 25 percent chance with each pregnancy of having the child affected by the disorder. If you and your partner carry the mutated gene, but are not affected, and you become pregnant, what is the chance your child will NOT be affected by the disorder?

1. 25 percent
2. 50 percent
- 3. 75 percent**
4. Not enough information to answer the question

#### STATS6

The chance of passing on a genetic condition applies equally to each pregnancy. If a couple has a child with an autosomal recessive disorder (see question above), the chance of having another child with the disorder is \_\_\_\_\_.

- 1. 25 percent**
2. 50 percent
3. 75 percent
4. Not enough information to answer this question.

## MEDIA LITERACY

### MELANOMA SKIN CANCER

#### CANCERML1

What is the purpose of the message on this webpage?

1. Provide treatment information about melanoma skin cancer.
2. Explain the different stages of melanoma skin cancer.
- 3. Provide general, introductory information about melanoma skin cancer.**
4. Explain that melanoma skin cancer is dangerous and common for all adults.

#### CANCERML2

Who is the author of this message?

1. Anonymous
- 2. National Cancer Institute**
3. 1-800-4-Cancer
4. American Cancer Society

CANCERML3

What makes this author credible?

1. Government site, authorship is clear, resources for information are cited, webpage states when this resource was last updated.
- 2. Government site, authorship is clear, purpose of site is clear, webpage states when this resource was last updated.**
3. Government site, webpage states when this resources was last updated, tilde ~ in the URL.
4. Credibility cannot be identified or verified.

CANCERML4

Has the information on this page been reviewed or created by health professional/s?

- 1. Clearly YES**
2. Clearly NO
3. Not clear from the information available

CANCERML5

When was the information last reviewed or updated?

1. January 11, 2011
- 2. May 18, 2012**
3. Current date
4. Unknown

CANCERML6

What point of view or information do you think is LEFT OUT of this message?

1. It is important to understand the signs of possible melanoma, since it is an aggressive skin cancer.
2. It is important to understand the risk factors associated with developing melanoma.
- 3. Melanoma skin cancer is the most underfunded of all cancers by federal and private agencies and yet it is one of the most common cancers and needs more funding.**
4. Suspicious-looking areas that develop on the skin should be examined by a health professional as soon as possible.

CANCERML7

Is all of the information in this message likely based on scientific evidence?

- 1. Yes**
2. Some parts
3. Missing evidence

## CANCERML8

How credible do you think this message is?

1. Very credible
2. Fairly credible
3. Not credible
4. Not sure

## GARDASIL

### GARDML1

What is the main purpose of the message on this webpage?

1. To educate people about the human papillomavirus.
2. To explain why human papillomavirus vaccination is important for young women.
3. **To promote the vaccine *Gardasil*.**
4. To provide information about a cure for cervical cancer.

### GARDML2

Who is the author of this message?

1. Gardasil
2. FDA Staff
3. **Merck**
4. Specific author not clear

### GARDML3

What makes this author credible?

1. Government website, authorship is clear, resources for information are cited, webpage states when this resource was last updated.
2. Information published on a credible website, content of message is rich and contains valid research, website is not trying to generate revenue.
3. Information has been published in a public domain.
4. **Credibility should be verified with additional information from other sources.**

### GARDML4

Has the information on this page been reviewed or created by physicians or other health care professionals?

1. Clearly YES
2. Clearly NO
3. **Not clear from information available on this webpage**

GARDML5

When was this information last reviewed or updated?

1. February 6, 2012
2. Today
3. December 2011
4. **Unknown**

GARDML6

What point of view or information do you think is LEFT OUT of this message?

1. The Gardasil vaccine may help prevent young men and women from developing or spreading HPV.
2. Gardasil does not protect against all forms of HPV.
3. Young men and women should get vaccinated before they become sexually active.
4. **There is a common misconception that the HPV vaccine protects against all types of HPV.**

GARDML7

Which statement most closely resembles the author/sender's view of the topic (based on the information provided on the webpage)?

1. HPV is more common than many people think and vaccination is one way to prevent the virus from spreading.
2. **We encourage young men and women to get the Gardasil vaccination before its too late.**
3. It is especially important for boys to receive Gardasil as part of their routine vaccinations.
4. It is important for young men and women to understand the effects and side effects of taking (and not taking) any optional vaccinations.

GARDML8

Is all of the information in this message likely based on scientific evidence?

1. **YES**
2. Some parts
3. Missing evidence

GARDML9

How credible do you think this message is?

1. Very credible
2. Fairly credible
3. Not credible
4. Not sure

## **DIGITAL LITERACY**

### **DLSEARCH**

Have you searched for health information on the Internet?

1. NEVER
2. 1-2 times
3. 3-5 times
4. 6-10 times
5. 11+ times

### **DLDIFFICULT**

How difficult was it to find the information you needed?

1. Difficult
2. Somewhat difficult
3. Not very difficult
4. Easy

### **DLFIND**

Have you always been able to find the answers to your health-related questions?

1. NEVER
2. SELDOM
3. SOMETIMES
4. USUALLY
5. ALWAYS

### **DLWiki**

What are some of the main websites you have used?

0. Null
1. Wikipedia

### **DLWebMD**

What are some of the main websites you have used?

0. Null
1. WebMD

### **DLNIH**

What are some of the main websites you have used?

0. Null
1. National Institutes of Health

### **DLLocal**

What are some of the main websites you have used?

0. Null
1. Local hospital website



DLLarge

What are some of the main websites you have used?

0. Null
1. Large hospital website (like Mayo Clinic)

DLOther

What are some of the main websites you have used?

0. Null
1. Other

DLSCORES

Have you used digital applications (on your computer or smart phone device) for any of the following?

0. NULL
1. Figuring out health-related scores, such as BMI (Body Mass Index)

DLJOURNAL

Have you used digital applications (on your computer or smart phone device) for any of the following?

0. NULL
1. Food journaling, exercise journaling, or other health-related journaling

DLEXERCISE

Have you used digital applications (on your computer or smart phone device) for any of the following?

0. NULL
1. Exercise routines

DLNUTAPP

Have you used digital applications (on your computer or smart phone device) for any of the following?

0. NULL
1. Nutrition applications, such as calorie trackers, weight loss plans, or nutrition plans

DLAPPOTHER

Have you used digital applications (on your computer or smart phone device) for any of the following?

0. NULL
1. Other \_\_\_\_\_

## **DIGITAL LITERACY GENERAL Q'S**

### **DLSOURCE**

It costs money to run a website. Which of the following helps you figure out the source of a website's funding?

1. Right-click on website homepage and then click on View Source.
2. Scrolling to the bottom of a website's homepage and viewing disclosure statement.
3. **Checking the address of the website, such as addresses ending in ".gov," ".edu," ".org," or ".com."**
4. Right-click on the URL in the address bar and click Open URL.

### **DLRUNWEB**

How can you tell who runs a website? Which of the following indicates one way you can tell?

1. Open the website's Javascript.
2. **The organization/institution/company is clearly noted on every major page, along with a link to the site's homepage.**
3. Right-click on the website homepage and then click on View Source.
4. Right-click on the URL in the address bar and then click "Search in Google."

### **DLPURPOSE**

How can you tell what a health website's purpose is? Which of the following indicates one way you can tell?

1. Use a search engine to find reviews of that website to see if you can find that website's true purpose.
2. Right-click on the website homepage and click on View Source.
3. **Many websites have a link to information about the site, often called "About this Site." With a credible site, this page should clearly state the purpose of the site and help you evaluate the trustworthiness of the information displayed on that website.**
4. Check the address of the website and if the address is long, the website is most likely trying to sell you something.

## DLOrigSourc

How can you figure out what the original source of the website's information is?

1. All websites put this information somewhere on their website. If the website contains a search box, try typing in "references" in the search box.
2. **Good health and medical websites post this information at the end of material that was not originally created by the authors of that site.**
3. Do a crosscheck by copying part of the text of a website and pasting it into a search engine to see where else that same information appears.
4. Check the fact sheets listed at the bottom of a website's home page.

## DLCURRENT

How can you tell how current the health information is on a website?

1. **Health experts should update the material on a regular basis. Good websites should clearly post the most recent update, but there if they don't – there is no way to figure out when that information was last reviewed and updated.**
2. Right-click on the home page and click View Source.
3. All website creators are required to list this information somewhere on their website. Sometimes you have to search through the website to find this information.
4. Scroll to the bottom of the website's homepage to find the most recent date listed.

## DIGITAL LITERACY SCENARIO

### SCENWebsites

Of the following sources, which do you think would provide you with the most useful, accurate, diverse, and up-to-date information for answering your question about this topic?

1. Wikipedia
2. Medical Encyclopedia
3. National Cancer Institute
4. Your local hospital's website

### SCENUSE1

How would you evaluate the usefulness (contains appropriately current, pertinent, and credible information) of the following web page (relative to helping your father, as outlined in the previous scenario)?

1. **Not at all useful**
2. Not very useful
3. Somewhat useful
4. Very useful

#### SCENUSE2

How would you evaluate the usefulness (contains appropriately current, pertinent, and credible information) of the following web page (relative to helping your father, as outlined in the previous scenario)?

1. Not at all useful
2. **Not very useful**
3. Somewhat useful
4. Very useful

#### SCENUSE3

How would you evaluate the usefulness (contains appropriately current, pertinent, and credible information) of the following web page (relative to helping your father, as outlined in the previous scenario)?

1. Not at all useful
2. Not very useful
3. Somewhat useful
4. **Very useful**

#### **OPEN-ENDED TEXT**

##### OPENSEARCH

How would you go about searching for information on the Internet? (In response to Scenario).

##### OPENKEYWDS

What key words would you type into a search engine regarding this topic? (In response to Scenario).

##### OPENENGINE

Which search engine would you use? (In response to scenario).

##### OPENWebsts

What websites if any would you most likely go to for information?

##### OPENWhy

Why do you think the source you indicated above would provide you with the most useful, accurate, diverse, and up-to-date information?

## Appendix I: Codebook for Health Status and Behavior Questions

Questions are adapted from the Health Information National Trends Survey (National Cancer Institute, 2008) and the Behavioral Risk Factor Surveillance System 2011 Questionnaire (Centers for Disease Control and Prevention (CDC), 2011a).

### HEALTH

In general would you say your health is...

1. Excellent
2. Very good
3. Good
4. Fair
5. Poor

### SAD

How often did you feel each of the following during the past 30 days?  
So sad that nothing could cheer you up...

1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

### NERVOUS

How often did you feel each of the following during the past 30 days?  
Nervous...

1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

### FIDGETY

How often did you feel each of the following during the past 30 days?  
Restless or fidgety...

1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

HOPELESS

How often did you feel each of the following during the past 30 days?

Hopeless...

6. All of the time
1. Most of the time
2. Some of the time
3. A little of the time
4. None of the time

ENERGY

During the past 30 days, for about how many days have you felt very healthy and full of energy?

---

PAIN

During the past 30 days, for about how many days did pain (of any kind) make it hard for you to do your usual activities, such as self-care, work, or recreation?

---

TOBACCO

Do you currently use any tobacco products?

1. Yes
2. No

EVERSMK

Have you ever used any tobacco products?

1. Yes
2. No

TALL

About how tall are you without shoes (in inches)?

---

WEIGH

About how much do you weigh without shoes (in pounds)?

---

PRTICIPT

During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?

1. Yes
2. NO
3. Don't know/not sure

EXERCISE

About how many times per week do you exercise?

---

EXMINS

And when you exercised, for about how many minutes did you usually keep at it?

---

FLU

There are two ways to get the seasonal flu vaccine, one is a shot in the arm and the other is a spray, mist, or drop in the nose called FluMist. During the past 12 months, have you had a seasonal flu vaccine?

1. Yes
2. No
3. Not Sure

DRINKDAY

During the last 30 days, about how many days did you have at least one drink of any alcoholic beverage such as wine, beer, a malt beverage or liquor?

---

DRINKNO

One drink is equivalent to a 12-ounce beer, a 5-ounce glass of wine, or a drink with one shot of liquor. During the last 30 days, on the days when you drank, about how many drinks did you drink on the average?

---