Health Literacy and Adherence to Antiretroviral Treatment among Human Immunodeficiency Virus (HIV) Infected Youth

Ann-Margaret Navarra

Submitted in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy
under Executive Committee
of the Graduate School of Arts and Sciences

Columbia University

2011

ABSTRACT

Health Literacy and Adherence to Antiretroviral Treatment among

Human Immunodeficiency Virus (HIV) Infected Youth

Ann-Margaret Navarra

Poor health literacy has been associated with a range of negative health outcomes and few studies have assessed the relationship between adolescent health literacy and health outcomes. Human immunodeficiency virus (HIV) infected adults with lower health literacy have suboptimal treatment adherence, but this association has not be examined in the adolescent HIV-infected population. Research incorporating more comprehensive models of health literacy including beliefs about HIV treatment may help to better define the connection between health literacy and adherence to HIV treatment. The primary objective of this study was to examine the association between health literacy, literacy, beliefs about medications, media use and adherence to antiretroviral treatment in HIV-infected adolescents.

Methods: Using a cross-sectional descriptive survey design, a convenience sample of 50 HIV-infected youth was recruited from four HIV clinical settings. The primary outcome was adherence to antiretroviral treatment and was measured with 3- day self reported adherence estimates. Instruments to measure the predictor variables of interest were the Test of Functional Health Literacy in Adults (TOFHLA), Beliefs about Medication Scale (BAMS), Rapid Estimate of Adult Literacy in Medicine-teen version (REALM-teen), and media use was evaluated with a brief investigator-developed questionnaire. Descriptive statistics, bivariate and multivariate analyses using logistic regression were computed with the level of significance set to 0.05.

Results: The sample population included 50 participants, ages 13-24 years (median age=20.4 years) either perinatally (n=40) or behaviorally (n=10) infected. The median and mean $\pm$SD self reported adherence estimates were 100% (range 0-100) and 86.0% $\pm$ 26.92, respectively. Adherence estimates were highly correlated with HIV-viral load (Spearman's rho=-0.615, p=0.000). Adequate levels of health literacy were demonstrated in 80.0% (n=40) of youth. Below grade level reading was observed in 72.0% (n=36) of participants, despite 48.0 % (n=24) of the sample having completed high school and or currently enrolled in college. Common media devices (computer, internet access, DVD/VCR player, television, cable/satellite television) were reported in the homes of $\geq$ 90.0% of youth and cellular phone ownership was reported in 46 of 50 (92.0%) participants. More than half of participating HIV-infected youth reported not spending any time reading offline (56.0%) or online (60.0%) and 74.0% reported going online during the preceding day. Using self reported 3-day adherence estimates (100% adherent, <100% adherent) in a fitted logistic regression model, health literacy was not predictive of adherence (p=0.152). Participants with higher positive outcome expectancy scores were significantly more likely to have self reported adherence estimates of 100% (Adjusted OR=1.066, 95% CI=1.018-1.117) and the odds of 100% adherence was significantly lower among the 63.9% (23/36) of participants with below age level reading, compared to the 85.7% of youth (12/14) with $\geq$ age level reading and 100% adherence (Adjusted OR=0.066, 95% CI=0.005-0.831).

Conclusions: These finding provide support for the integration of beliefs into health literacy models with HIV-infected youth in the study of treatment adherence. Although health literacy was not associated with antiretroviral adherence in this study, this may have been explained by the small sample size, and additional research with a larger sample is needed to adequately describe this relationship. Considering the association of age level reading ability to

antiretroviral adherence and the large percentage of youth with below grade level reading in this sample, this relationship warrants further exploration in this population. Finally media may offer the potential for new and improved methods to deliver health education, especially in HIV-infected youth with low literacy skills.

Table of Contents

Appendices

List of Tables

List of Figures

Acknowledgements

There are so many individuals to thank for their support during these past four years of doctoral education at Columbia University, School of Nursing. First and foremost, I am deeply grateful for the unyielding and generous support of my advisor and dissertation sponsor, Dr. Elaine Larson. It has been an honor to be mentored by Dr. Larson and the direction and guidance offered during my pre-doctoral fellowship has been invaluable to my growth as a nurse scientist. Dr. Larson consistently motivated and inspired me and she believed in my potential to succeed, a most precious gift for a doctoral student. Dr. Larson has always been available and willing to assist me in achieving my academic goals and her overall commitment to scholarship and the advancement of nursing science is extraordinary. Her career path has been unprecedented by most and we are very blessed to have her as the Associate Dean of Research at Columbia University, School of Nursing.

I would like to thank Dean Sarah Cook for her support and assistance for my positions as teaching assistant and nursing instructor. Mentoring other nursing students was a wonderful opportunity and helped me to more fully appreciate the value of leadership in nursing education.

Dr. Patricia Stone, Director of the PhD program at the School of Nursing is an outstanding researcher and educator. Her respectful and positive attitude for my ideas as an emerging scientist helped me greatly in the development of my dissertation proposal. I am also sincerely grateful to Dr. Arlene Smaldone and Dr. Melissa Stockwell for their involvement and contribution to my dissertation.

Dr. Natalie Neu, Medical Director of Project Services to Assist Youth (STAY) was instrumental to the success of my dissertation study. Each stage of the research process was advanced by her energy and enthusiasm for my success and I am very thankful for Dr. Neu's

participation. Dr. Sima Toussi, Medical Director of the Pediatric Center for Special Studies at Weill Cornell Medical College welcomed me into her clinic and was an active and supportive collaborator throughout the entirety of my dissertation study. I was also fortunate to have a dedicated research assistant, Stephanie Bellini, RN. Stephanie spent many hours with me during my initial attempts to recruit youth, and helped me greatly during every phase of this study.

I have been very blessed with a wonderful family and I could not have achieved this awesome accomplishment without my husband, Joseph Navarra. Joe has not only encouraged me to be the very best that I could be, he made it possible. His partnership and love is a powerful source of strength in my life. Joe helped me to balance the roles of wife, mother and student, graciously assuming extra responsibilities during these past four years, and did so with a smile. My daughter Theresa reminded me daily of the awesome responsibility inherent in parenting and the importance of my presence in her life as a mother. My highest ambition is for my daughter's achievements to far surpass mine, especially in serving populations most in need.

My parents, Theresa Marie and Joseph Dunn helped pave the way for my lifelong pursuit of knowledge by their steadfast guidance. My mother facilitated my individual development and her non-judgmental attitudes are largely responsible for my care of the underserved today. My father taught me about perseverance and the importance of hanging in there, even when life gets tough. He is one of the proudest fathers a daughter could have and his pride has been a constant source of encouragement throughout this journey.

My in-laws Lynn and John Navarra have always been there for me and very much appreciated for their contribution to my life. They are always willing to help in any way possible and their kindness is unlimited for our family. It is truly impossible to name the many other family members and friends surrounding my life and this accomplishment and my sincere gratitude

extends to everyone. The very best thank you I could think of is to be sure that this dissertation study marks just the beginning of a research career committed to helping lessen disparities for vulnerable populations of children and adolescents.

Dedication

This dissertation study is dedicated to the many HIV-infected families with whom I have had the privilege of caring for and to my dedicated colleagues who joined me each and every day.

CHAPTER 1

This chapter offers an introduction to the problem of health literacy and adherence in HIV-infected youth. A synopsis of research findings to date involving health literacy and health outcomes, including antiretroviral adherence in HIV-infected youth is presented. Current gaps in the body of health literacy research are summarized and the significance of the problem for HIV-infected youth introduced.

Background/Introduction

In 1993, the published findings of the 1992 National Assessment of Adult Literacy (NAAL) survey reported a surprisingly high prevalence of illiteracy in the United States. The results of this survey demonstrated that 90 million adults scored in the lowest two levels of a five level scale. There was difficulty with integrating information from complex texts and also with the performance of calculations requiring two or more sequential operations (Kirsch, Jungleblut, Jenkins, & Kolstad, 1993). These findings have been supported with evidence from more recent studies including estimates that 46-51% of Americans experience difficulty reading with 1 in 5 demonstrating rudimentary functional literacy (Kalichman & Rompa, 2000). The reading level of nearly one quarter of American adolescents has been described to be below their expected grade level (Kamil, 2003) and one third of high school students do not graduate with many being minority students (Bridgeland, Dilulio, & Morrison, 2006). Below grade reading level in adolescents has been significantly related to violent behavior (Davis, Byrd, Arnold, Auinger, & Bocchini, 1999) and also described to be a barrier to seeking help for treatment of sexually transmitted diseases (Fortenberry et al., 2001).

The earliest research demonstrating the gap between health education materials and patient inability to comprehend them was conducted in the 1980s (Doak, Doak, & Root, 1985). However

this work and subsequent publications focused on literacy and its relationship to health, and not on health literacy as a distinct concept. Although the term *health literacy* was first used in 1974 (National Library of Medicine, 2000), there were few references to health literacy in the literature until 1992. The seminal research project on health literacy was funded by the Robert Wood Johnson Foundation in 1992 (Williams et al., 1995) and the study objective was to determine the basic reading and numeracy abilities required for adequate function in the health care setting. The Test of Functional Health Literacy in Adults (TOFLHA) was developed for this project to measure health literacy among English and Spanish participants (Parker, Baker, & Nurss, 1995).

Over the past three decades, there have been many definitions used to describe the concept of health literacy. The Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs of the American Medical Association (1999) defines health literacy as "a constellation of skills, including the ability to perform basic reading and numerical tasks required to function in the health care environment" (p. 553). The World Health Organization (WHO) has recently adopted a definition of health literacy that reflects a health promotion orientation. In this context, health literacy is represented 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 health "(Nutbeam, 1998, p. 357).

In the United States, 90 million individuals are estimated to have inadequate levels of health literacy (Institute of Medicine, 2008) and the need for improved health literacy has been added to goals set by the national agenda. It was included as an objective in Healthy People 2010 (United States Department of Health, 2000) and maintained as a goal in the proposed Healthy People 2020 (United States Department of Health, 2009). Low levels of health literacy have been

closely associated with negative treatment outcomes for people with diabetes, asthma, and other chronic health conditions (Kalichman, Cherry, & Cain, 2005) and have also been related to lower self reported health (Baker et al., 1997) , and overall general poorer health (Gazmararian, Baker, Parker, & Blazer, 2000; Baker, Parker, Williams & Clark, 1998). Increased number of hospitalizations (Baker et al., 1998; Baker et al., 2002), and emergency rooms visits (Baker et al., 2004), lack of preventative health care services, and increased risk of death have also been reported for individuals with inadequate health literacy (Institute of Medicine, 2009).

Currently there is no consistent conceptual or operational definition of health literacy and debate exists regarding the underlying constructs that should be measured in health literacy research. This may explain the gap between the current definitions of health literacy and available measures of health literacy (Peerson & Sanders, 2009; Baker, 2006). In the adolescent population there is limited research on the relationship between health literacy and health outcomes; most research to date on adolescents has focused on functional literacy or ability to read and write and related outcomes rather than health literacy and health outcomes (Manganello, 2008). Although literacy is an important component of health literacy, reading level alone does not explain the skills involved in becoming a health literate citizen (Zarcadoolas, Pleasant & Greer, 2005). Health literacy is a complex construct. The specific pathways by which health literacy may affect patient behavior and health outcomes are not entirely clear (Paasche-Orlow & Wolf, 2007). Cultural beliefs surrounding illness and health are considered essential to patient understanding and application of health related information (Shaw et al., 2009). In HIV-infected adolescents, the degree to which a teen's beliefs about HIV medications influence either health literacy and or adherence is largely undetermined. The evolution of health literacy research is best reflected in greater appreciation of the need for more

integrated models encompassing factors such as individual beliefs and culture (Andrulis & Brach, 2007).

The construct of health literacy in the adolescent population may differ conceptually from what has been described in the adult population. The developmental stage of adolescence marks a crucial stage in the life of a teen with milestones in physical maturity, psychosocial growth, education and self care, including health care management. Yet it is unclear how well teens are able to understand, process, and evaluate health care information (Manganello, 2008). A defining attribute of health literacy in adolescents includes media literacy (Manganello, 2008) and there is evidence to suggest that adolescents use media sources such as the Internet to access health related information (Borzekowski & Riekert, 2001). Yet media usage among HIV-infected adolescents has not been described to date.

Individuals with chronic health conditions and poor health literacy often have limited knowledge and understanding of their illness. Racial and ethnic minorities are far more likely to be below basic or at basic level in their health literacy and a lack of health literacy skills may contribute to health disparities (IOM, 2008). Health literacy has been described to be a stronger predictor of treatment adherence than was years of education (Baker et al., 1996).

Lack of adherence to antiretroviral therapy is one of the main causes for treatment failure worldwide and there is evidence to suggest that adherence rates to antiretroviral medications of > 95% are associated with better virological and immunological outcomes (Paterson et al., 2000; Sethi, Celentano, Gange, Moore & Gallant, 2003). Suppression of HIV viral load with antiretroviral treatment may also help to decrease the inflammation and immune activation thought to contribute to HIV related co-morbidities including cardiovascular disease (USDHHS, 2009). HIV-induced activation of both inflammation and coagulation increases the risk of

mortality among HIV-positive patients and antiretroviral treatment interruptions may further augment this risk, possibly due to elevated IL-6 and D-dimer levels (Kuller et al., 2008).

In HIV-infected adults, health literacy and education have been shown to be predictive of two day self reported treatment adherence, and those with less years of education and lower literacy, defined at scores of 85% or less on an adapted TOFHLA scale were between 3 and 4 times more likely to have missed a dose of medicine (Kalichman, Ramachandran, & Catz, 1999). In a similar study involving a larger sample size (n=145), Kalichman & Rompa (2000) demonstrated that HIV-infected adults with lower health literacy had higher viral loads, lower CD4-T lymphocyte cell counts, were less likely to be taking antiretroviral medications, reported a greater number of hospitalizations, and reported poorer health than those with higher health literacy. Health literacy is frequently below functional levels in medical populations, and understanding medical instructions is essential for treatment adherence (Kalichman et al, 1999; Parker et al., 1995).

Problem Statement

Among HIV-infected adults, lower health literacy has been associated with higher viral loads, lower CD4-T lymphocyte cell counts and lower adherence to taking antiretroviral medications (Kalichman et al., 2005; Kalichman & Rompa, 2000). Currently there are more than 30 antiretroviral agents, and these medications when used in combination have helped transform HIV from an almost uniformly fatal disease to a chronic illness (Hammer et al., 2008). Yet such benefits cannot be appreciated without optimal adherence to highly active antiretroviral treatment (HAART). A single study in HIV-infected teens reported no significant association between health literacy and adherence to antiretroviral treatment (Murphy et al., 2010). These findings, however, are inconsistent with results of similar studies in the HIV-infected adult

population. The current body of evidence on health literacy is in its infancy; this is reflected in the knowledge gaps in understanding the relationship between health literacy and health outcomes in the pediatric setting (Sanders, Federico, Klass, Abrams, & Dreyer, 2009). Adolescents with chronic illness are challenged in the management of their health conditions to make important decisions based on available information (Chisolm & Buchanan, 2007). This is especially true for HIV-infected adolescents struggling with adherence to their antiretroviral treatment regimens.

Aims

The primary objective of this exploratory study was to examine the association between health literacy, functional literacy, beliefs about medications, media use and adherence to antiretroviral treatment in HIV-infected adolescents. Secondary aims were to explore the association between beliefs about medications and health literacy in HIV-infected adolescents and to describe the association between media use and health literacy in HIV-infected adolescents.

Significance

Both the incidence and prevalence of HIV disease continue to increase and this is due to increased survival as well as new infections. The most recent estimates indicate that there were approximately one million persons living with HIV in the United States at the end of 2003 (Glynn & Rhodes, 2005). There were an estimated 56,300 new HIV infections in the United States in 2006, with the highest risk category being sexual transmission in young people ages 13-29 years (Hall et al., 2008). Suboptimal adherence is associated with antiretroviral failure, the development of resistance to antiretroviral therapy, and subsequent reduction of treatment options (Williams et al., 2006). The benefits of antiretroviral therapy include a reduction in

quantitative viral load and subsequent decreased risk of HIV transmission due undetectable viral loads in heterosexual discordant couples (Attia, Egger, Muller, Zwahlen, & Low, 2009). Uncontrolled HIV replication imposes an increased risk of morbidity and mortality at all CD4-T lymphocyte strata (Kuller et al., 2008) and the devastating consequences of HIV disease are preventable with antiretroviral treatment and adherence. However, long term treatment with antiretroviral medications involves daily therapy to often complex regimens, thus representing an ongoing challenge to HIV-infected patients, families, and treating clinicians. At best, the rates of adherence to medication for adults and children with any chronic illness have been described to be approximately 50% with decrements occurring over time (Jay, Litt, & Durant, 1984; Rapoff, 1989; Festa, Tamaroff, Chasalow, & Lanzkowsky, 1992). These statistics are supported in the literature on adolescent chronic treatment, as 50% of teens with long term conditions not complying with care (Adams, Pill, & Jones, 1997; Kyngas, Hentinen, Koivukangas, & Ohinmaa, 1996).

Adolescence is a crucial time of development, as it represents a time of transition between childhood and adulthood. It is characterized by rapid changes at both the individual and societal levels and an understanding of these changes have important implications for the identification of health risks, but also offer opportunities for health promotion. One such opportunity is in chronically ill adolescents. While health literacy has the potential to affect all adolescents, it is especially relevant for the growing population of HIV- infected youth because of the need for their active participation in health care decisions, including those related to the initiation and maintenance of antiretroviral treatment.

The relationship of health literacy to health outcomes is likely to be more complex than initially described and it is vital for health care professionals and policy makers to understand the

conditions which are present for literacy to be relevant to health outcomes such as treatment adherence (Powers & Bosworth, 2006). The current increased rates of HIV infection among youth, coupled with the known benefits of antiretroviral treatment speak to the need for additional research on the relationship between health literacy and antiretroviral treatment adherence. The paucity of evidence regarding predictors and reliable estimates of adherence in HIV-infected youth impedes the development of effective health promotion interventions. The findings from this research study will add to the current knowledge about this problem by identifying significant predictors of adherence to provide guidance regarding selection of intervention strategies in larger randomized trials.

CHAPTER 2

This chapter entails a comprehensive review of the findings from the existing body of health literacy and adherence research, recent progress and existing gaps. The conceptual link between literacy and health literacy is explored, and poor health outcomes related to low literacy skills examined. The distinct differences between adolescent and adult health literacy, including the influence of media and individual beliefs on the health of modern youth are discussed.

Currently available health literacy screening instruments are reviewed and associated challenges with the measurement of health literacy illustrated. Evidence to date describing the poor health outcomes related to health literacy, including suboptimal adherence to antiretroviral adherence among HIV-infected adults is presented. The paucity of health literacy research among HIV-infected youth and the need for expanded health literacy models for the care of this population is described.

Review of the Literature

Literacy in the United States

In 1993, the findings from the National Adult Literacy Survey (NALS) demonstrated that 40 million adults scored at the lowest level of literacy and were not able to perform basic reading, writing, and numeracy skills (Kirsch et al., 1993). Nearly three decades later, inadequate literacy has been recognized as a crisis in the United States (Gazmararian, Curran, Parker, Bernhardt, & DeBuono, 2005). Although literacy is defined as the ability to read, write, and speak in English, it also encompasses the skills required to compute and solve problems at levels of proficiency necessary to function on the job, in the family of the individual, and in society (National Institute for Literacy, 2009).

One factor contributing to the high illiteracy rates in the United States is the stagnant high school graduation rates of approximately 70% since 1995 (Orfield, 2004). Low caregiver literacy has been associated with poor health outcomes in children (Sanders et al., 2009) and it is therefore concerning that one fourth of all births in the United States are to women under the age of 30 without a high school diploma (Parker, Wolf, & Kirsch, 2008). There has been an ongoing influx of immigrants to the United States and the United States Census bureau predicts that by the year 2015, immigrants will account for half of the projected population growth (Kirsch, Braun, Yamamoto, 2007) and many of these immigrants are non-English speaking and without a high school diploma (Parker, et al., 2008). Approximately half of the expected job growth in the coming decade is predicted to be in knowledge intensive work sectors, and there is an aging population of well educated workers who are approaching retirement; this combination of factors has been described as the perfect storm (Parker et al., 2008). The consequences include higher numbers of unemployed and uninsured workers, and greater problems of health care quality, cost, and disparities (IOM, 2009).

Literacy and Health Outcomes

Empirical data collected over the past two decades have demonstrated a strong association between low literacy skills and poor health outcomes, impacting on both morbidity and mortality (Parker et al., 2008; Elo & Preston, 1996; Kitigawa & Hauser, 1973). A recent systematic review of the literature assessed the relationship between literacy and health outcomes in patients of all ages and the findings suggested that individuals with low literacy had poorer health outcomes, and were 1.5 to 3 times more likely to experience an adverse health outcome in comparison to those with a higher level of health literacy (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004).

In the pediatric population, pre-adolescents with low literacy are four times more likely to have engaged in recent tobacco use and this was a significant predictor for both genders; in this same study, the odds of having misused alcohol were also significant higher among males with lower literacy (Hawthorne, 1997). Adolescents with below grade reading level are more likely to be carrying a weapon and there was a significant relationship between below grade reading and violent behaviors in a sample of youth ages 11-18 years (Davis et al., 1999).

In HIV-infected youth with perinatal transmission, little is known about the language and reading skills of this population. A recent study sought to compare the receptive language abilities, word recognition skills and school functioning of perinatally HIV-infected with youth who were perinatally HIV-exposed, but not infected. The sample comprised 340 (206 HIV positive and 134 HIV negative) children and adolescents; deficits in receptive language, word recognition and school functioning were demonstrated in the HIV-infected youth with poorer performance in reading and language abilities, in comparison to the uninfected cohort (Brackis-Cott, Kang, Dolezal, Abrams, & Mellins, 2009). These finding suggest learning difficulties at higher than expected rates among the HIV-infected youth with perinatal transmission.

Conceptualizing Health Literacy

Both health researchers and health care professionals in developed and developing countries have long been concerned about the link between health and education (Evans, Barer, & Marmor, 1994; World Bank, 2000). The relationship between literacy to health has received intense scrutiny since the publication of the 1992 NAAL survey (Powers & Bosworth, 2006). Literacy and health literacy are highly correlated (Yin, Forbis, & Dreyer, 2007) and the term health literacy has been used for the past 30 years to reflect the intersection of the fields of

literacy and health (Green, Bianco, & Wyn, 2007). Although literacy or reading ability is an important component of health literacy, reading level alone does not explain the complex human skills involved in becoming a health literate citizen (Zarcadoolas, Pleasant, & Greer, 2005).

Health literacy was assessed nationally in the United States for the first time as a component of the 2003 NAAL survey. There was a representative sample of more than 18,000 adults, ages 16 years and older. Of this sample, 36% had limited health literacy skills. According to this assessment, 78 million US adults are not able to perform basic health tasks such as following written instructions to take a medication of an empty stomach and 30 million are unable to perform below basic health tasks such as dosing an over the counter medication (Kutner, Greenberg, Baer, 2006).

As the field of health literacy has expanded and received greater attention, the term health literacy has come to have different meanings for various audiences leading to both confusion and debate (Baker, 2006). The different definitions of health literacy are reflective of the different orientations to the problem of health literacy (Baker, 2006). In the United States, the term health literacy has been often used to describe the relationship between patient literacy levels and the ability to adhere to prescribed medical regimens (American Medical Association, 1999). Most of the published literature has focused on a definition of health literacy that includes the ability to read and act on oral and written material in health care settings (Ishikawa & Yano, 2008).

In 1998, Nutbeam described a broader concept of health literacy, defining it as the cognitive and social skills which determine the motivation and ability of individuals to access, understand and use information in ways which maintain good health. Nutbeam (2000) has proposed three levels of health literacy within this definition, and these include: functional health literacy,

interactive health literacy, and critical health literacy. Functional literacy is the ability to read and write, interactive literacy is the ability to coordinate functional literary with social skills in daily life for the purpose of extraction and application of information, and critical literacy is the ability to critically evaluate information. This classification illustrates that different levels of literacy progressively allow for greater autonomy and empowerment; it also demonstrates that progression between levels is dependent on cognitive development and exposure to various forms of communication (Nutbeam, 2000).

Others have also recognized the importance of a broader concept of health literacy and moved away from the exclusive use of functional or medical literacy to describe the concept of health literacy. Consistent with the definition of health literacy proposed by Nutbeam (2000), Kickbush (2006) as cited in Peerson & Saunders (2009) described health literacy as active, dynamic, empowering and as an important life skill to navigate health choices in everyday life, influencing both health and well being. Health literacy evolves over the course of an individual's life and is impacted by health status, demographic, sociopolitical, psychosocial, and cultural factors (Zarcadoolas et al., 2005).

Adolescent Health Literacy

The construct of health literacy in the adolescent population may differ conceptually from what has been described in the adult population. The developmental stage of adolescence marks a crucial stage in the life of a teen with milestones in physical maturity, psychosocial growth, education and self care including health care management. Yet it is unclear how well teens are able to understand, process, and evaluate health care information (Manganello, 2008). Adolescence is therefore an important developmental stage to assess and test related health literacy interventions.

A framework specific to adolescent health literacy has been described (Manganello, 2008) and to date, this is the only known model to conceptualize adolescent health literacy. Health literacy has been described as a shared function of individual and social factors (IOM, 2009) and this framework illustrates the relationships among individual, interpersonal and systematic contributors of health literacy and health outcomes (Figure 2.1). The developmental stage of adolescence is integrated as the influence of family, peers, educational systems, and media use are recognized.

Figure 2.1. A Framework for Studying Adolescent Health Literacy

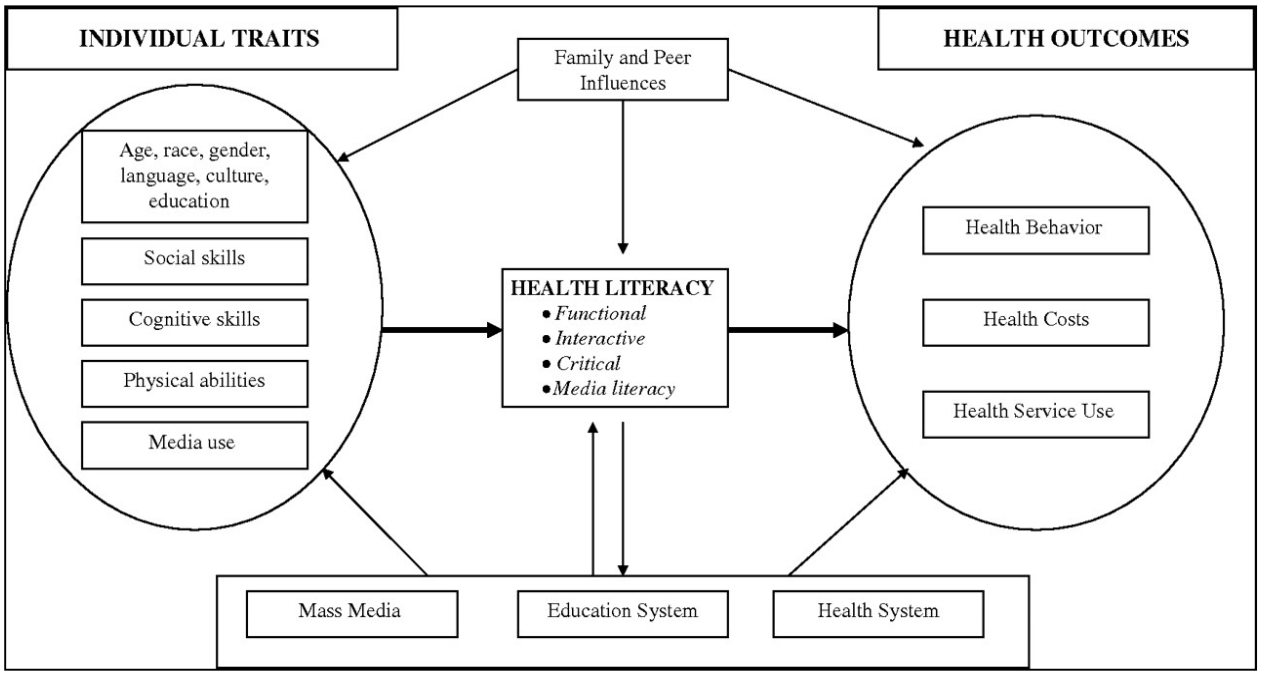

Figure 2.1. "Health Literacy and Adolescents: A Framework and Agenda for Future Research," by J.A. Manganello, 2008, Health Education Research, 23(5), p.843.

Media and Adolescent Health Literacy

Adolescent health literacy skills including media literacy and critical thinking are necessary to access health related information from mass media, understand the content, and evaluate the credibility of the information obtained. The integration of media use into adolescent health literacy frameworks is valuable because time spent with media has steadily increased among modern youth. A recent national survey performed by the Kaiser Family Foundation (2010) reported that youth ages eight to eighteen years spend 7 hours and 38 minutes per day using some type of media (television, music/audio, computer, video games, print, movies) device. This time spent did not include computer use for school or work, texting, or cell phone use. Disparities in race and age were identified; blacks and Hispanics and 11 – 14 year olds were among the groups with highest levels of media exposure.

There is evidence to suggest that adolescents use media sources such as the Internet for access to health-related information (Borzekowski &Riekert, 2001). Yet adolescents will only obtain maximum benefit if they are able to search for, evaluate and use online internet information effectively (Gray, Klein, Noyce, Sesselberg, & Cantrill, 2005).

Individual Beliefs and Health Literacy

The specific pathways by which health literacy may affect patient behavior and health outcomes are not entirely clear (Paasche-Orlow et al., 2006). Cultural beliefs surrounding illness and health are considered essential to patient understanding and application of health. It has been increasingly recognized that health literacy must be viewed in the broader context of individual factors, language and culture (IOM, 2009) and studies in adults are beginning to explore this relationship. Negative beliefs about medications among adults with chronic illness

have been shown to influence patterns of medication adherence, as there was a 2.1 greater odds (95 % CI, 1.3-3.7) of lower medication adherence in adult patients with higher negative beliefs scores, in comparison to those with lower scores (Gatti et al., 2009). In HIV-infected adults, mistaken beliefs about HIV-medications were not found to be a mediator of the health literacy-adherence relationship (Graham et al., 2007).

In the adolescent HIV population, the degree to which a teen's beliefs about HIV medications influence health literacy and adherence is largely unknown. A recent published systematic review of the literature provides support for this finding because there were no studies designed to examine the relationships among beliefs, health literacy, and adherence among HIV-infected youth (Reisner et al., 2009). In one study to date including a small sample (n=20) of adolescents with behaviorally acquired HIV-infection and adherence difficulties, the relationship between beliefs and adherence to antiretroviral treatment in HIV-infected youth was assessed; predictors of adherence included perceived threat of illness (p=0.03) and total beliefs scores (Garvie et al. 2011).

The evolution of health literacy research is best reflected in greater appreciation of the need for more integrated models encompassing factors such as individual beliefs and culture (Andrulis & Brach, 2007). Individual beliefs surrounding antiretroviral treatment are an important component of health related decision making in the adolescent HIV-infected population.

Measurement of Health Literacy

There is ongoing discussion regarding the underlying constructs that should be measured in the assessment of health literacy which may likely be reflective of the lack of consistent definition. In fact, the gap between the current definitions of health literacy and available measures of health literacy has gained attention (Jordan, Osborne, & Buchbinder, 2011). Although health literacy is a complex construct, researchers have developed instruments to assess literacy skills using health-related materials (Weiss et al., 2005). The two most commonly used measures of health literacy are the Test of Functional Health Literacy in Adults (TOFHLA) and the Rapid Estimate of Adult Literacy in Medicine (REALM). More recently, the Health Activities Literacy Scale (HALS) and the Newest Vital Sign (NVS) have been added to the currently available measures of health literacy.

Test of Functional Health Literacy in Adults (TOFHLA)

The full version TOFHLA measures both numeracy and literacy and is a valid and reliable indicator of a patient's ability to read health related materials (Parker, Baker, Williams, & Nurss, 1995). The numeracy section contains 17 analytic questions and the investigator uses prompts to measure a participant's ability to understand health related instructions such as taking prescription medications, keeping medical appointments, seeking financial aid in a health care clinic and interpreting blood glucose results (Parker et al., 1995). The reading component includes 50 items related to three health related passages. Respondents review the scenarios and then select one of the four possible choices to fill in the blanks to test their understanding of the information in the scenarios. Test items in this section are presented in a modified cloze procedure with every 5^{th} to 7^{th} word missing and participants must select from the four possible

choices. There is only one correct response with the remaining choices being either grammatically or contextually incorrect. For example, “the X-ray will _____(take, view, talk, look) from 1 to 3 (beds, brains, hours, diets) to do” (Parker et al., 1995).

The TOFHLA demonstrates excellent internal validity in adults with Cronbach alpha’s of 0.98 and is available in both English and Spanish (Parker et al., 1995). In HIV-infected youth, reliability of the short version TOFHLA (S-TOFHLA) has been demonstrated, Cronbach alpha > 0.7 (Murphy et al., 2010). The time required for administration of the TOFHLA is approximately 18-22 minutes for administration of the full version, and 7-10 minutes for the short version. TOFHLA scores range from 0-100 with higher scores indicating better health literacy. Classification of scores as inadequate (0-59), marginal (60-74), and adequate (75-100) health literacy is commonly performed in clinical research (Parker et al., 1995). Some researchers have used cut off scores below 75% to 85% correct to define lower health literacy (Kalichman et al., 2008) and other researchers have used scores of 60%-74% to represent marginal health literacy (Weiss et al., 2005).

Rapid Estimate of Adult Literacy in Medicine (REALM)

The REALM (Davis et al., 1991) is a word recognition instrument and tests the ability to read and pronounce medical terms in three minutes (Davis et al., 1991). Although not designed to measure comprehension, word recognition tests are useful predictors of general reading ability in English (Davis et al., 2004; Markwardt,1989).The REALM is comprised of 66 health terms divided in three columns in ascending order of difficulty and participants earn one point for each word read and pronounced correctly. Scoring of the REALM is correlated with grade reading levels. A score of less than 0-44 correlates with a sixth grade reading level, a score of 45-60 correlates with a seventh to eight grade reading level, and a score of greater than 61-66 correlates

with a ninth grade reading level (Davis et al., 1991). Psychometric properties of the REALM include both high intra-subject reliability (r=.97) and criterion validity. A major limitation of the REALM is that it is only available in English (Davis et al., 1991).

Rapid Estimate of Adult Literacy in Medicine-teen version (REALM-teen)

The REALM-teen is a brief and reliable word recognition measure designed to predict general reading ability in health care settings among teens in 6^{th} through 12 grades (Davis et al., 2006). Similar to the parent instrument, the REALM, the REALM-teen consists of 66 health related words arranged in increasing order of difficulty. The specific words for this measure were selected from education pamphlets provided by the American Academy of Pediatrics and then later pilot tested. Adolescents tested with the REALM-teen are asked to speak the word aloud, in the order listed on this measure. The total score is based on the number of words pronounced correctly and is related to grade level. A score of 0 to 37 is equivalent to a $\leq$ third grade level; a score of 38 to 47, fourth to fifth grade; a score of 48 to 58, sixth to seventh grade; a score of 59 – 62, eight to ninth grade; a score of 63-66, $\geq$ tenth grade. The internal consistency is described as excellent (Cronbach alpha=0.94) with strong test-re-test reliability (r=0.98); the REALM-teen has high criterion based validity, when correlated with the wide range achievement test (WRAT-3) (r=0.83) and offers ease of administration/scoring in less than three minutes (Davis et al., 2006). The REALM-teen is not available in Spanish and cannot be used to determine deficiencies in computing, comprehending, and or acting on health education (Davis et al., 2006) and instead it may be viewed as a sufficient literacy screening tool in health care settings. Use of the REALM-teen in clinical trials with HIV-infected youth has not been previously reported.

Health Activity Literacy Scale (HALS)

The health activities literacy scale (HALS) in one of the more recently developed health literacy measures for adults. The HALS was created through coding and extraction of health related tasks from existing large scale literacy assessments such as the NALS (Rudd, Kirsch, & Yamamoto, 2004). Health literacy is assessed with 191 health related tasks including items related to health promotion, health protection, disease prevention, health care maintenance, and systems navigation. The HALS is a 0 – 500 scale that represents a progression of health literacy related skills based on item response theory (IRT). The scores correspond to five different levels and an individual scoring at a level 5 would be able to perform health related tasks with a high degree of proficiency than an individual scoring at a level 3 (Rudd et al., 2004). The HALS takes approximately one hour to complete, and therefore more time would be needed for its administration in comparison to the TOFHLA-S or REALM (Baker, 2006).

Newest Vital Sign (NVS)

The Newest Vital Sign (NVS) represents another one of the recently developed measures of health literacy in adults and is suitable for use as a quick screening test for limited literacy in primary health care settings. The NVS is a nutrition label that is accompanied by six questions and requires three minutes for administration. Answering four or more questions correct is consistent with adequate literacy and a score of less than four correct questions indicates the possibility of limited literacy. Psychometric testing demonstrates reliability (Cronbach alpha > 0.76 for the English version and 0.69 for the Spanish Version); correlation with the TOFHLA ($r=0.49$; $p<0.001$) is described in the literature (Weiss et al., 2005).

If health literacy is an independent concept reflective of the needed skills and capacities that enable individuals to gain greater control of their health, this very definition has important implications for the measurement of health literacy (Speros, 2005). Instruments designed to measure health literacy to date have been described as inadequate because they measure word recognition or reading ability, to the exclusion of the other important components of health literacy such as numeracy, oral skills, and navigational skills (Sanders et al., 2009). Health literacy research that encompasses more comprehensive conceptual models and frameworks may help to limit the potential limitations of current measures.

Health Literacy and Health Outcomes

There is evidence to suggest that health literacy is a stronger predictor of health status than socioeconomic status, age, or ethnic background (Williams, Baker, Parker, & Nurss, 1998; Lindau et al., 2002; Schillinger et al., 2002; Parker, Ratzen, & Lurie, 2003). Inadequate health literacy, as measured by reading fluency, is an independent predictor of all-cause mortality and cardiovascular death among community-dwelling elderly persons (Baker et al., 2007). In adults with a low level of health literacy, a decreased use of preventative health care services including influenza and pneumococcal vaccinations, mammograms, and Papanicolaou smears have been reported (Scott et al., 2002). Poor health literacy is associated with negative treatment outcomes for individuals with diabetes, asthma, and other chronic health care conditions (Kalichman et al., 2005). Increased health care costs and an inefficient use of services have been described in adults with inadequate health literacy, and this includes higher costs of emergency room services (Howard, Gazmararian, & Parker, 2005). Poor functional health literacy has been shown to impede access to adequate health care (Kalichman et al., 2008) and affect treatment adherence across medical populations.

In the HIV-infected population, adults with lower health literacy have more adverse health care outcomes and poorer treatment adherence (Kalichmanet al., 2005). Functional health literacy was assessed using the TOFHLA in HIV-infected adults. HIV-infected individuals with lower health literacy had decreased CD4 counts, higher viral loads, reported poor health status, more hospitalizations, and were less likely to be taking antiretroviral medications in comparison to HIV-infected individuals with higher health literacy.

There has been limited research designed to examine the relationship between child/adolescent health literacy and health knowledge, behavior, or outcomes (Manganello, 2008; Yin et al., 2007). In a recent systematic review of 24 studies in children 0-18 years of age published after 1980, the relationship between parent and child literacy and child health outcomes was examined (DeWalt & Hink, 2009). The body of research reviewed demonstrated that among young children, lower parental literacy is associated with worse health outcomes. In the adolescent population, lower than average literacy was related to more risk taking or violent behaviors. Among these 24 studies reviewed, there was one study performed to assess if literacy and patient understanding are related to oral contraception use; the results demonstrated that patients of all literacy levels had limitations in their understanding of oral contraceptives. (Davis, et al., 2006). There were no identified studies examining the relationship of health literacy or literacy to the health outcome of adherence with oral medication use in the adolescent population.

Adherence to Antiretroviral Therapy

Lack of adherence to treatment has been problematic since the inception of prescribed treatment for health conditions (Chesney, 2006). Treatment for HIV disease is no exception and

adherence to antiretroviral regimens represents an ongoing challenge for both the patient and clinician, as clinician directed strategies to support adherence are often not translated into behavioral changes in the patient. The best approach to measure individual patient adherence in both clinical and research practice remains unclear and the use of different methodologies and definitions can lead to inconsistencies in predictors and estimates of patient adherence (Berg & Arnsten, 2006). The following sections will detail the operational definitions and commonly used measures of antiretroviral treatment adherence.

Operationalizing Adherence

Adherence is a difficult construct to operationalize due to the absence of a gold standard in its measurement (Wagner et al., 2001; Alcoba, 2003; Chesney, 2006) and is commonly defined as the proportion of medications taken divided by medications prescribed (Miller & Hays, 2000). Although there is uniform agreement that good patient adherence yields improved patient outcomes, the adherence literature does not include a consistent estimate to define optimal adherence. Although there is no standardized cut-point to dichotomize continuous adherence estimates for analysis, using 100% has been described as the most conservative estimate, especially when measuring adherence for shorter durations, such as 7 days or less (Pearson, Simoni, Hoff, Kurth, & Martin, 2007). In a review of the literature on self report and adherence to antiretroviral therapy including 77 studies with individual 18 years and older, the most common cut-off for optimal adherence was 100% in 21 of 48 studies (Simoni et al., 2006). In the pediatric HIV population, 3-day self reported adherence estimates have included 100% to describe full or complete adherence to a prescribed antiretroviral treatment regimen (Van Dyke et al., 2002; Malee et al., 2011). Yet there have been other studies performed in the pediatric HIV population using lower adherence thresholds including $\geq$95% (Williams et al., 2006) or $\geq$90%

(Murphy et al., 2010). However it has been shown in HIV-infected adults that adherence of 95% or greater is needed for optimal virologic outcomes (Patterson et al., 2000) and better patient adherence helps to prevent the risk for the development of antiretroviral resistance (USDHHS, Panel on Antiretroviral Guidelines for Adults and Adolescents, 2011). Therefore the current definitions of optimal adherence should be consistent with the latest evidence on the related health outcomes.

Measuring Antiretroviral Adherence

Adherence to antiretroviral therapy may be measured with indirect and direct methods. Indirect measures include self report, pharmacy refill, electronic monitoring devices, and pill counts. Directly observed therapy has been evaluated as an intervention for poor adherence but is also sometimes included as an assessment method (Berg & Arnsten, 2006). Therapeutic drug monitoring represents is a direct measure of adherence and it is expensive, invasive and without any established standards for collection and interpretation of results (Berg & Arnsten, 2006), thereby limiting use for select circumstances. Self report is the most common method used in clinical practice (Chesney, 2006: Berg & Arnsten, 2006) and medication refill history obtained from pharmacy records has also been as an objective measure of adherence in the HIV-infected population (McMahon et al., 2011).

Self Reported Adherence Estimates

Measurement of adherence to HIV-medications with self report has been described as the most commonly used assessment method in both clinical and research practice because it is inexpensive, requires minimal time and is of low patient- provider burden (Chesney, 2006: Berg & Arnsten, 2006). Self reported adherence in HIV-infected individuals ages $\geq$ 18 years has been significantly associated with HIV-1 RNA level (Simoni et al., 2006; Nieuwkerk & Oort, 2005)

and recent studies have shown it to be predictive of viral load in HIV-infected children and adolescents (Van Dyke et al., 2002; Garvie, Wilkins, & Young, 2010). Assessment of antiretroviral adherence with self report of missed doses has been widely used in HIV clinical and research practice, since the development adherence questionnaire used in the Adult AIDS Clinical Trial Group (ACTG) studies (Chesney et al., 2000). Survey items in the original instrument included self report of skipped doses during the preceding 2 days and were preceded with directions that highlighted the difficulty in adhering to HIV treatment. A priori reliability estimates of the ACTG adherence measure have been described as good, Cronbach alphas=0.81-0.84; more specifically, the Cronbach alpha of questions relating to missed doses (yesterday, two, three and four days ago) was 0.81 (Reynolds et al., 2007). In behaviorally infected HIV positive youth, ages 16-24 years of age, adherence to antiretroviral treatment was assessed using 3-day self report of missed doses and was significantly correlated to viral load (Garvie, Wilkins, & Young, 2010).

The methodological limitations of self reported adherence include potential for overestimation of adherence (Arnsten et al., 2001; Liu et al., 2006) and low sensitivity for identifying non-adherence (Liu et al., 2006). Although overestimation of adherence using self report has been explained by social desirability (Liu et al., 2001), there has been more recent evidence to suggest absence of this association (Pearson et al., 2007).

Pharmacy Refill

Pharmacy refill history represents another indirect measure of adherence and may be calculated using time to refill (the number of doses dispensed divided by the time between refills x 100%) (Grossberg, Zhang, & Gross, 2004). This method been shown to correlate with HIV viral load (Low-Beer, O'Shaughnessy, Hogg, & Montaner, 2000) but limitations include reliance

on the assumption that filling or renewing medications indicates that patients are adherent to the prescribed regimen (Miller & Hays, 2000). In addition, the utility of this method is augmented when patients are receiving pharmacy services from one pharmacy provider or closed pharmacy system (Berg & Arnsten, 2006).

Predictors of Antiretroviral Adherence

Predictors of adherence and non-adherence have been examined in the adolescent population. In a prospective cohort study of 231 HIV-infected adolescents with horizontal transmission, younger age (hazard ratio = 0.11; 95% CI, 0.4 – 0.30) and depression (hazard ratio = 2.21; 95% CI, 1.10 – 4.42) were significantly associated with failure to maintain adherence; independent positive predictors of adherence during the preceding Saturday were not dropping out of high school ($p=0.03$), low intensity of alcohol use ($p<0.001$) and a higher CD4 count ($p=0.01$) (Murphy et al., 2005).

In a cross-sectional evaluation based on data collected in the Pediatric AIDS Clinical Trial Group (PACTG) 219, the relationship of self reported medication adherence to health, demographic, and psychological characteristics of 2088 HIV-infected children with perinatal HIV transmission, ages 3- 18 years and their caregivers was examined. In the final multiple regression model, factors associated with either significant or marginally significant increases in non-adherence included a detectable viral load (OR=2.46, 95% CI 1.85 – 3.26; $p <0.001$), adherence assessed by the subject (OR=1.90, 95% CI 1.36 – 2.65; $p <0.001$), repeating a grade in school (OR=1.36, 95% CI 1.03 – 1.81; $p=0.03$), recent stressful life event (OR=1.55, 95% CI 1.14 – 2.09; $p=0.05$), diagnosis of depression or anxiety (OR=1.85, 95% CI 0.95 – 3.61; $p=0.07$), and increasing age in years (OR=1.05, 95% CI 1.00 – 1.10; $p=0.07$ (Williams et al., 2006. Factors associated with adherence were higher caregiver education level (OR=0.84, 95% CI 0.75

– 0.95; p=0.003), having a primary care giver that was not the biological parent (OR=0.66, 95% CI 0.51 – 0.86; p=0.002), treatment with antipsychotics (OR=0.12, 95% CI 0.02 – 0.88; p=0.04), use of a buddy system for adherence support (OR=0.58, 95% CI 0.34 – 0.98; p=0.04), and previous adherence assessments (OR=0.79, 95% CI 0.65 – 0.95; p=0.01) (Williams et al., 2006).

The consequences of suboptimal adherence are many, including antiretroviral treatment failure, the development of genotypic and or phenotypic resistance to antiretroviral treatment regimens, and subsequent reduction in treatment options (Williams et al., 2006). Adherence to antiretroviral treatment continues to be one of the major barriers to successful treatment with highly active antiretroviral therapy (HAART) and HIV-infected adolescents must face a lifetime of antiretroviral treatment (Rudy, Murphy, Muenz, & Ellen, 2009).

Adherence to Antiretroviral Therapy and Health Literacy

The relationship between health literacy and antiretroviral treatment adherence has been examined and in a sample of HIV-infected adults, a robust relationship between health literacy and adherence was demonstrated. Antiretroviral adherence was measured using unannounced pill counts and health literacy with the TOFHLA. When adherence was defined as 90% of pills taken, lower health literacy was associated with non-adherence to prescribed antiretroviral regimens (OR=4.96, 95% CI = 1.55 to 15.88) (Kalichman et al., 2008).

In a recent pilot study, a nurse delivered antiretroviral treatment adherence intervention was performed in a sample of 30 HIV-infected adults with low health literacy skills. In this quasi-experimental, pre-post test design, HIV-infected adults scoring less than 80% on the TOFHLA were invited to participate in two 90 minutes nurse delivered educational interventions, followed with one 60 minute booster session over the course of four weeks. The results of this study

demonstrated improved antiretroviral treatment adherence and HIV disease/treatment knowledge post the nursing educational interventions (Kalichman et al., 2005).

Adherence to Antiretroviral Therapy and Health Literacy in HIV-Infected Youth

There is one known study investigating both health literacy and adherence to antiretroviral therapy in HIV-infected adolescents (Murphy et al., 2010), and this study offers the best evidence to date examining the relationship between health literacy and adherence in HIV-infected youth. This study used a cross sectional design and included a sample of 186 HIV-infected youth, ages 16-24 years, recruited from five cities in the United States. The sites of recruitment were primarily through the Adolescent Trials Network for HIV/AIDS Interventions, with locations in Philadelphia, PA, Baltimore, MD, Los Angeles, CA, and Fort Lauderdale, FL; participants were also recruited from one non- network site in Detroit, MI. Youth participating in the study met inclusion criteria of HIV-seropositive status, ages 16-24 years of age, and English speaking. Other criteria for participation were two of the following: currently prescribed antiretroviral treatment or advised of the need to be on ART by a physician, having had sexual intercourse or having tried alcohol/drugs. One of these criteria had to be problematic as defined by adherence of less than 90% during the past month, having unprotected sexual intercourse during the past three months or the results of substance use screening (Knight et al., 1999) indicating problematic use.

Health literacy was measured with the S-TOFHLA (Baker, Williams, Parker, & Gazmararian, 1999) and it was modified to include four numeracy items from the full version TOFHLA. Illness management was assessed with the diabetic self care practice instrument (Frey & Denyes, 1989) and it was also adapted for use in HIV-infected adolescents. Psychological status assessed with the Brief Symptom Inventory (BSI) measure (Derogatis & Spencer, 1982) and drug and

alcohol use during the past three months was measured with the alcohol, smoking, and substance involvement screening test (ASSIST) (Ali et al., 2002). Adherence to antiretroviral treatment was measured with 3-day self report of missed doses and ability to identify HIV medications using module 1 of the AIDS Clinical Trial Group (ACTG) pediatric questionnaire (Van Dyke, et al., 2002). Data collection of psychosocial, medical (number of health care and emergency room visits, hospitalizations over past 3 months), and HIV (CD4+T-lymphocute counts, plasma HIV-1 quantitative viral load) characteristics were also collected.

The age range of participants was 16-24 years (mean age=20.5) with 78.0% being African American/Black. There was a relatively even distribution of males (n=92) and females (n=88) and six youth were reported to be transgender/transsexual The sexual orientation of participants included homosexual and bisexual youth, and 56.6% self identified as heterosexual. The educational level in 50.0% of the sample was less than high school and the median monthly income was $506.00 dollars. The mode of transmission for this HIV-infected cohort was perinatal or mother to child in 31 of the 186 participants, and although not specified, behavioral transmission presumed for the remaining 155 youth. The mean CD4+T-lymphocute count was 465 cells per millimeter, indicative of overall normal immune status and median quantitative $\log_{10}$ HIV viral load was 3.92 (range= 1.40-5.88). Hospitalizations and emergency room visits during the preceding three months were low (mean 1.1 and 1.3, respectively).

Functional health levels were adequate in 85.5% of the sample population, yet only 34.0 % reported 3-day adherence estimates of > 90.0% or better. In the multivariable regression analyses, reading comprehension raw scores from the S-TOFHLA was the dependent variable and the results of analyses testing the association with adherence categorized as $\geq$ 90.0% , >0% and <90.0% , and 0% demonstrated no significant association of health literacy with 3-day self

reported antiretroviral adherence, adjusting for age and education level (p=0.98). There was also no statistically significant association of health literacy with self efficacy to adhere to ART (p=0.55) or medical appointments (p=0.85), BSI scores (p=0.053), CD4+T-lymphocyte counts (p=0.15), HIV viral load (p=0.13), number of emergency room visits (0.28), hospitalizations (p=0.14), race/ethnicity (p=0.93). However health literacy was significantly associated with receipt of medical care over the past three months and more specifically, a one unit increase on the reading comprehension raw scores of the S-TOFHLA was associated with a 8.9% increase in the likelihood of receiving medical care three or more times (AOR 1.09, 95th CI 1.04- 1.15), compared to receipt of no medical care (p=0.0002).

In the 186 participating teens, 34% reported $\geq$90% medication adherence during the past three days, and the authors proposed that the lower than expected self reported adherence estimates may have been explained by the stable health of participating HIV-infected youth, thereby lessening the importance of antiretroviral treatment, irrespective of their adequate health literacy scores.

Evidence Suggesting No Association between Health Literacy and Adherence

Despite the reported overall improvement in health outcomes associated with high health literacy, there are other outliers to suggest the contrary in the adult HIV literature. In one such study, the relationship of health literacy to the health outcomes of HIV viral load, and 3-day self reported measure of adherence to antiretroviral therapy were assessed in a sample of 266 HIV-infected adults with a history of alcohol problems. The results of this longitudinal study performed during the years of 1997-2001 demonstrated that adults with low health literacy as measured by the REALM demonstrated consistent trends toward higher odds of adherence and HIV virological suppression (Paasche-Orlow et al., 2006). There were similar results published

in a research study by Golin (2002). A possible explanation of these findings is that chronic illness including substance abuse lends itself to more exposure with the health care system, and that over time this interaction may confound the results of literacy and or health literacy scores. An alternate explanation suggested by (Paasche-Orlow et al., 2006) is that the resilience required for lower literate subjects to access care and participate in a study may have resulted in a selection bias. There are other studies in HIV adult cohorts reporting no association between health literacy and adherence to antiretroviral treatment (Wolf et al., 2004).

The gaps in understanding the relationship between health literacy and health outcomes in adult population as evidenced by these outliers are not unique. In the adolescent HIV population, it remains to be determined whether health literacy is a predictor of adherence. The challenges of testing this relationship include the lack of a consistent health literacy definition, debate regarding the underlying constructs that should be measured in health literacy, and limitations in the available health literacy measures. A comprehensive health literacy model tailored to the adolescent population offers promise in testing this relationship may lead to a better understanding of the indirect and direct relationships between health literacy and health outcomes such as adherence. The devastating consequences of HIV disease are preventable with optimal adherence to antiretroviral treatment. The body of health literacy research in the HIV adolescent population needs to extend beyond a single study for the future development of interventions aimed to improve health outcomes in HIV-infected youth.

CHAPTER 3

This chapter presents the primary objective, aims and related hypotheses of this study entitled, health literacy and adherence to antiretroviral treatment among HIV-infected youth (ages 13-24 years). An overview of the modified health literacy model is presented and followed with the findings from the pilot test performed. The current study design including recruitment procedures, sample population, eligibility criteria, clinical settings, study measures, data collection methods and ethical considerations are described. Statistical analyses for each aim and related hypothesis are detailed. Initial testing of the Media Use Instrument, a measure developed for use in this study and findings from the completed pilot testing are also presented. The clinical research protocols for this current study and the completed pilot testing and tool developed for scoring of the Beliefs about Medication Scale (BAMS) are included in Appendices A, B and C.

Methods

Aim I

The primary objective of this study was to examine the relationship between health literacy, functional literacy, beliefs about antiretroviral medications, media use and adherence to antiretroviral treatment among HIV-infected youth (ages 13 – 24 years). There are three stated hypotheses under this aim.

H1. Higher heath literacy is positively associated with adherence to antiretroviral treatment in HIV-infected youth (ages 13-24 years).

H2. Higher functional literacy is positively associated with treatment adherence in HIV-infected youth (ages 13-24 years).

H3. Individual beliefs about antiretroviral medications influence patterns of adherence to medications in HIV-infected youth (ages 13-24 years).

Aim II

The second aim was to explore the association between beliefs about antiretroviral medications and health literacy in HIV-infected adolescents. There is one stated hypothesis under this aim.

H4. Beliefs about antiretroviral medications are associated with health literacy in HIV-infected youth (ages 13-24 years).

Aim III

The third aim was to describe the association between media use and health literacy in HIV-infected adolescents. There is also one stated hypothesis under this aim.

H5. Media use is associated with health literacy in HIV-infected youth (ages 13-24 years).

Conceptual Model

A framework specific to adolescent health literacy has been described (Manganello, 2008) and to date, this is the only known model to conceptualize adolescent health literacy (Chapter 2, p. 15). The influence of family, peers, education and media use are integrated, highlighting the important attributes associated with the developmental stage of adolescence. Interrelationships among these variables and the individual, interpersonal and systemic contributors of adolescent health literacy are illustrated including the influence on health outcomes such as adherence.

It has been increasingly recognized that health literacy must be viewed in the broader context of individual factors, language and culture (IOM, 2009). Although one study has shown that beliefs including perceived threat of illness to be predictive of antiretroviral adherence in

behaviorally HIV-infected youth (Garvie et al., 2011), there were no studies designed to examine the relationships among beliefs, health literacy, and adherence in a recent systematic search of the adherence literature among HIV-infected youth (Reisner et al., 2009). Based on this gap in the current body of evidence and recommendations from the Institute of Medicine (2009), the conceptual framework used in this pilot study has been modified and individual beliefs about antiretroviral treatment and medications have been added, Figure 3.1.

Figure 3.1. An Adapted Framework for Studying Adolescent Health Literacy

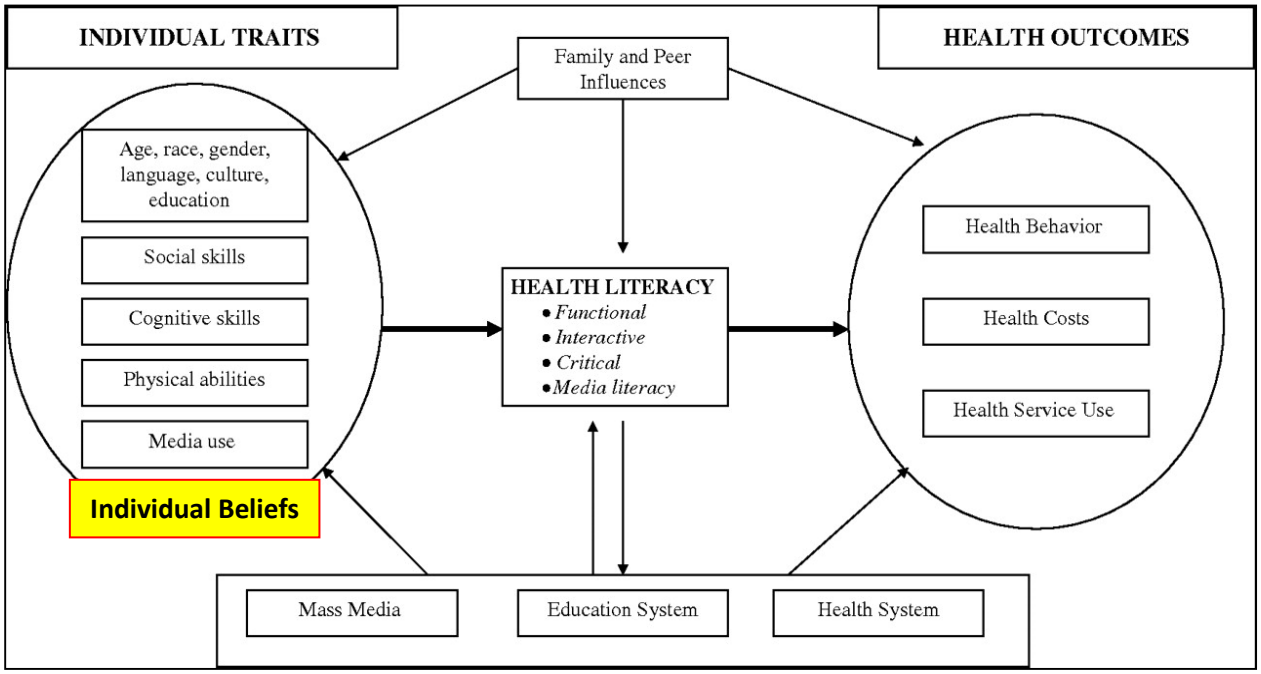

Figure 3.1. Adapted from "Health Literacy and Adolescents: A Framework and Agenda for Future Research," by J.A. Manganello, 2008, Health Education Research, 23(5), p 843.

Pilot Testing of Primary Study Measures

Pilot testing was conducted during June 2010 – July 2010. The objectives were to gain familiarity with the primary study measures (TOFHLA, REALM-teen, Beliefs about Medication Scale (BAMS), and Media Use Questionnaire), assess the time to administer in an adolescent population during scheduled clinic visits, and to determine any unanticipated effects. A Research Assistant (RA) was present for each of the six pilot testing sessions and performed testing on three participants after demonstrating competence on use of the study measures and interview techniques.

Participants were recruited from the ambulatory care network of New York Presbyterian-Columbia University Medical Center campus. These sites were the Young Men's Clinic and the Adolescent Medicine Practice. The Young Men's Clinic offers primary care services for adolescent and young adult males ages 12-30 years of age with a focus on reproductive health. The Adolescent Medicine Practice offers comprehensive health care services to youth ages 12 - 22 years of age.

A total of six teens from the two clinical settings participated in the pilot testing. Criteria for participation in the pilot testing were similar to the inclusion criteria for the parent study with the exception HIV seropositive status and included: HIV seronegative status, age range of 13- 24 years of age, English speaking, no cognitive deficits which might prevent survey completion and receipt of a daily medication for a chronic medical problem.

The first participant was enrolled on June 11th, 2010 and pilot testing was complete on July 16th, 2010, and this was after accruing six participants from two clinical settings. The recruitment timeline was as follows:

June 11th: two subjects were enrolled from the Adolescent Medicine Practice

June 18th: two subjects were enrolled from the Young Men's Clinic

June 25th: no subjects were enrolled

July 16th: two subjects were enrolled from the Young Men's Clinic

The principal investigator and the RA visited the clinical settings during scheduled clinic hours. Healthcare professionals at either site described the purpose of the pilot testing and proposed parent study to eligible youth. Adolescents expressing interest would be referred to the PI for a more detailed explanation.

Table 3.1 summarizes the health literacy, literacy and basic demographic characteristics of the volunteers. Participants were predominantly Latino with an age range of 17-25 years; there were five males and one female. Two of the six participants tested had age appropriate reading levels; health literacy was adequate in four and marginal in two of the volunteers. The BAMS was not performed on two of the six youth due to no reported history of prescribed medication(s) for any chronic illnesses.

Each participant was given a $20.00 Wendy's gift card after completing the study instruments. A signed written receipt was obtained after receiving the gift card. Funding was received from Training in Interdisciplinary Research to Reduce Antimicrobial Resistance (TIRAR) to compensate youth participating in the pilot testing phase.

Each volunteer was asked to provide feedback, if any, on the study procedures and experience with the primary survey measures. Feedback given by youth participating in the pilot testing proved to be valuable information including subjective reports of heavy time burden when administering the BAMS and TOFHLA consecutively. Participants described the sequential administration of these measures as "long" and both instruments did have the longest

time to administer, in comparison to the REALM-teen and Media Use Questionnaire. Based on this feedback, the order of the instruments was later randomized into five groups with separation of the TOFHLA and BAMS during the research study. In addition, pilot testing with the first two participants demonstrated the need for a script which was created and used for the remaining four teens, Appendix B. Finally scoring of the BAMS during the pilot testing phase prompted the need for a scoring tool to ensure reliability of test results, Appendix C.

Table 3.1. Summary of Findings from Pilot Testing (June 2010 – July 2010)

Age	Sex	Grade	REALM Raw Score	REALM Reading Level	TOFHLA Score	Health Literacy Level	Media Use Tool Tested	BAMS Tested
18 yrs	F	1st year College	59/66	8th-9th Grade	75/100	Adequate	Yes	yes
19 yrs	M	12th grade	50/66	6th-7th grade	66/100	Marginal	Yes	yes
25 yrs	M	Associate Degree	65/66	10th & >	90/100	Adequate	Yes	yes
20 yrs	M	3rd yr College	62/66	8th – 9th Grade	79/100	Adequate	Yes	yes
20 yrs	M	11th grade	64/66	10th & >	86/100	Adequate	Yes	No daily medication
17 yrs	M	11th grade	57/66	6th – 7th grade	74/100	Marginal	Yes	No daily medication

Note. The abbreviations F and M denote female and male.

Study Design

This multi-site pilot study employed a cross-sectional descriptive survey design to analyze potential predictors of antiretroviral adherence including health literacy, literacy, beliefs about medication, and media use in a sample of 50 HIV-infected adolescents.

The principal investigator (PI) was assisted in recruiting patients and also with data collection by two physician collaborators with a sub-specialty in pediatric infectious diseases, one pediatric nurse practitioner, a doctorally prepared pediatric nurse practitioner, one social worker and one research assistant (RA).

Training of Research Assistant

There was one RA assigned to assist with interviews and scoring of study packets. The educational background of the RA includes a Bachelor in Nursing from Columbia University, School of Nursing Entry into Practice (ETP) program and current enrollment in the acute care nurse practitioner program at Columbia University, School of Nursing. Training of the RA was initiated during the summer of 2010 and included independent review of literature selected by the PI on adolescent HIV, the problem of suboptimal adherence, the potential association of health literacy to antiretroviral adherence, and administration and scoring of the study instruments. Training also included mock interviewing using the study measures with other nursing students and the PI prior to beginning interviews during pilot testing. In the presence of the PI, the RA completed three interviews during the pilot testing phase, and demonstrated competence.

There were 30 hours of training in total prior to beginning interviews in the research study. Compensation of the RA was afforded by funding received from the Alpha Zeta Chapter of Sigma Theta Tau, International Nursing Honor Society Research Award in June 2010.

Sample

A convenience sample of youth with HIV-infection was recruited from four clinical settings; the inclusion and exclusion criteria for study participation are described below. Both perinatally (mother to child) and horizontally HIV-infected youth were eligible for participation.

Inclusion Criteria

- HIV seropositive status
- Age range of 13-24 years
- Fully disclosed of HIV diagnosis
- English speaking
- Current treatment with a prescribed antiretroviral treatment for six months or longer
- Absence of major neuro-cognitive deficits allowing for completion of survey instruments

Exclusion Criteria

- HIV seronegative status
- <13 years or >24 years of age
- Non-disclosure of HIV diagnosis
- Non-English speaking
- Prescribed antiretroviral regimen for less than 6 months

Cognitive deficits impeding completion of the survey instruments

The time to an undetectable viral load in most HIV-infected individual adhering to their antiretroviral treatment regimens has been estimated to be three to six months, unless harboring resistant mutations of HIV (USDHHS- Panel on Antiretroviral Guidelines for Adults and Adolescents, 2011).Therefore a minimum of six months of prescribed antiretroviral was

specified to most accurately to describe the HIV biomarker of quantitative viral load in the sample population.

Screening Measures to Assess Participant Eligibility

There were two screening measures used to assess participant eligibility and these were the Mini Mental Health State Exam (MMSE) and a Rosenbaum hand held vision card.

Mini Mental Health State Exam (MMSE)

The MMSE (Folstein, Folstein, & McHugh, 1975) was used to assess for the presence of neuro-cognitive deficits in participating youth. The presence of any undiagnosed neuro-cognitive deficits could potentially affect performance on the study measures. There has been very limited data on the incidence and prevalence of neuro-cognitive deficits in HIV-infected adolescents (Lyon, McCarter, & D'Angelo, 2009) and yet review of the literature concerning HIV-infected youth provides evidence for subtle cognitive and language delays in children due to HIV-infection, with many being asymptomatic (Brown, Lourie, & Pao, 2000). Psychometric testing with the MMSE in HIV-infected youth, including youth with an AIDS diagnosis and or diagnosis of dementia diagnosis has demonstrated a sensitivity of 50% and 92% specificity in the detection of encephalopathy (Lyon et al., 2009).

The MMSE contains 35 items divided into five areas for screening: orientation, attention and calculation, recall, and language. The total score is derived by adding the number of correct responses, possible scores range from 0-30. Scores of 23-30 are normal, 19-23 considered borderline and less than 19, impaired. In this current study, the cut off score of 24 was selected because in the one known study to date with HIV-infected youth, a score of less than 24 was used to identify HIV dementia (Lyon & D'Angelo, 2009). Time to administration is reported to be 10 minutes but in this sample, average administration time was approximately four minutes.

There were two participants not meeting the eligibility criteria of a MMSE score of 24 or higher. After consultation with the medical providers of these two participants, an exception was made due to the absence of any neurological disease on clinical exam. In addition, neither participant scored in a range designated as impaired as per the MMSE, and or presented with deficits precluding survey completion.

Vision Screen

Visual screening is recommended as a preliminary procedure for the TOFHLA and was performed using a handheld vision card to assess visual acuity of participants. Participants with prescribed corrective lenses were asked to wear them for this screen. A ruler was used to measure 14 inches from the participant's cheekbone and the 20/50 line was highlighted by covering the screening lines below. If a participant was not able to read print at the 20/50 line, the participant would then be asked to sequentially read the lines with larger visual print until a majority correct was achieved. Inability to read a simple majority at the 20/100 line would result in consultation with the medical provider to determine extent of visual deficits and eligibility for study participation.

Clinical Settings

Participants were recruited from Columbia University Medical Center, Project Services to Assist Youth (STAY) and the Center for Pediatric Special Studies at Weill Cornell Medical College. Project STAY is a New York State (NYS) AIDS Institute designated specialized care center. Healthcare services at Project STAY and the Center for Pediatric Special Studies include comprehensive medical and psychosocial health care for adolescents and young adults living with HIV or at risk for HIV.

The clinic population at Project STAY encompasses 72 HIV-infected adolescents/young adults ages 15 to 25 years and there were approximately 35 of the 72 adolescents receiving antiretroviral treatment during the time of this study. The Center for Pediatric Special Studies at the Weill Cornell Medical College provides specialized HIV health care services to 75 HIV-infected adolescents and approximately 65 of these patients were receiving antiretroviral therapy during the study period. Patients typically receive HIV related health care services every 8-12 weeks at both sites.

In February 2011, two additional clinical sites were added to enhance recruitment efforts, namely the Pediatric HIV clinic at the New Presbyterian Morgan Stanley Children's Hospital (MS CHONY) and the Family Centered Immunotherapy Clinic at Nyack Hospital. Both clinical sites are part of the New York Presbyterian Health Care Network. The Morgan Stanley HIV Clinic provides HIV care to 70 HIV-infected youth with an age range of birth through adolescence. This HIV-infected population is primarily perinatally HIV-infected and 60 of the 70 patients have a prescribed antiretroviral regimen. Nyack Hospital's Immunotherapy clinic provides HIV care to 15 HIV-infected adolescents with approximately half of this population receiving antiretroviral treatment during the study period.

Recruitment

After approval by the appropriate institutional review boards, recruitment of eligible participants was initiated on September 10, 2010 at Project STAY and Sept 17, 2010 at the Pediatric Center for Special Studies. Efforts to recruit participants occurred during regularly scheduled clinic hours at both locations and this was elected to avoid unnecessary absences from school and or work related to participant enrollment.

The PI and the trained RA visited both study sites weekly during regularly scheduled clinic hours. Clinic hours at Project STAY were held on Fridays from 9am - 2pm and at the Center for Pediatric Special Studies on Monday and Tuesday afternoons, 1pm - 4pm and also on Thursdays, from 9am - 4pm. Patients receiving HIV care at both sites typically receive reminder phone calls and or texts before scheduled visits to support compliance with medical care. The PI regularly communicated with the clinic staff via phone and email at both sites to discuss the patient schedule for the upcoming week, and also to maximize efficiency of time spent in the clinical settings. If staff from these clinical settings reported that none of the patients scheduled for the upcoming day met study eligibility criteria, the researcher and or RA did not visit the site(s). However, if an interested, eligible participant was present in the absence of the PI, contact by a clinic staff member via phone would ensue in an attempt to facilitate recruitment efforts.

Participants were recruited from the Morgan Stanley Children's Hospital HIV clinic and the Family Centered Immunotherapy Clinic at Nyack Hospital by the PI. Routine HIV Clinic sessions at the Morgan Stanley HIV clinic are offered for patients on Mondays, Tuesdays and Wednesdays during the hours of 8:30am - 5:00pm.

The Family Centered Immunotherapy Clinic at Nyack Hospital offers pediatric HIV healthcare services once weekly. Recruitment efforts occurred during one clinic session, February 8, 2010 and three eligible HIV-infected patients were enrolled at this site.

Recruitment Procedures

During scheduled clinic hours, staff members working in each of the clinics would introduce the study to eligible participants with informal overview of the study aims and related procedures. Youth expressing interest in the research study would then meet with the PI for a comprehensive description of the research protocol. If a potential candidate agreed to

participate, assignment to either the PI or RA would ensue and this was determined based on availability or presence in the clinic.

Protection of Study Volunteers and Consent Process

Institutional review board (IRB) approval was granted at each participating clinical site, New York Presbyterian Hospital-Columbia University Medical Center, New Presbyterian Hospital-Weill Cornell Medical College, and Nyack Hospital. Approval for this protocol was obtained from the IRB of New York Presbyterian Hospital- Columbia University Medical Center and Weill Cornell Medical College on August 18, 2010. A modification to the protocol was submitted and approved for the addition of Nyack Hospital and the Morgan Stanley Children's Hospital.

Informed consent and assent when indicated were obtained on all study participants in accordance with the regulations specific to the protection of study volunteers of the IRB at each institution. Participants were informed of their right to withdraw participation from this study at any time.

The research study was described in detail to eligible participants and their parent(s), if the candidate was between the ages of 13 to 17 years. Signed written and verbal consent was obtained from HIV-infected participants ages 18 years and older by the PI or the physician collaborator at each site.

Signed written and verbal assent was obtained for HIV-infected participants ages 13-17 years of age receiving medical care at New York Presbyterian's Project STAY, Weill Cornell Medical College's Center for Pediatric Special Studies, the Pediatric HIV clinic at MS CHONY and Nyack Hospital's Family Centered Immunotherapy Clinic by Ann-Margaret Navarra or the physician collaborator designated from each clinical site.

This research study involved no more than minimal risk and therefore a waiver/alteration request of the standard written consent procedures was granted from each of the corresponding IRB boards. If the parent or guardian of a potential participant ages 13 – 17 years of age was not present during the time of recruitment, verbal telephone consent was obtained from the guardian by either the physician collaborator or one of the co-investigators at the designated site. Verbal assent was obtained from the participant as described above.

Power Analysis

It was estimated that with a power of 0.80, the level of significance set at 0.05, and a sample of 80 participants it would have been possible to detect a significant difference between the 'adherent' and 'non-adherent' groups (dichotomized as above the median or at or below the median in rate of pharmacy refills) if the TOFLHA scores vary by ≥25%. (http://www.stat.uiowa.edu/~rlenth/Power/index.html). Because the sample size was smaller, a post hoc power analysis was performed and is described in the Discussion section.

Study Variables

The primary predictor variables of interest in this study were health literacy, literacy, beliefs about medications and media use and the primary outcome variable is adherence. Operationalization of these variables is outlined in Table 3.2.

Table 3.2. Conceptualization and Measurement of Primary Study Variables

Concept	Variable	Definition	Data Type	Measure
Health Literacy	Reading Comprehension/ Numeracy	The skills necessary to gain access to, understand and use information in ways that promote and maintain health (Nutbeam, 1998).	Continuous Categorical	Test of Functional Health Literacy in Adults (Parker, Baker, Williams, & Nurss, 1995)
Literacy	Functional Literacy		Continuous Categorical	Rapid Estimate of Adult Literacy Medicine-teen version (Davis et al., 2006)
Health Beliefs	Beliefs About Medications Subscales: Positive and Negative Outcome Expectancy, Perceived Threat, Intent to Adhere	The viewpoints and beliefs of participants regarding their HIV illness and related antiretroviral treatment.	Continuous	Beliefs About Mediations Scale (Riekert & Drotar, 2002)
Media Activities	Media Use	Time spent in the day preceding study enrollment using media devices outside of school and or work.	Continuous Categorical	Media Use Questionnaire (Adapted from Kaiser Family Foundation (2010) Media Study
Adherence	Antiretroviral Treatment Adherence	Self reported estimates of current antiretroviral regimen during the 3 days preceding study enrollment.	Continuous Categorical	3-day Self Report (Garvie et al., 2010)

Measurement of Primary Study Variables

Health Literacy

The full version Test of Functional Health Literacy in Adults (TOFHLA, described in Chapter 2) was used to measure health literacy in the study population. This is a health literacy screening tool and the shortened version TOFHLA (S-TOFHLA) has known reliability estimates in the adolescent HIV-infected population (alpha >0.7); the numeracy component of the S-TOFHLA has been described as less reliable in HIV-infected youth, alpha=0.56 (Murphy et al., 2010) and was therefore not selected for use in this study.

Testing and scoring were performed as per the instructions and answer key provided in the TOFHLA manual (Nurss, Parker, Williams & Baker, 2001). Consistent with these guidelines, there was a maximum of 10 minutes allowed for participant completion of the numeracy component and 12 minutes for the reading comprehension section. The average time for administration in non HIV-infected youth has been estimated to be 12.9 minutes with a range from 8.9 to 17.3 minutes (Chisolm & Buchanan, 2007) and in this current study, time to administer ranged from 14 to 22 minutes with an average time of 17 minutes.

TOFHLA scores are based on the combined results from the reading comprehension and weighted numeracy raw scores. Total TOFHLA scores may range from 0-100 and higher scores are suggestive of better health literacy levels. Classification of health literacy scores are categorized into three levels, inadequate (0-59), marginal (60-74), and adequate (75-100) (Parker et al., 1995).

Literacy

The Rapid Estimate of Adult Literacy in Medicine-teen version (REALM-teen, described in Chapter 2) was used to measure literacy in this pilot study. The REALM-teen is a word recognition screening measure used to predict general reading ability and was designed for use in health care settings to assess literacy skills among teens (Davis et al., 2006). The development of the REALM-teen included a sample of children and adolescents, ages 10-19 years of age, and this measure is designed to screen youth in grades six through twelve for below grade level reading (Davis et al., 2006). Although an adult version of the REALM exists, the teen version was selected for use in this current study because participants were recruited from pediatric settings and words used in this measure were selected from pamphlets designed by the American Academy of Pediatrics for adolescent health education.

The REALM-teen is a one page instruments containing 66 health related terms divided in three columns and are arranged in ascending order of difficulty. Participants were asked to say each of the words once, beginning with the first word listed in column one (upper left had corner). As per the directions in the REALM-teen administration manual, if a participant encountered a word that they did not recognize, the choices were to sound it out or skip saying the word.

Scoring was consistent with directions in the administrative manual and this included using dictionary pronunciation as the scoring standard. Participants received one point for each word pronounced correctly with no additions and or deletions. Words pronounced with an accent were not scored incorrectly, if otherwise consistent with dictionary pronunciation. Scoring in the REALM-teen ranges from 0 to 66 and are related to grade level with higher scores suggestive of a higher reading grade level. Table 3.3 depicts REALM-teen scores and associated reading grade

level. The average time to completion among HIV-infected youth participating in this study was less than 3 minutes or less and this is consistent with previously described time to administration (Davis et al., 2006).

Table 3.3 Interpretation of REALM-teen Raw Scores

REALM-teen Raw Score	Reading Grade Level	Related Literacy Skills
0 to 37	Less than third grade	Fivefold greater likelihood of reading below grade level compared with scores of 38-47
38 to 47	Fourth to fifth grade	----------
48 to 58	Sixth to seventh grade	----------
59 to 62	Eight to ninth grade	----------
63to 66	Greater than tenth grade	Will be able to read most health related education material for patients

Table 3.3. Adapted from "Rapid Estimate of Adolescent Literacy in Medicine REALM-Teen Administration Manual" by T.C. Davis, J. Bocchini, R. Byrd, S. Long, M. Wolf.

Beliefs about Medication

The Beliefs about Medication Scale (BAMS) is a 59 item health beliefs questionnaire using a 7-point Likert scale to assess perceived threat, positive outcome expectancy, negative outcome expectancy, and intent regarding oral medication adherence. Youth were asked to rate how much they agree or disagree with the statements about their illness and its medications; the endpoints were strongly agree versus strongly disagree for each of the subscales with the exception of intent to adhere, endpoints were definitely not likely versus definitely likely (Riekert & Drotar,

2002). Psychometric properties include demonstrated reliability (alpha= 0.79- 0.87; test-retest reliability, r= 0.71 – 0.77), and validity with a sample of chronically ill teens (n=133), including youth with HIV-infection (Riekert & Drotar, 2002). Theoretical ranges for the subscales have been described by Riekert & Drotar (2002) including perceived threat (13-91), positive outcome expectancy (64-140), negative outcome expectancy (13-76), and intent (22-49).

There is a potential for low literacy in the sample population (Brackis-Cott et al., 2009); therefore administration of the BAMS was performed in a read along method with the PI or RA reading each survey item to study the participant. The objective of the BAMS was to measure beliefs and not functional literacy, thus reading along with the participant helped support the validity of individual responses and minimize any feelings of embarrassment related to poor reading skills (Wolf Williams, Parker et al., 2007). Familiarity using and interpreting a Likert scale was assessed and explained to each participant, irrespective of reported past experience. A scoring instrument was developed for use in this study based on written instructions emailed by the author of this tool, Dr. Kristin Riekert, Appendix C. Higher scores indicate greater levels of agreement. Scoring was performed by summing survey items pertaining to each subscale (perceived threat, positive & negative outcome expectancy, intent). Reverse coding of survey items #3 (perceived threat subscale) and 54, 57, 59 (intent subscale) was performed as per the scoring instructions. The average administration time in this study was approximately 11 minutes.

Media Use

The Media Use Questionnaire was developed to assess media ownership and measure daily time spent with media devices among HIV-infected teens participating in this study. This

measure was adapted from the instrument used in the Kaiser Family Foundation (2010) Media Study and has not been previously tested in a HIV-infected population.

The modified Media Use Questionnaire contains three sections including ownership of media devices and time spent outside of school or work using media related to, and not related to use of the internet. There are also two survey items designed to assess the preferred media source for obtaining health related information. Consistent with the Kaiser Foundation (2010) instrument, participants were asked to report the time spent using media yesterday and more specifically, the daily amount of time (unit of measure in minutes/hours) outside of school and work using media devices such as computers with internet access, computer games, television, audio equipment, social networks such as Face book and print media were some of the media devices included in the survey questions. The categories of time spent using media in the modified measure ranged from no time to various levels of minutes and hours, and were developed based on categories in the Kaiser (2010) media tool and results of the Kaiser (2009) media survey.

Although the types of media devices assessed were similar to the Kaiser Family Foundation (2010) survey, there are some important distinctions. In the modified tool, the number of survey items was reduced from 54 to 12 and specific time frames (i.e. morning, afternoon, evening) were not assessed when measuring time spent viewing television. In addition, parental rules surrounding media use and the simultaneous use of more than one media device were not assessed in the modified instrument.

Due to the concern of participant low literacy skills as described above in the section on BAMS, administration was performed in a read along method and the PI or RA read each survey item to study participants. The average time for completion of this measure was 8 minutes with a range of 6-9 minutes.

Testing of Media Use Questionnaire

In July 2010, this measure was administered to 12 teens from a local high school in the Washington Heights section of New York City, and the objective was to gain feedback on the usefulness and content of the measure. The high school students were part of a scientific summer curriculum sponsored by the Center for Evidence-based Practice in the Underserved, led by a Columbia University, School of Nursing senior researcher.

Each of the students was first given a brief lecture by the PI on data collection using survey instruments and then offered a copy of the media use questionnaire for review. Students were asked to administer the tool to one another and report on ease of use, content, time to administration and report any challenges and or areas of confusion in the application of the tool. Students were also asked to discuss appropriateness of the choices listed categorizing time spent with the various medical devices. Feedback from students was positive, affirming that the instrument was easily comprehended and reflective of modern media devices and daily time usage; testing also demonstrated that this measure had an administration time of 10 minutes or less. Based on this preliminary testing, very minor changes in wording were made. For example, one student identified a typographical error and another questioned the utility of survey items related to ownership of beepers/pagers due perceptions of this device was obsolete. However this item was not subsequently omitted because it represented the opinion of one student.

Adherence Estimate

The primary outcome of this study was adherence, and was measured by 3-day participant self report. Adherence estimates were collected in the absence of the medical provider and or parent/legal guardian of youth less than18 years of age. To minimize the potential for social desirability bias (Simoni et al., 2006; Garvie, Wilkins, & Young, 2010), questions regarding

antiretroviral adherence during the past three days were worded in a non-punitive manner. For example, the researcher would say, “Before beginning the questionnaires, could you tell me how many doses of your HIV medicines you missed yesterday? How many doses did you miss on _____(investigator names day two days ago)? How many doses did you miss on _____(investigator names day three days ago)?”

This method has been previously tested and validated in HIV-infected youth and 3d-recall of missed antiretroviral dosing has been shown to predict HIV-quantitative viral load among HIV-infected adolescents. Self-reported adherence estimates were operationalized with the doses missed calculation for each antiretroviral medication and an average missed doses calculation was computed (Garvie, Wilkins, & Young, 2010).

The *doses missed calculation* is calculated as follows:

Reported number of tablets/capsules missed multiplied by the dosing schedule (once daily, twice daily, etc.) during the past 3 days /divided by total number of prescribed doses over past 3 days. This percentage was subtracted by 100% to obtain the 3-day adherence estimate.

Medications that were not a component of the antiretroviral treatment regimen were not included in the calculation. Participants reporting ‘don’t know’ to the number of missed antiretroviral medications were scored as having missed the dosage for the time period assessed (morning and or evening of the specific day).

Pharmacy Time to Refill Adherence Estimate

Pharmacy refill data using the time to refill estimate were collected, but not used in the final analysis due to unreliable and missing data among the study population. Data collection involved seven individual pharmacies including one participant with a change to mail-order pharmacy. It was also not possible to distinguish between participants receiving home delivery of their

antiretroviral medications from participants picking up HIV medications that were delivered to their designated clinical setting. Based on limited feasibility to reliably measure adherence using pharmacy refill data in this study and evidence to support the use of 3-day self report in HIV-infected youth (Garvie, Wilkins, & Young, 2010), adherence was operationalized using self report exclusively.

The average time to complete the screening measures, primary study instruments, and adherence estimate was 43 minutes. A description of the average time for completion of each measure is presented in Table 3.5.

Definition of Terms

Adolescence

Youth in this study included HIV-infected participants ages 13-24 of age and were referred to as adolescents despite being beyond the classic age marking the end of this developmental stage, 21 years of age. HIV-infected patients are typically cared for in pediatric HIV setting during the developmental stage of adolescence or ages 13-21 years. Specialty HIV care extends through young adulthood until successful transition to an adult HIV clinic has occurred, typically at 24 year of age (Maturo et al., 2011).

Virologic and Adherence Outcomes

An undetectable HIV viral load or HIV virologic suppression was defined as a HIV RNA level of less than 400 copies/ml, and a detectable HIV viral load greater than 400 copies/ml. Optimal adherence to antiretroviral treatment was defined as to 3-day self reported adherence estimates of 100% (Malee et al., 2011).

Clinical Staging of HIV Disease

Participants in this study were classified into one of four clinical stages as designated by the Centers for Disease Control and Prevention (2008) guidelines. A category of stage 1, stage 2, stage 3, and stage unknown is given to HIV-infected adults and adolescents 13 years and older and adults for the purposes of surveillance. Consistent with these guidelines, if the CD4+T-lymphocyte count and percentage did not correspond to the same stage, the more severe clinical stage was selected, see Table 3.4. Study participants with perinatal HIV-infection and a history of an AIDS diagnosis in childhood maintained this diagnosis, irrespective of current clinical and or immunological status (CDC, 2008).

Table 3.4. Human Immunodeficiency Virus (HIV) Staging for Adults and Adolescents ≥ 13 Years

HIV Stage	Laboratory Evidence	Clinical Manifestations
Stage 1	CD4+T-lymphoctye count of ≥ 500 or CD4% of ≥ 29	No AIDS defining conditions
Stage 2	CD4+T-lymphoctye count of 200 -499 or CD4% of 14-28	No AIDS defining conditions
Stage 3	CD4+T-lymphoctye count of < 200 or CD4% of <14%	Current or past AIDS defining conditions
Stage 4	No information about participant CD4+T-lymphocyte and or CD4 %	No information about history of current or past AIDS defining conditions

Table 3.4. Adapted from ”Revised Surveillance Case Defintions for HIV Infection Among Adults, Adolescents, and Children Aged < 18 Months and for HIV Infection and AIDS Among Children 18 months to < 13 Years – United States, 2008” by Centers for Disease Control and Prevention, 2008, in Morbidity and Mortality Weekly Report, 57 (RR-10), p. 4.

Table 3.5. Average Time to Completion of Study Measures

Study Measure	# of Survey Items	Average Time
TOFHLA full version	50	17 minutes
REALM-teen	66	2 minutes
BAMS	59	11 minutes
Media Use Questionnaire	12	8 minutes
3 –day Adherence Estimate	3	1 minutes
MMSE	35	4 minutes
Vision Screen	----------	< 1 minute

Medical Record Data Extraction

De-indentified data were extracted from the medical records of all participating youth. The PI completed data collection forms for New York Presbyterian's Project STAY, Morgan Stanley Children's Hospital HIV Clinic, and Nyack Hospital's Family Centered Immunotherapy Clinic. The medical director of the Center for Pediatric Special Studies-Weill Cornell Medical College completed data collection forms for participants enrolled at this clinical site because of logistical challenges with access to electronic medical records. Variables assessed and related data source are listed below in Table 3.6, and were typically based on the date of study enrollment. Quantitative HIV viral load and CD4+ T-lymphocyte counts included the two most recent results within six months of study enrollment. Hospitalizations and emergency visits also reflected a six month retrospective period. Consultation with the medical provider and or social worker ensued, if the variable assessed was missing and or with conflicting results.

Table 3.6. Summary of Variables Collected in Medical Record Review

Variable	Data Source(s)
Age	Medical Record
Gender	Self Reported Status in Medical Record
Sexual Orientation	Self Reported Status in Medial Record
Race/Ethnicity	Self Reported Status/Healthcare Provider Documentation
Residence	Social Worker/ Healthcare Provider Documentation
Education	Social Worker/ Healthcare Provider Documentation
Hospitalizations	Healthcare Provider Documentation
Emergency Room Visits	Healthcare Provider Documentation
Medical Insurance	Social Worker Documentation
Current Psychiatric/ Psychological Disorder	Health Care Provider Documentation
Substance Use/Current History	Health Care Provider Documentation/Self Reported History in Medical Record
Mode of HIV transmission	Healthcare Provider Documentation
HIV Staging	Health Care Provider Documentation & Supporting Laboratory Evidence
Current Antiretroviral Regimen	Healthcare Provider Documentation/Pharmacy History
HIV Quantitative viral load	Laboratory Report
CD4 T-lymphocyte Count and percentage	Laboratory Report
Adherence Estimates – Medical Provider	Healthcare Provider Documentation with Follow-up Discussion

Age at the time of the study enrollment was assessed on each participant. Date of birth was extracted from the medical record and age in months, and months and years calculated.

Gender was described as per participant self report and included male, female, transgender (female to male), transgender (male to female), and transsexual.

Sexual Orientation was documented as per participant self report and included heterosexual/straight, gay/lesbian, bisexual and a category for other if a participant's sexual orientation was not represented by these categories.

Race/Ethnicity was described as documented in the medical record. Race and ethnicity were both included in the data collection tool with race categorized as African American or black, white, Asian, Native Hawaiian or other Pacific Islander, American Indian/Alaskan Native, and other). Classification of ethnicity included white, non-Hispanic, Hispanic, and other. If a category of 'other' was listed for race or ethnicity, there was consultation with the medical provider and or social worker for clarification.

Residence was defined as the permanent location where the participant lives and sleeps.

Education was consistent with the current and or highest grade level of participants and may have included high school, college or a vocational program.

Hospitalizations were the number or overnight stays at a medical facility.

Emergency Room Visits were the number of times medical care was obtained for an acute healthcare issue in an emergency room.

Medical Insurance was the participant's primary health care coverage providing full or partial payment to the medical center(s) for health services received at the time of study enrollment.

Current psychiatric/psychological disorder included documentation of a psychiatric and or psychological disorder by a psychiatrist, psychologist and or the primary medical provider.

Current history of substance use/abuse was based on self reported use/abuse of alcohol and or any illegal substances including marijuana, cocaine/crack and heroin and non-prescribed substances such as barbiturates and also any combination of these substances.

Mode of HIV transmission was defined as the route of transmission for HIV, categorized as perinatal transmission (mother to child), horizontal transmission (sexual contact with infected person(s), intravenous drug use (shared needles with infected contact), or other (for unknown risk). Mode of HIV transmission was based on the primary medical provider's written and/or electronic notes.

HIV Staging was consistent with the Center for Disease Control clinical and immunological classification of HIV disease status, Table 3-4.

Current antiretroviral regimen or the medications used for treatment of HIV disease at the time of enrollment and during the preceding six months or longer.

HIV quantitative viral load results were obtained from the medical record. The two most recent results within six months retrospective of the study period were recorded. The unit of measure for HIV viral load was 1000 copies per milliliter.61

CD4+ T-lymphocyte count results were obtained from the medical record. The two most recent results within six months retrospective of the study period were recorded. Both the CD4+ T-lymphocyte absolute count and percentage were recorded; the standard unit of measure for recorded CD4 + T-lymphocyte absolute counts was per cubic millimeter.

Adherence estimate was the documentation in the medical record by the healthcare provider describing, estimating and or calculating participant adherence to the current antiretroviral regimen at the time of the study visit. Due to inconsistency among providers in the four clinical

settings, medical providers were later contacted to describe the method if any, used to arrive at the adherence estimate. This was exclusively performed for descriptive purposes.

Data Collection/ Study Procedures

Following IRB approval from both institutions, patients were recruited during regularly scheduled hours at each of the clinical settings. A private exam room was provided for the researcher in each clinical site and was used for study interviews/survey administration and for consent. After informed consent and assent had been obtained, participants and the parent/legal guardian, when indicated were given the opportunity to ask questions and time was allowed for clarification of study procedures before beginning testing. Medical providers and parents of youth less than 18 years of age were asked to leave the exam room, if present. The MMSE and vision screen were first administered and then self reported adherence estimates were obtained. Data from the screening instruments (TOFHLA, REALM-teen, BAMS, and Media Use Questionnaire were collected by the PI or RA in face to face interviews during a regularly scheduled clinic visit. The order of the primary study instruments was randomly decided, as indicated below and the TOFHLA and BAMS were not administered sequentially based on feedback received during the pilot testing stage.

Group 1: Media, BAMS, REALM, TOFHLA

Group 2: BAMS, Media, REALM, TOFHLA

Group 3: TOFHLA, REALM, BAMS, Media

Group 4: TOFHLA, REALM, Media, BAMS

Group 5: BAMS, Media, TOFHLA, REALM

Data extraction from the medical records of participants was performed after enrollment to minimize potential for researcher bias during testing.

Compensation

At the conclusion of testing, participants were given a $20.00 Gap gift card to compensate them for their time and were also given an opportunity to ask and questions and or offer feedback. Funding for the gift cards was awarded from a grant sponsored by the Alpha Zeta Chapter of Sigma Theta Tau, International Nursing Honor Society Research Award in June 2010.

Data Management

All confidential information and the hard copies of the completed instruments were stored in a locked file cabinet and access was limited to the PI. Numeric coding was used to protect the identity of participants, codes ranged from 1001-1051 with 1001 representing the first participant and 1051 the final participant in this pilot study. Computers used in this study were password protected and access was limited to the PI and or RA. There was written backup of all study files to protect against computer failure. Data collected were directly entered directly into IBM SPSS Statistics, version 19 for subsequent data analysis.

Statistical Analysis

IBM SPSS Statistics, version 19 (Chicago, IL) was used to perform all statistical analyses. Prior to beginning data analysis, the database was cleaned and double-checked for accuracy by the PI. Initially descriptive statistics (mean and standard deviation, median and range, frequency and percentage) were computed to summarize scores on all study instruments including health literacy and literacy levels, beliefs about medications, and media use in the sample population. Descriptive statistics were also used to describe the psychosocial and HIV characteristics of the sample population. Data were assessed for normality through histograms. Log transformation of variables with skewed data was performed, and if zero values existed, the number 1 was added during the log transformation of the variable. Non-parametric statistical tests were used for non-

normally distributed data. The level of significance for testing of each hypothesis was set to an alpha of 0.05.

Computation of Composite Scores/Recoded Variables for Statistical Analyses

Health Literacy

The continuous health literacy scores from the TOFHLA were collapsed into dichotomous variables, inadequate and adequate. Participants with TOFHLA scores of 0-74 were coded as inadequate health literacy and scores of 75-100 were coded as adequate health literacy.

Adherence Estimates

Due to the negatively skewed data of the 3-day adherence estimates, adherence was dichotomized into above and below the median score, <100% adherent and 100 % adherent (Simoni et al., 2006). Quantitative HIV viral loads were also dichotomized due to positively skewed data into above and below the median score of undetectable HIV viral load, represented as < 400 and >400 copies per ml.

Computation of Total Beliefs Composite Score

A total beliefs composite score was computed by combining each of the subscales in the BAMS (positive outcome expectancy, negative outcome expectancy, intent to adhere, perceived threat). Survey items were reverse coded as per the scoring instructions of the BAMS, so that a higher score indicated more positive beliefs.

Literacy-Age Level Reading Variable

The reading grade level equivalent for participant raw scores on the REALM-teen was compared to the chronological age of each participant. A dichotomous age level reading variable was created including below age level reading and at or above age level reading.

Media Use Binary Variables

Binary variables were computed based on reported frequency to categorize time spent yesterday using the following media devices/sources: cellular phones (≤1 hour, > 1 hour), videogames offline and online (none, ≥ 5 minutes), reading offline and online (none, ≥ 5 minutes), Google/Yahoo search engines (≤ 30 minutes, > 30 minutes), social websites (≤ 1 hour, > 1 hour), television (≤ 1 hour, > 1 hour), number of text messages sent (≤ 25, > 25), # of emails sent and received (≤ 10, > 10), audio offline (≤ 1 hour, > 1 hour), and audio online (< 30 minutes, ≥ 30 minutes).

Media Use Composite Score

A composite variable was computed describing the amount of time spent using television, audio devices, and playing video games (TAV). Scores for total TAV time were divided into three categories (< 1 hour per day, 1-3 hours per day, > 3hours per day).

Aim I

The primary objective of this study was to examine the relationship between health literacy, functional literacy, beliefs about medication, media use and adherence to antiretroviral treatment among HIV-infected youth (ages 13 – 24 years).

Logistic regression analyses were conducted using dichotomized 3-day self reported adherence scores as the outcome variable (<100% adherence, 100% adherence) and the TOFHLA score as the primary predictor variable of interest to test the association of adherence to antiretroviral treatment. Other variables included in the regression model were literacy, beliefs about medications, media use and potential confounders found to be significant ($p<0.05$) in the bivariate analyses.

H1. Health literacy is positively associated with adherence to antiretroviral treatment in HIV-infected adolescents.

Bivariate analyses were performed using Chi square test for independence or Fisher's Exact test to examine the relationship of health literacy (inadequate/adequate) and adherence to antiretroviral therapy using both 3-day adherence estimates (<100 % adherent, 100% adherent) and also with HIV-viral load (<400 copies/ml, >400 copies/ml). Quantitative HIV-viral loads were also used as an estimate of antiretroviral adherence in these analyses because of the statistically significant association of plasma HIV viral load and self reported adherence to antiretroviral medications (Nieukerk & Oort, 2005).

Mann Whitney non-parametric statistical tests were used to examine the relationship between 3-day adherence estimates and binary levels of health literacy. The correlation between the continuous health literacy scores and 3-day adherence estimates were performed using Spearman's rank correlation coefficient.

H2. Higher functional literacy is positively associated with treatment adherence in HIV-infected adolescents.

Bivariate analyses were performed using Chi square test for independence or Fisher's Exact test to examine the relationship of literacy (below age level reading/ $\geq$ age level reading) and adherence to antiretroviral therapy using both 3-day adherence estimates (<100 % adherent, 100% adherent) and also using HIV-viral load (<400 copies/ml, >400 copies/ml).

Mann Whitney non-parametric statistical tests were used to examine the relationship between adherence using both 3-day adherence estimates and HIV-quantitative viral load and binary categories of age level reading.

The correlation between the continuous REALM raw scores and 3-day adherence estimates and also with quantitative HIV viral load were performed using Spearman's rank correlation coefficient.

H3. Individual beliefs about medications influence patterns of adherence to medications in HIV-infected adolescents.

Correlations between the continuous 3-day adherence estimates and composite total beliefs scores and also with each of the subscales in the BAMS (positive outcome expectancy, negative outcome expectancy, intent to adhere, perceived threat) were performed using Spearman's rank correlation coefficient.

The Mann Whitney non-parametric statistical test was used to examine the relationship between the beliefs composite score and each of the beliefs subscale scores and binary levels of 3-day self reported adherence.

Aim II

The second aim was to explore the association between beliefs about medications and health literacy in HIV-infected adolescents. There is one stated hypothesis under this aim.

H4. Beliefs about medications are associated with health literacy in HIV-infected adolescents.

Correlations between the continuous health literacy scores and composite total beliefs scores and also with each of the subscales in the BAMS (positive outcome expectancy, negative outcome expectancy, intent to adhere, perceived threat) were performed using Spearman's rank correlation coefficient.

The Mann Whitney non-parametric statistical test was used to examine the relationship between health literacy (inadequate/adequate) and the beliefs composite score and each of the beliefs subscale scores.

Aim III

The third aim was to describe the association between media use and health literacy in HIV-infected adolescents. There is also one stated hypothesis under this aim.

H5. Media use is associated with health literacy in HIV-infected adolescents.

Bivariate analyses were performed using Chi square test for independence or Fisher's Exact test to examine the relationship of health literacy and time spent using media devices including: cellular phones, playing videogames online and offline, reading online and offline, viewing television, listening to music online/offline, using social websites and search engines such as Google/Yahoo and the number of emails and text messages sent and minimum time spent using television, audio, video games (TAV) composite variable.

3.7. Plan for Statistical Analyses to Test Study Hypotheses

Aim/Hypothesis	Statistical Test
Aim 1. To examine the relationship between health literacy, functional literacy, beliefs about medication, media use and adherence to antiretroviral treatment among HIV-infected adolescents (ages 13 – 24 years). There are three stated hypotheses under this aim.	Multivariable logistic regression with adherence as the dependent variable. Predictor variables included scores on the BAMS, TOFHLA, REALM-teen, media use, confounders found to be significant in bivariate analyses.
H1. Heath literacy is positively associated with adherence to antiretroviral treatment in HIV-infected adolescents.	Chi square test for independence or Fisher's Exact test Mann Whitney non-parametric statistical tests Spearman's rank correlation coefficient
H2. Higher functional literacy is positively associated with treatment adherence in HIV-infected adolescents.	Chi square test for independence or Fisher's Exact test Mann Whitney non-parametric statistical tests Spearman's rank correlation coefficient
H3. Individual beliefs about medications influence patterns of adherence to medications in HIV-infected adolescents.	Mann Whitney non-parametric statistical tests Spearman's rank correlation coefficient
Aim 2. To explore the association between beliefs about medications and health literacy in HIV-infected adolescents. There is one stated hypothesis under this aim.	
H4. Beliefs about medications are associated with health literacy in HIV-infected adolescents.	Mann Whitney non-parametric statistical tests Spearman's rank correlation coefficient
Aim 3. To describe the association between media use and health literacy in HIV-infected adolescents. There is also one stated hypothesis under this aim.	
H5. Media use is associated with health literacy in HIV-infected adolescents.	Chi square test for independence or Fisher's Exact test

Potential Confounding Variables

Potential confounding variables in this study included age (Becker, 2002), gender (Comulada et al, 2003), education (Murphy et al., 2005), mode of HIV transmission, clinical stage of HIV disease (Murphy et al, 2005), current psychological/psychiatric history (Rudy et al, 2009) and substance use (Comulada et al, 2003). Bivariate analyses were computed with each of these potential confounders and level of adherence (<100% adherence, 100% adherence). Variables found to statistically significant were included into the multivariate analyses.

Plan for Dissemination

The findings of this study will be disseminated at a local, regional and national level. Abstracts describing the results of this study have been submitted for presentation in October 2011, Stony Brook University Converging Science Summit and Greater New York Hospital Association & United Hospital Fund Annual Symposium. In addition, dissemination of findings will be submitted for platform presentation at the 2012 Eastern Nurses Research Society meeting. A final manuscript will be submitted to the Journal of the Association of Nurses in AIDS Care. Volunteers participating in this study will be contacted by the researcher and a round table lunch meeting to share the results will be planned at each site.

CHAPTER 4

Results

This chapter provides a summary of the recruitment response and characteristics of the study population. The study findings are presented in both narrative and table format and the results of the statistical analyses used to test each hypothesis are detailed and presented by aim.

Recruitment Response

Fifty one participants were recruited from four clinical sites during the time period of September 10, 2010 through April 25, 2011. Data from one participant recruited from Project STAY had to be later excluded because the subject did not meet the eligibility criteria of prescribed antiretroviral treatment for six months at the time of enrollment and this brought the final sample size down to 50.

Recruitment efforts primarily included routine visits to each of the clinical settings during regularly scheduled clinic hours. Total weekly time spent recruiting participants averaged between 12 to 15 hours per week. Among the total of 71 eligible participants approached by the clinical staff and researcher from the four sites, there were 10 patients who agreed to participate but were not compliant with the scheduled study appointment and an additional 10 who refused to participate. The main reason offered by youth for not wanting to participate was lack of time. Thus the intended sample size of 80 participants was not achieved, although the overall refusal rate was low (10/71, 14.1%). The stated inclusion criteria of currently prescribed antiretroviral treatment for six months or longer precluded enrollment of an additional 12 HIV-infected youth who were treated for less than six months. The number of participants per clinical site by mode of HIV transmission (perinatal and behavioral) is summarized below in Table 4.1.

Table 4.1. Recruitment per Clinical Site

	Participants Enrolled	**Perinatal Transmission**	**Behavioral Transmission**
Clinical Setting	**n (%)**	**n (%)**	**n (%)**
Weill-Cornell Center for Pediatric Special Studies	24 (48.0)	23 (95.8)	1 (4.2)
New York Presbyterian Project STAY	18 (36.0)	9 (50.0)	9 (50.0)
Morgan Stanley Children's Hospital HIV Clinic	5 (10.0)	5 (100.0)	0 (0)
Nyack Hospital	3 (6.0)	3 (100.0)	0 (0)
Total	**50**	**40 (80.0)**	**10 (20.0)**

Tables 4.2 and 4.3 summarize the demographic characteristics of the 50 HIV-infected participants. Participants had a median age of 20.4 years (range 13.75-24.83 years) with 56.0% (28/50) female. African Americans comprised 56.0% (28/50) of the sample, and most (37/50) participants were heterosexual (74.0%). Nearly half (48.0%) were high school graduates or had completed a graduate equivalency diploma (GED).

All participating youth had health insurance at the time of study enrollment and most (70.0%) resided with biological family member(s). Active substance use/abuse was not reported in 68.0% of the sample and 36.0% had a documented active psychological/psychiatric disorder. Participants were primarily perinatally HIV-infected (80.0%) with a median CD4+T-lyphomcye count of 552.5 (range 3-1584) and median HIV $\log_{10}$ viral load of 0 copies/ml (range 0 - 5.42).

Table 4.2. Psychosocial Characteristics of Study Population (N=50)

Variable	Results
Age in years	
Mean (±SD)	19.7 ± 3.13
Median (range)	20.4 (13.75 – 24.83)
Gender, n (%)	
Male	28 (56.0)
Female	22 (44.0)
Race/Ethnicity, n (%)	
African American	28 (56.0)
Caucasian	3 (6.0)
Hispanic/Latino	13 (26.0)
Asian	2 (4.0)
Mixed race	2 (4.0)
Other	2 (4.0)
Sexual Orientation, n (%)	
Heterosexual	37 (74.0)
Homosexual (gay/lesbian)	9 (18.0)
Bisexual	2 (4.0)
Unknown	2 (4.0)
Education, n (%)	
High School Drop Out/no GED	8 (16.0)
8th Grade Student	2 (4.0)
High School Student	16 (32.0)
High School/GED graduate	5 (10.0)
Post High School Vocational Training	3 (6.0)
College Student	15 (30.0)
Other	1 (2.0)
Substance Use/Abuse, n (%)	
No reported use	34 (68.0)
Alcohol	6 (12.0)
Marijuana	4 (8.0)
Poly-substance use/abuse	4 (8.0)
Unknown/not documented	2 (4.0)
Health Care Insurance, n (%)	
Medicaid	37 (74.0)
Medicare	3 (6.0)
Medicaid Managed Care	7 (14.0)
ADAP	3 (6.0)
Residence, n (%)	
Family	35 (70.0)
Friend/partner	5 (10.0)
School	2 (4.0)
Supportive Housing	4 (8.0)
Alone	4 (8.0)
Psychiatric/Psychological Disorder, n (%)	
Yes	18 (36.0)
No	29 (58.0)
No recent evaluation	3 (6.0)

Table 4.3. HIV Characteristics of Study Population (N=50)

Variable	Results
Mode of HIV transmission, n (%)	
Perinatal	40 (80.0)
Sexual	10 (20.0)
CDC Stage, n (%)	
Stage 1 (Asymptomatic)	6 (12.0)
Stage 2	20 (40.0)
Stage 3 (AIDS)	24 (48.0)
AIDS Diagnosis, n (%)	
Yes	24 (48.0)
No	26 (52.0)
Overnight hospitalization	
Mean (±SD)	0.14 ± 0.45
Median (range)	0 (0-2)
Emergency room visits	
Mean (±SD)	0.20 ± 0.54
Median (range)	0 (0-2)
Log_{10} HIV viral load (copies/ml)	
Mean (±SD)	1.18 ± 1.84
Median (range)	0 (0-5.42)
HIV viral load dichotomized, n (%)	
< 400 copies/ml	37 (74.0)
> 400 copies/ml	13 (26.0)
CD4+T-lymphocute count (cells/ul)	
Mean (±SD)	562.88 ± 310.94
Median (range)	552.5 (3-1584.0)
CD4+T-lymphocyte percentage	
Mean (±SD)	26.98 ± 9.81
Median (range)	28 (1 - 42.0)
3-day Adherence Estimates	
Mean (±SD)	86.0 ± 26.92
Median (range)	100.0 (0-100)
Adherence Dichotomized, n (%)	
100% reported adherence	35 (70.0)
<100 % reported adherence	15 (30.0)

Self Reported Adherence

Three day self reported adherence in this study population was highly negatively skewed with median 3-day adherence estimate of 100 % and range 0-100 (mean=86.0, SD $\pm$ 26.92). Reported missed antiretroviral doses three days prior to study enrollment were low, median 0 and range 0-100 (mean=14.0, SD $\pm$ 26.92).

Predictors of antiretroviral adherence and self reported adherence estimates dichotomized by level (<100% adherence, 100% adherence) were examined for differences using bivariate analyses with Chi square test for independence or Fisher's Exact test. There were no statistically significant differences in gender, mode of HIV transmission, AIDS diagnosis, substance use, psychological/psychiatric illness, all p values > 0.05, Table 4.4. Correlation between age in years and self reported adherence estimates were examined and no statistically significant association was demonstrated (Spearman's rho=-0.087, p=0.549).

The self reported adherence estimates in this study were higher in comparison to evidence from prior studies in HIV-infected youth. The reliability of self reported adherence was tested by correlating self reported antiretroviral adherence estimates with quantitative HIV-viral loads using Spearman's rank correlation coefficient, and there was a strong, negative correlation between these two variables (Spearman's rho=-0.615, p =0.00). There was also a statistically significant positive, moderate correlation between both CD4+T-lymphocyte count and CD4+ T-lymphocyte percentage and participant adherence estimates, Table 4.5.

Data collection of the HIV biomarkers was performed on the same day of study enrollment in 56% (28/50) of the sample, thus on the same day adherence estimates were measured. An additional eight participants (16%) had HIV biomarkers collected 1day to 5 weeks preceding the study visit and 12 (24%) six to nine weeks earlier. There were two participants (4%) with either

one or both of the documented HIV biomarkers preceding adherence estimates by 13 to 16 weeks.

Medical Provider Estimates of Adherence

Adherence estimates documented in participant medical recorders were inconsistent across and within clinical settings. Of the 50 medical records reviewed, data from one participant was not available and one other participant reported complete non-adherence and a narrative description, instead of a calculated adherence estimate was detailed.

Among the remaining 48 medical records, adherence estimates included both one and two time frames as follows: past three days (2.1%), one week (8.3%), same day/ past seven days (31.3%), one week/one month (29.2%) and two weeks/ past month (18.8%). There were three youth (6.3%) with no documented adherence estimates and two (4.2%) with no specific time frame described.

Table 4.4. Bivariate Analyses Testing for Differences by Level of Adherence

Variable	< 100 % Adherence (n=15)	100 % Adherence (n=35)	Total	P Value*
Gender, n(%)				
Male	10 (35.7)	18 (64.3)	28	0.367
Female	5 (22.7)	17 (77.3)	22	
Mode of Transmission				
Perinatal	12 (30.0)	28 (70.0)	40	1.00
Horizontal	3 (30.0)	7 (70.0)	10	
AIDS Diagnosis				
Yes	7 (29.2)	17 (70.8)	24	1.00
No	8 (30.8)	18 (69.2)	26	
Substance Use				
Yes	4 (26.7)	11 (73.3)	15	1.00
No	11(31.4)	24 (68.6)	35	
Psychiatric History[1]				
Yes	4 (22.2)	14 (77.8)	18	0.739
No	9 (31.0)	20 (69.0)	29	

Note. *Bivariate analyses were performed using Chi square test for independence or Fisher's Exact test. [1]Three case excluded due to unknown status.

Table 4.5. Self Reported Adherence Estimates and HIV Biomarkers

	Self-Reported Adherence Estimate	
HIV Biomarker	**Total Sample (N=50)**	**P value***
Quantitative HIV Viral Load (copies/ml)	-0.615	**0.000**
CD4+T-lymphoctye count (cell/ml)	0.378	**0.007**
CD4+T-lymphoctye Percentage	0.371	**0.008**

Note. *Correlation tested using Spearman's Rank Correlation Coefficient

Health Literacy Characteristics

Table 4.6 summarizes the health literacy abilities and associated characteristics of the 50 HIV-infected youth. Participants predominantly had adequate health literacy levels as measured by the TOFHLA; the health literacy level in 80.0% of the study population was adequate, (median total TOFHLA score= 83.5; range=35-99). Median numeracy and reading comprehension raw scores among youth were 14.5 (range=5-17 out of a possible range of 0-17) and 44.0 (range 14-50 out of a possible range of 0-50).

Table 4.6. Health Literacy Characteristics of Study Population (N=50)

Health Literacy Variable	Summary Value
Reading comprehension raw score (0-50)	
Mean(±SD)	41.9 ±7.35
Median (range)	44.0 (14-50)
Numeracy raw score (0-17)	
Mean(SD)	13.5 ±2.89
Median (range)	14.5 (5-17)
Weighted numeracy raw score (0-50)	
Mean(±SD)	40.3 ± 8.70
Median (range)	43.5 (15-50)
TOFHLA total score (0-100)	
Mean(SD)	82.2 ±13.18
Median (range)	83.5 (35-99)
Functional health literacy level, n (%)	
Inadequate (0-59)	4 (8.0)
Marginal (60-74)	6 (12.0)
Adequate (75-100)	40 (80.0)

Note. Health literacy was measured using the full version Test of Functional Health Literacy in Adults (TOFHLA).

Literacy

Literacy was measured by the word recognition test, REALM-teen (Davis et al., 2006) and literacy skills of this sample are summarized in Table 4.7. Although the median age of the sample was 20.4 years, 42.0% of participants had raw scores consistent with a 6^{th} to 7^{th} reading grade level equivalent. There were 36 of the 50 subjects (72.0%) with below age level reading in this sample, despite nearly half having completed high school education and 30.0% enrolled in college courses at the time of study enrollment.

Table 4.7. Literacy Skills of Study Population (N=50)

Literacy Variables	Summary Value
Word List 1* (0-22)	
Mean (±SD)	20.86 ±1.23
Median (range)	21.0 (16-22)
Word List 2* (0-22)	
Mean (SD)	22.08 ±3.97
Median (range)	22.0 (1-22)
Word List 3*(0-22)	
Mean (±SD)	15.22 ±5.78)
Median (range)	17.0 (0-22)
REALM Raw Score (0-66)	
Mean (±SD)	56.14 ± 9.85
Median	58.5 (21-66)
Reading Grade Range Equivalent, n (%)	
3rd grade and below (raw scores 0-37)	3 (6.0)
4th to 5th grade (raw scores 38-44)	1 (2.0)
6th to 7th grade (raw scores 45-58)	21 (42.0)
8th to 9th grade (raw scores 59-62)	12 (24.0)
10th grade and above (raw scores 63-66)	13 (26.0)
Reading Level of Participants, n (%)	
Below grade level	36 (72.0)
Grade level	13 (26.0)
Above grade level	1 (2.0)

Note. Literacy measured using word recognition test, Rapid Estimate of Adult Literacy-teen (REALM-teen). Word lists (1-3) are in ascending order of difficulty.

Media Ownership and Media Use

Tables 4.8 and 4.9 summarize reported media ownership and time spent using media devices among study participants. Common media devices (computer, internet access, DVD/VCR player, television, cable/satellite television) were reported in the homes of ≥ 90% of the sample and cellular phone ownership was reported in 46 of 50 participants.

Survey items measuring time spent using media were retrospective for the past 24 hours and excluded use during school and or work hours. More than half of participating HIV-infected youth reported not spending any time reading offline (56.0%) or online (60.0%). Television

viewing was greater than one hour in 30 of the 50 participants and this included 8 youth with a reported television viewing time of more than 5 hours. Time spent on social websites was greater than one hour in nearly half the sample (48.0%) including 17 youths who reported spending greater than 3 hours on these websites. Text messaging of more than 25 texts during the previous day was frequently reported in more than half the respondents (54.0%) and listening to music offline in 25 of participating youth (50.0%) was common. The minimum amount of combined time spent using television, audio and playing video games was 1-3 hours in 58% of youth.

Table 4.8. Media Availability among Respondents (N=50)

Media Device	Device in Home n (% yes)	Owns Device n (% yes)
Computer	47 (94.0)	----------
Internet Access	46 (92.0)	----------
CD Player	26 (52.0)	----------
DVD or VCR Player	48 (96.0)	----------
Radio	37 (74.0)	----------
Television (TV)	50 (100)	----------
Video games that connect to TV	37 (74.0)	----------
Cable/Satellite TV	45 (90.0)	----------
Premium TV (HBO/Showtime)	33 (66.0)	----------
Cellular Phone		46 (92.0)
Cellular phone/internet access		42 (84.0)
Laptop computer		33 (66.0)
Handheld Videogame player		22 (44.0)
iPod or other MP3 player		44 (88.0)
Pager (Beeper)		0 (0)

Table 4.9. Media Use Characteristics of Study Population (N=50)

Time Spent Using Media	Frequency (%)
Cellular Phone	
≤ 1hour	30 (60.0)
>1 hour	20 (40.0)
Text Messaging	
≤ 25 texts sent	23 (46.0)
> 25 texts sent	27 (54.0)
Listening to Music (offline)	
≤ 1 hour	25 (50.0)
>1 hour	25 (50.0)
Listening to Music (online)	
< 30 minutes	26 (52.0)
≥30 minutes	24 (48.0)
Television Viewing (offline)	
≤1 hour	20 (40.0)
>1 hour	30 (60.0)
Playing Videogames (offline)	
No time	37 (74.0)
≥ 5 minutes	13 (26.0)
Playing Videogames (online)	
No time	40 (80.0)
≥ 5 minutes	10 (20.0)
Reading (offline)	
No time	28 (56.0)
≥ 5 minutes	22 (44.0)
Reading (online)	
No time	30 (60.0)
≥ 5 minutes	20 (40.0)
Emails sent/received	
≤10	34 (68.0)
> 10	16 (32.0)
Social Websites	
≤1 hour	26 (52.0)
> 1hour	24 (48.0)
Yahoo/Google	
≤30 minutes	31 (62.0)
> 30 minutes	19 (38.0)
Television, Audio, Video Total	
<1 hour	11 (22.0)
1-3 hours	29 (58.0)
> 3 hours	10 (20.0)

Note. Results depict self reported time spent using media during past day.

Beliefs about Antiretroviral Medications

Table 4.10 provides of summary of participants' beliefs regarding antiretroviral treatment. Total beliefs scores represent a combined total of the four subscales included on the BAMS: positive outcome expectancy, negative outcome expectancy, perceived threat and intent to adhere. The possible range of total beliefs scores on the BAMS was 53-371 and in this sample the median score was 240.5 (range=160-291).

Table 4.10. Participant Beliefs about Antiretroviral Medications (N=50)

Total Beliefs and Subscales	Results
Positive Outcome Expectancy (20-140)*	
Mean Score (±SD)	114.4 ± 17.51
Median (range)	117.0 (56-140)
Negative Outcome Expectancy (13-91)*	
Mean Score (SD)	37.9 ± 14.53
Median	36.5 (14-76)
Perceived Threat (13-91)*	
Mean Score (±SD)	44.7 ± 13.67
Median	43.0 (22-79)
Intent to Adhere (7-49)*	
Mean Score (±SD)	41.7 ± 8.22
Median (range)	43.0 (7-49)
Total Beliefs Composite Score (53-371)*	
Mean (±SD)	238.7 ± 28.46
Median (range)	240.5 (160-291)

* Upper and lower limits of each subscale

Mode of HIV Transmission

An important potential confounding variable in this study was mode of HIV-transmission because of the distinct clinical and psychosocial differences between youth with perinatal and horizontal HIV-transmission, length of time receiving medical care, HIV treatment and influence of maternal HIV/AIDS related illness. Although 80% of the participants (40/50) were perinatally HIV-infected, bivariate analyses were performed to test for differences by mode of HIV-

transmission. There was a statistically significant difference in reported substance use by mode of HIV transmission with 94.3 % of perinatally HIV-infected youth reporting no use, in comparison the 5.7% of youth with horizontal transmission in this study with no reported substance use (p=0.000). A trend toward statistical significance (p=0.052) was observed when comparing mean positive outcome expectancy scores with higher mean rank scores in youth with horizontal infection (mean rank=33.50), in comparison to scores in youth with perinatal infection (mean rank=23.50), Table 4.11.

Table 4.11. Bivariate Analyses Testing for Differences by Mode of HIV Transmission

Study Variable	Perinatal HIV-Infection (n=40)	Horizontal HIV-Infection (n=10)	Total (N=50)	P Value
Adherence Estimates, n (%)				
100% Adherent	28 (80.0)	7 (20.0)	35	1.00*
<100% Adherent	12 (80.0)	3 (20.0)	15	
HIV Viral Load, n (%)				
<400 copies/ml	28 (75.7)	9 (24.3)	37	0.258*
>400 copies/ml	12 (92.3)	1 (7.7)	13	
Health Literacy Level, n (%)				
Adequate	30 (75.0)	10 (25.0)	40	0.179*
Inadequate	10 (100.0)	0 (0)	10	
Reading Age level, n (%)				
≥Age Level Reading	10 (71.4)	4 (28.6)	14	0.436*
<Age Level Reading	30 (83.3)	6 (16.7)	36	
Psychiatric History[1]				
Yes	14 (77.8)	4 (22.2)	18	1.00*
No	23 (79.3)	6 (20.7)	29	
AIDS Diagnosis				
Yes	17 (70.8)	7 (29.2)	24	0.164*
No	23 (88.5)	3 (11.5)	26	
Substance Use/Abuse				
Yes	7 (46.7)	8 (53.3)	35	**0.000***
No	33 (94.3)	2 (5.7)	15	
Beliefs, mean rank scores				
Total Beliefs Scores	24.60	29.10	50	0.382□
Positive Outcome	23.50	33.50	50	**0.052**□
Negative Outcome	25.76	24.45	50	0.799□
Perceived Threat	25.08	27.20	50	0.680□
Intent to Adhere	24.96	27.65	50	0.600□

Note. Perinatal HIV transmission indicates mother to child transmission of HIV; sexual transmission of HIV-infection is horizontal. Substance use/abuse is self reported data.
*Bivariate analyses were performed using Chi square test for independence or Fisher's Exact test. □Wilcoxon Rank Sum Test with mean rank scores shown above.
[1]Three case excluded due to unknown status.

Aim I

The primary objective of this study was to examine the relationship between health literacy, functional literacy, beliefs about medication, media use and adherence to antiretroviral treatment among HIV-infected adolescents (ages 13 – 24 years).

Using self reported 3-day adherence estimates (100% adherent, <100% adherent) in a fitted logistic regression model, health literacy was not predictive of self reported adherence estimates. Participants with higher positive outcome expectancy scores were significantly more likely to have self reported adherence estimates of 100%. The odds of 100% adherence was significantly lower among the 63.9% (23/36) of participants with below age level reading, compared to the 85.7% of youth (12/14) with ≥ age level reading and 100% adherence. Self reported substance use was not predictive of adherence in this model, Table 4.12.

Table 4.12. Predictors of Adherence as Measured by 3-day Self Report (N=50)

Predictor Variable	Estimate	Standard Error	Odds Ratio	95% Confidence Interval	P Value*
Health Literacy	-0.048	0.033	0.954	0.893-1.018	0.152
Positive Outcome Expectancy	0.064	0.023	1.066	1.018-1.117	**0.006**
Reading Age Level					
< age level reading	-2.711	1.288	0.066	0.005-0.831	**0.035**
≥ age level reading[a]					
Substance Use					
No reported Use	-0.571	0.816	0.565	0.114-2.80	0.485
Reported Use[a]					

Note. Health literacy was measured with TOFHLA, possible range of scores= 0-100
Positive outcome expectancy was a subscale in the BAMS, possible range of scores=20-140.
[a]reference category

H1. Higher health literacy is positively associated with adherence to antiretroviral treatment in HIV-infected adolescents.

Bivariate analyses were performed using Chi square test for independence or Fisher's exact test to examine the association of health literacy (inadequate/adequate) and adherence to antiretroviral therapy using both 3-day adherence estimates (100% adherent, <100% adherent) and also quantitative HIV-viral load (<400 copies/ml, >400 copies/ml). Of the 40 participants with adequate health literacy level, 27 or 67.5 % were 100% adherent compared to the 13 with less than 100% adherence. Among the 10 participants with inadequate health literacy levels, 8 or 80.0% were 100% adherent compared to two participants with less than 100% adherence (p=0.702). When using plasma quantitative HIV viral load as an indirect measure of adherence (<400 copies/ml, >400 copies/ml), there were 37 participants with an undetectable HIV viral load and 78.4% (29/37) of participants had adequate health literacy levels, compared to 11 of the 13 (84.6%) with adequate health literacy and a detectable (> 400 copies/ml) HIV viral load (p=1.00).

Using the Mann Whitney non-parametric statistical test, there were no statistically significant mean differences in underlying distributions of the 3-day adherence estimates of participants with adequate (mean rank=24.90) and inadequate health literacy (mean rank=27.90), z score =-0.720, p=0.472.

There was no correlation between the continuous health literacy scores and 3-day adherence estimates using Spearman's rank correlation coefficient, Spearman's rho=-0.011, (p =0.938), Table 4.13.

H2. Higher functional literacy is positively associated with treatment adherence in HIV-infected adolescents.

Bivariate analyses were performed using Chi square test for independence or Fisher's exact test to examine the relationship between literacy dichotomized as (below age level reading/ ≥ age level reading) and adherence to antiretroviral therapy using both 3-day adherence estimates (100 % adherent, <100% adherent) and also HIV-viral load (<400 copies/ml, >400 copies/ml). Among the 14 participants with age level reading and higher, 12 (85.7%) were 100% adherent to antiretroviral treatment in comparison to 2 (14.3%) participants with less than 100% adherence; there were 36 youth with below age level reading and 23(63.9%) participants reported 100% adherence, compared to the 13 (36.1%) with less than 100% adherence (p=0.179).

Using HIV-viral load (<400 copies/ml, >400 copies/ml) as an indirect measure of adherence, there were no statistically significant differences in the literacy skills (< age level reading/ ≥ age level reading) of the 37 youth with undetectable HIV viral load compared to the literacy skills of the 13 youth with detectable plasma viral levels (> 400 copies/ml) and below age level reading (p=0.303).

There was no statistically significant correlation between the continuous REALM raw scores and 3-day adherence estimates (Spearman's rho=-0.122; p value=0.400) and also between REALM and quantitative HIV viral load (Spearman's rho=-0.106; p=0.464), Table 4.13.

Using Mann Whitney non-parametric statistical tests, there were no statistically significant differences in the mean rank scores of 3-day adherence estimates of participants with ≥ age level reading (mean rank=29.43) and < age level reading (mean rank =23.97), z=-1.47, p=0.142.

H3. Individual beliefs about medications influence patterns of adherence to medications in HIV-infected adolescents.

There was a moderate, statistically significant positive correlation between participant self reported 3-day adherence estimates and the belief subscale of intent to adhere (Spearman's rho=0.420, p=0.002). Positive outcome expectancy was moderately, positively correlated with participant adherence estimates, Spearman's rho=0.360, p=0.010. No statistically significant linear associations were observed between adherence estimates and the belief subscales of negative outcome expectancy (Spearman's rho=-0.085, p=0.559) or perceived threat (Spearman's rho=-0.005, p=0.975), Table 4.13.

Using Mann Whitney non-parametric statistical tests, there was a statistically significant difference in mean composite beliefs scores of participants with 100% adherence compared to less than 100% adherence (z=-2.022, p=0.043). Mean differences in rank scores were also observed in positive outcome expectancy (z=-2.553, p=0.011) and intent to adhere (z=-2.99, p=0.003) in participants with reported 100% adherence compared to less than 100% adherence, Table 4.14.

Table 4.13. Correlation of Adherence with Beliefs, Health Literacy and Literacy

	Antiretroviral Adherence	
Study Variable	**Total Sample (N=50)**	**P Value***
Beliefs		
Total Beliefs	0.264	**0.06**
Positive Outcome Expectancy	0.360	**0.010**
Negative Outcome Expectancy	-0.085	0.559
Perceived Threat	-0.005	0.975
Intent to Adhere	0.420	**0.002**
Health Literacy		
TOFHLA Total Score (0-100)	-0.011	0.938
Literacy		
REALM Raw Total Score (0-66)	-0.122	0.400

Note. Self-reported 3-day antiretroviral adherence estimates used in analyses.
*Correlation tested using Spearman's Rank Correlation Coefficient

Table 4.14 Beliefs about Antiretroviral Treatment by Adherence Level

Beliefs about Antiretroviral Treatment	Mean Beliefs Scores ± SD (N=50)	100% Adherence Mean Rank (n=35)	<100% Adherence Mean Rank (n=15)	z-score	P-value
Total Belief Score	238.7 ± 28.46	28.23	19.13	z= -2.022	**0.043**
Positive Outcome Expectancy	114.4 ± 17.51	28.94	17.47	z= -2.553	**0.011**
Negative Outcome Expectancy	37.9 ± 14.53	25.00	26.67	z= -0.371	0.711
Perceived Threat	44.7 ± 13.67	25.89	24.60	z= -0.286	0.775
Intent to Adhere	41.7 ± 8.22	29.51	16.13	z= -2.989	**0.003**

Note. Wilcoxon Rank Sum Test with mean rank scores for self reported 3-day adherence levels shown above.

Aim II

The second aim was to explore the association between beliefs about medications and health literacy in HIV-infected adolescents. There is one stated hypothesis under this aim.

H4. Beliefs about medications are associated with health literacy in HIV-infected adolescents.

There was no statistically significant linear associations between the continuous health literacy scores using the total TOFHLA raw scores and the composite total beliefs scores (Spearman's rho=0.122, p=0.399). The belief subscales were correlated with total TOFHLA raw scores and no linear associations were observed with positive outcome expectancy (Spearman's rho=0.051, p=0.725), negative outcome expectancy (Spearman's rho=-0.040, p=0.783), intent to adhere (Spearman's rho=0.122, p=0.399) and perceived threat (Spearman's rho=0.079, p=0.584).

Using Mann Whitney non-parametric statistical tests, there was no statistically significant differences observed in average composite belief scores of participants with adequate (mean rank =25.40) and inadequate health literacy (mean rank =25.90), z=-0.097, p=0.923.

When testing for differences in the distributions of scores for each of the belief subscales, there were no statistically significant differences in the mean rank scores of positive outcome expectancy (z=-0.182, p=0.856), negative outcome expectancy (z=-0.158, p=0.875), perceived threat (z=-0.316, p=0.752), and intent to adhere (z=-0.305, p=0.761) in participants with adequate compared to inadequate levels of health literacy.

Aim III

The third aim was to describe the association between media use and health literacy in HIV-infected adolescents. There is one stated hypothesis under this aim.

H5. Media use is associated with health literacy in HIV-infected adolescents.

Table 4.15 is a summary of the bivariate analyses performed using Chi square test for independence or Fisher's Exact test to examine the relationship of health literacy and time spent using media devices including: cellular phones, playing videogames online and offline, reading online and offline, viewing television, listening to music online/offline, using social websites and search engines such as Google/Yahoo and the number of emails and text messages sent and minimum time spent using television, audio, videogames (TAV) composite variable.

Among the 40 HIV-infected youth with adequate health literacy, 21 (95.5%) reported spending five minutes or more reading offline rather than no time at all, in comparison to one of the 10 participants (4.5%) with inadequate health literacy who spent at least 5 minutes reading ($p=0.016$). No other statistically significant findings were found with time spent using other media devices and health literacy levels, Table 4.15. The preferred route to seek health related information was an internet source, namely Google/Yahoo (70.0%, n=35) and the telephone was the most frequently reported device to communicate with a healthcare provider (78.0%, n=39).

Table 4.15. Health Literacy Levels and Media Time (N=50)

Media Usage (time spent yesterday)	**Adequate Health Literacy (score=75-100) (n=40)**	**Inadequate Health Literacy (score=0-74) (n=10)**	**P value***
Cellular Phone			
≤ 1hour	24 (80.0%)	6 (20.0%)	1.00
>1 hour	16 (80.0%)	4 (20.0%)	
Text Messaging			
≤ 25 texts sent	16 (69.6%)	7 (30.4%)	0.155
> 25 texts sent	24 (88.9%)	3 (11.1%)	
Listening to Music (offline)			
≤ 1 hour	20 (80.0%)	5 (20.0%)	1.00
>1 hour	20 (80.0%)	5 (20.0%)	
Listening to Music (online)			
< 30 minutes	22 (84.6%)	4 (15.4%)	0.490
≥30 minutes	18 (75.0%)	6 (25.0%)	
Television Viewing (offline)			
≤1 hour	17 (85.0%)	3 (15.0%)	0.720
>1 hour	23 (76.7%)	7 (23.3%)	
Playing Videogames (offline)			
No time	30 (81.1%)-	7 (18.9 %)	0.707
≥ 5 minutes	10 (76.9 %)	3 (23.1 %)	
Playing Videogames (online)			
No time	32 (80.0%)	8 (20.0%)	1.00
≥ 5 minutes	8 (80.0%)	2 (20.0%)	
Reading (offline)			
No time	19 (67.9%)	9 (32.1%)	**0.016**
≥ 5 minutes	21 (95.5%)	1 (4.5%)	
Reading (online)			
No time	25 (83.3%)	5 (16.7%)	0.494
≥ 5 minutes	15 (75.0%)	5 (25.0%)	
Emails sent/received			
≤10	26 (76.5%)	8 (23.5%)	0.468
> 10	14 (87.5%)	2 (12.5%)	
Social Websites			
≤1 hour	23 (88.5%)	3 (11.5%)	0.164
> 1hour	17 (70.8%)	7 (29.2%)	
Yahoo/Google			
≤30 minutes	23 (74.2%)	8 (25.8%)	0.282
> 30 minutes	17 (89.5%)	2 (10.5%)	
Television, Audio, Video Total[a]			
<1 hour	9 (81.8%)	2 (18.2%)	1.00
1-3 hours	31 (79.5%)	8 (20.5%)	

CHAPTER 5

This chapter provides a discussion and review of the results, comparing and contrasting findings with the current body of evidence. The strengths, limitations and challenges are presented. The study results with implications for clinical practice and avenues for future research are described.

The perinatally HIV-infected population is a relatively stable cohort in the United States comprised of approximately 8500 youth in the developmental stage of adolescence and or young adulthood (Hazra, 2010). Maternal-infant transmission of HIV was the primary mode of transmission for this pediatric population, but in 1994 findings from Pediatric AIDS Clinical Trail Group (PACTG) 076 demonstrated that zidovudine administered in the antepartum, intrapratum, and neonatal periods could reduce this transmission rate by 67.0% (Connor et al., 1994). Such remarkable progress has not been yet appreciated in the prevention of horizontal transmission among youth, as sexual transmission among youth ages 13-24 years represents one of the fastest growing segments of populations newly infected with HIV disease (CDC, 2011).

Overview of Results

The findings of this study make several important and new contributions to the body of knowledge regarding HIV-infected youth. First, the HIV-infected adolescents and young adults in this study (80.0% of whom were perinatally HIV-infected) were in overall good HIV health, despite many being pioneer survivors and born during a time when treatment options were suboptimal. Most youth in this current study had undetectable HIV viral loads, CD4+T-lymphocyte percentages reflective of normal immune function, and self reported adherence estimates of 100%. Current evidence published on the HIV health status of infected youth has

been limited, especially among perinatally HIV-infected surviving into late adolescence and young adulthood.

The health literacy model used for this research represents the initial attempts to use an expanded health literacy framework in a HIV-infected cohort and it provided a good fit for the study variables and health outcome of adherence. Health literacy was not associated with antiretroviral adherence in this study and 80.0% of the sample had adequate levels of health literacy. The lack of statistical significance may be explained by the smaller than anticipated sample size as well as the high levels of both adherence and health literacy among the participants. The limited power precluded detection of statistically significant differences unless they were extremely large. While it is plausible that the favorable HIV health outcomes (i.e. self-reported adherence, HIV biomarkers) observed in participating youth could be explained by the high percentage with adequate health literacy levels, this study was not sufficiently powered to provide confirmatory data.

An a posteriori estimate of the statistical power of the results was computed using SAS version 9.2, Carey, NC because the intended target accrual of 80 participants was not achieved, and in addition, little is known about the range and variance of scores among this population on the instruments being used in this study. Therefore with a level of significance set at 0.05, and the current sample of 50 participants, the power to detect a significant difference between the 'adherent' and 'non-adherent' groups (dichotomized as 3-day self reported adherence estimates of 100% versus less than 100%) in participants with an inadequate level of health literacy compared to adequate health literacy using the TOFHLA was 17.5%.

The health literacy framework (Manganello, 2008) was modified to include individual beliefs and there was a robust association between positive outcome expectancy and adherence to

antiretroviral treatment among participants (p=0.006). Functional literacy in the model was represented by age level reading (below, at or above) and there was a high prevalence of below age level reading in this sample, and not recently described in this population. The risk of poor behavioral outcomes associated with low literacy has been described in uninfected youth (Bryan, Freer, & Furlong, 2007), and in this study was significantly associated with adherence to antiretroviral treatment.

The conceptual framework used offers an explanatory model for the influence of media on health literacy and the outcome of antiretroviral adherence. The importance of media use in the lives of modern youth cannot be overemphasized, as time spent engaged with media has been described to be surpassed only by time spent sleeping (American Academy of Pediatrics , 2010). Media use and ownership has not been previously reported in HIV-infected youth, and the data in this current study suggest moderate to high level use.

Self Reported Adherence Estimates

The median 3-day adherence estimate of 100% in this sample was higher than previous reports in HIV-infected youth (Murphy et al., 2010; Murphy, 2001). Adherence estimates of less than 90.0% (Williams et al, 2006; Murphy et al., 2005; Naar-King et al., 2006; Mellins et al., 2009) and even lower estimates of 40.0% (Murphy et al., 2010) have been reported. Irrespective of these differences, findings similar to the current study were depicted in a recent study designed to describe the immunologic and virologic outcomes in 451 HIV-infected children. Undetectable HIV viral load was observed in 68.0% of the sample and a CD4% of $\geq$ 25.0 % in 78.0 %, indicative of normal immune function (Van Dyke et al., 2011). Although self-reported adherence estimates were not described, these HIV biomarkers are suggestive of

good adherence and also highlight the potential for optimal HIV health among treatment experienced, high risk youth in care.

Estimates of adherence made by medical providers were extracted from the medical records of study participants and were largely inconsistent, reflective of the lack of a common operational definition. Adherence estimates ranged from 3-day to 30-day time frames with some providers using more than one time interval in the estimate (i.e. past 7 days and past month). Some estimates did not include a time frame and others were missing from participant medical records. Although provider estimates have been used in clinical practice, there is more evidence to support the use of self report, especially if there is no operational definition of adherence used in the clinical site.

Factors associated with poor adherence to antiretroviral treatment have been described in this group, but there has been less evidence generated on the resiliency or protective factors associated with high levels of adherence. Such factors are important to explain for the development of effective adherence interventions and also offer an explanation for the high adherence estimates seen in this study. Beliefs about HIV medication (Garvie et al, 2011), low viral load and higher CD4 +T-lymphocyte counts (Rudy, 2009), being in school (Murphy et al., 2005), lower rates of substance use (Murphy et al., 2005), and social support (Comulada, Swendeman, Rotheram-Borus, Mattes, & Weiss, 2003) have been associated with good adherence and antiretroviral use. Many of these characteristics were largely represented among the HIV-infected youth participating in this study and may have contributed to the high proportion of respondents with self reported adherence of 100%. It is however crucial to consider the inherent risk of bias in the interpretation of these self reported adherence estimates, including overestimation of adherence. Nevertheless, the strong correlation between self reported

adherence and quantitative HIV viral load (Spearman's rho=-0.615; p=0.000) strengthen these results, because viral load has been significantly associated with self reported adherence in other studies with HIV-infected youth (Murphy et al., 2005; Williams et al., 2006; Garvie, Wilkins, & Young, 2010) and adults (Simoni et al., 2006; Reynolds et al., 2007). Additionally data collection of self reported adherence estimates in this present study included acknowledgement of the intrinsic difficulties involved in taking HIV medications and assumed missed doses, thereby helping to reduce social desirability bias and over inflation of the results.

Predictors of Adherence

Health Literacy

Consistent with the findings from one other known study performed to date in HIV-infected youth (Murphy et al., 2010), there was no significant correlation between health literacy and adherence to HIV treatment in this current study. However there were some important differences between the sample, health literacy measure and related statistical analysis used in Murhpy (2010) including a larger sample of 186 youth, 16.7% of whom were perinatally HIV-infected. In the current study, 80.0% were perinatally HIV-infected, and therefore these two studies involve populations of HIV-infected youth with distinctly different psychosocial and medical features. The age range, distribution of gender, and race/ethnicity were similar in both studies but in Murphy (2010), 50.0% of the sample was less than a high school graduate and in this current study, nearly half the sample (47.0 %) had a high school/GED diploma or higher education.

There were dissimilarities in the specific inclusion criteria of the Murphy (2010) study, when compared to the present study and not all enrolled participants were currently receiving ART, some may have been advised of the need for initiation of HIV treatment. Additionally

consideration for study participation included youth with one of the following problematic behaviors: unprotected sex during the past three months, substance use issues or poor adherence defined as <90% in the preceding month. It is therefore plausible that the lower than expected percentage of youth (33.7%) with 3-day self reported adherence of 90% or greater in Murphy (2010) may have represented a selection bias. The explanation offered for theses suboptimal adherence estimates by Murphy (2010) included a cohort that was in good health, thus not having good motivation to comply with antiretroviral treatment, even though health literacy levels were adequate. However the clinical staging of HIV disease status was not described, and therefore the number of participants with an AIDS diagnosis and or Stage 2 disease was unknown. This explanation was not relevant to this current study because although 48.0 % of participants had an AIDS diagnosis, they were in otherwise good health and yet self reported adherence to antiretroviral treatment was optimal.

In the current study, the full version TOFHLA was used to measure health literacy, an instrument with 17 numeracy items, three reading comprehension sections with 50 related survey questions . A modified version of the S-TOFHLA was used in Murphy (2010) and this includes four numeracy items and two reading passages with 36 related survey questions; the researchers modified this instrument by adding four numeracy items from the full version TOFHLA. Using the Gunning Fog index, the readability of the first two prose passages on both the S-TOFHLA and full version TOFHLA are grades 4.3 and 10.4 respectively, but the full version TOFHLA includes a third passage with readability of grade 19.5 (Baker, Williams, Parker, & Gazmararian, 1999). Unlike the current study, a word recognition screening measure was not used in Murphy (2010) so it is not possible to compare and or contrast functional literacy levels of participants. Despite these differences between measures, $\geq$80% of participants in Murphy (2010) and the

current study had adequate levels of health literacy. One plausible explanation for these observed high health literacy levels suggested by Murphy (2010) is that study participants were receiving care at multidisciplinary, primary HIV care centers and this included receipt of psychosocial care and intensive health education. Such state of the art medical care may not be available for other cohorts of HIV-infected youth and therefore may have influenced health literacy levels. In both studies, adequate levels of health literacy were not associated with adherence. It is however important to recognize when interpreting the study findings presented by Murphy (2010) that only the reading comprehension scores of the S-TOFHLA were used to predict adherence in the regression model. In comparison, the full version TOFHLA scores comprised of numeracy and reading comprehension items were used in the fitted regression model of this current study. Numeracy is an important component of the construct of health literacy and may not correlate with reading comprehension scores for some disadvantaged groups (Golbeck, Paschal, & Hsiao, 2011). Numeracy skills are an important component of antiretroviral medication management and the findings from this current pilot study are the first to represent numeracy in the construct of health literacy in predicting adherence among the HIV-infected adolescent population.

Functional Literacy

The construct of health literacy includes functional literacy or the ability to read and write (Nutbeam, 2000). In this study, the high number (72.0%) with below grade level reading was of particular concern, yet may be explained by multiple factors. These youth were from lower socioeconomic backgrounds and therefore most likely attending school districts with inadequate funding. Multiple school absences were commonplace during the early and middle childhood of youth with perinatal infection. The chronic stress of maternal illness due to AIDS related illness

or placement with a foster parent due to maternal death cannot be overlooked as a negative predictor of academic success (Brackis-Cott et al., 2009).

Additionally, the long term neuro-cognitive effects of HIV-infection are unknown among HIV-infected youth surviving into adolescence and adulthood and also in newly HIV-infected youth. The data from this current study identify low levels of literacy and besides the psychosocial factors potentially contributing to this finding, infectious disease considerations include the impact of ongoing HIV viral replication in the central nervous system, the role of chronic inflammation, and the effect of HIV on the developing brain in perinatally HIV-infected youth (Hazra, 2010). The low literacy skills of the HIV-infected cohort in this study may have been a marker for another factor not measured in this current study.

Reading age level has been associated with antiretroviral adherence and in HIV-infected adults, the relationship between lower literacy levels and suboptimal adherence has been described (Graham et al., 2007). There is evidence to suggest that HIV-infected adults with low literacy were 3.3 times more likely to be non-adherent to antiretroviral regimens (95% CI 1.3-8.7; $p < 0.001$) but perceived social stigma was found to mediate this relationship (AOR 3.1, 95% CI 1.3-7.7) (Waite, Paasche-Orlow, Rintamaki, Davis, & Wolf, 2008). In another study with HIV-infected adults, low literacy as measured by the REALM was a significant predictor of medication non-adherence during the preceding 4 days (AOR, 95% CI=1.3-8.7) but this relationship was mediated by self-efficacy (Wolf, Davis, Osborn et al., 2007).

The advent of highly active antiretroviral therapy has resulted in perinatally HIV-infected youth reaching adolescence and young adulthood in large numbers, but the data describing the cognitive functioning, reading and language skills has been limited (Brackis-Cott et al., 2009). In a study using the Wide Range Achievement Test , third edition (WRAT-3) with a younger

sample of perinatally HIV-infected and exposed youth (ages 9-16 years), the HIV-infected cohort scored poorly, suggestive of limited vocabulary and lack of basic skills needed for reading (Brackis-Cott et al., 2009).

One surprising finding not previously described among HIV-infected youth was the disconnect between the literacy and health literacy scores in this study. The median age of this sample was 20.4 years and yet had 42.0% had scores on the REALM-teen equivalent to 6th to 7th grade reading levels. However these reading deficits did not negatively influence levels of health literacy among participating youth. A likely explanation for this result is related to the long term exposure with the health care system, treating medical professions and also frequent medical encounters throughout their life span. This finding highlights the larger context in which health literacy exits and supports movement away from definitions with an exclusive focus on functional literacy. Additionally the effects of low literacy in HIV-infected youth may be potentially mediated by interaction with the healthcare system and this warrants further exploration.

Beliefs and Antiretroviral Treatment

Health beliefs of the modern adolescent are influenced by a wide variety of views of illness including the educational system, cultural norms and media. In a recent systematic review of the literature designed to describe common beliefs about illness and health outcomes among adolescents, results were equivocal and no studies of HIV-infected youth were included (Haller, Sanci, Sawyer, & Patton, 2008).

Outcome expectancy using seven items to assess impression of taking HIV medications has been assessed in horizontally infected HIV positive youth, and higher outcome expectancy was demonstrated in the adherent youth; however the reliability of this scale was reported as low,

Cronbach alpha was 0.62 (Rudy et al., 2009). Individual beliefs (total beliefs and perceived threat of illness) were significant predictors of medication adherence in one study to date of behaviorally HIV- infected youth (Garvie et al., 2011). In this current study, positive outcome expectancy of HIV treatment was significantly associated with antiretroviral adherence and this was an important finding because health beliefs may be assessed and targeted for intervention.

Media Ownership and Use

The negative influence of media on the lives of young people has been well described and includes the potential for aggressive behavior, underage substance use, distorted body image and ideas about relationships, and cyber-bullying; there is however great promise with the use of media and this current generation of youth has unprecedented access to the larger world (Brown & Bobkowski, 2011). The HIV-infected youth in this current study were well equipped with media; more than 90.0% owned a computer with internet access and 74.0% reported going online in the preceding day. This information is valuable because 70.0% reported that their first choice for seeking health related information would be via the internet. Considering the combined effects of low reported time spent reading and the high percentage of below age level reading in this sample population, augmentation of traditional education extending beyond written pamphlets may be needed.

Other Findings

Psychiatric Disorders and Substance Use

Psychiatric disorders have been reported to be high among youth with HIV-infection, particularly in perinatally infected cohorts (Hazra, 2010) but the data from this current study suggest a lower than expected prevalence. A recent study performed in a sample of perinatally HIV-infected and exposed youth (ages 9-16 years) described the prevalence of psychiatric

disorders to be 60.7% in the 206 participants (Mellins et al., 2009). This reported prevalence was higher than the percentage (36.0%) in this current dissertation study and yet in both studies, youth were recruited from centers that provide primary and tertiary care to HIV-infected children and families. Possible explanations for these observed differences were related to the different data collection methods and age range in each study. Interviews with both the parent and HIV-infected youth and chart review were the methods used in the study by Mellins (2009) and this may have helped to identify more youth with mental health disorders, since parents were not interviewed in the current study. Additionally, participants in this current dissertation study were older. Youth ages 18 years and above could refuse mental health evaluations, as compared to teens in early and mid adolescence being brought for psychological care by a parent. The overall prevalence of self reported substance use was lower than expected (30.0%) but may have been explained by reliance on data extracted from the medical records and/or the fact that a large proportion were perinatally infected.

Practice Implications

The data from this study suggest that 3- day self reported adherence estimates, when used in combination with HIV-biomarkers estimates offer a user friendly, inexpensive and rapid method to assess antiretroviral adherence in HIV-infected youth. Other factors likely to influence adherence should also be assessed including both positive and negative beliefs about antiretroviral treatment, especially before the initiation of a HIV treatment regimens. A possible avenue to appraise health beliefs of HIV-infected youth would be measurement using the positive outcome expectancy subscale in the Beliefs about Medication Scale (BAMS). This scale includes 20 items and could be easily administered during a routine health care visit and may also encourage greater insight on beliefs surrounding HIV-treatment.

This observed variation among healthcare providers in adherence assessment highlights the need for a consistent methodology/time frame in clinical practice. Implementation of multiple adherence measures could lead to confusion and difficulties in the interpretation of adherence estimates and related predictors (Berg & Arnsten, 2006). While there is no single, 'gold standard' method to measure medication adherence, Chesney (2006) has recommended the use of adherence assessments with evidence of reliability and validity (Chesney, 2006) specific for the population of interest.

The results of this current study support expanded models of care with consideration for risk of low literacy in HIV-infected youth. Multidisciplinary health care teams equipped with social work and or psychological staff members may be in the best position to conduct a comprehensive psychosocial assessment with detail to current and past academic performance. However if this is not feasible, the REALM offers a viable alternative because it is a screening measure that is easy to administer by healthcare providers, well tolerated by HIV-infected youth, and with little time burden of three minutes or less.

Time spent using media should be periodically assessed and this practice recommendation is supported by the American Academy of Pediatrics (AAP) Committee on Communications and Media (2010). Informal conversations about internet sites frequented to obtain health related information should be part of health care visits, especially if misinformation is expressed by the HIV-infected youth. Time spent using media should also be appraised so that interventions appropriate to the individual learning and information-seeking style can be tailored. Recommended media time for children is 2 hours or less per day (AAP Committee on Communications and Media, 2010); no specific recommendation has been made for older adolescents.

Future Research

Research exploring beliefs about illness and treatment remains largely unexplored in the HIV-infected population and warrants further inquiry. The potential for media to positively influence healthcare and related choices of HIV-infected youth calls for further inquiry, as does the need for future studies to describe the literacy skills of HIV-infected youth.

Until evidence from more than two studies and with larger sample sizes (Murphy et al., 2010; Navarra, dissertation) is available, the relationship between health literacy and adherence in HIV-infected youth cannot be established.

Challenges and Limitations

There was a risk of emotional discomfort for participating teens due to perceived or real limitations in functional literacy, and this may have resulted in frustration and or feelings of shame, when attempting to complete the survey instruments. However efforts were made to limit this potential by using a read along style for administration of survey instruments. Exploring individual beliefs about antiretroviral treatment may have resulted in psychological discomfort due to the inherent challenges surrounding adherence. This was unlikely to have occurred, however, because although the study sites were equipped with on-site social work support, no referrals related to study participation were made.

Logistical challenges included coordination and communication with multiple healthcare professionals at several clinical sites. Recruitment efforts and data collection were highly dependent upon effective communication and collaboration with staff members across these clinical settings. Recruitment of youth was also dependent upon attendance at their scheduled medical visits, and patient non-compliance with medical appointments was commonplace during the study time frame.

Methodological limitations included a small sample size (n=50) with low power, and the resultant risk of type II error. Youth were recruited from state of the art HIV centers and therefore the study findings may not be generalizable to HIV-infected youth receiving care at clinics with fewer available services.

The ages of participants in this study were representative of a broad range on the pediatric spectrum, extending from early adolescence into young adulthood. Age related developmental differences associated may have influenced beliefs about HIV illness and antiretroviral treatment and due to the small sample size stratification by developmental stage was not possible.

There was no objective and/or direct measure of adherence used within the study sites; however adherence estimates were obtained in a consistent manner during this study and were strongly correlated with HIV biomarkers (i.e. HIV viral load, CD4 counts). Self reported adherence was measured for a 3-day period to help eliminate recall bias but data collected may not be representative of participant adherence trends over time. In addition, self reported adherence has been shown to overestimate adherence and not be a sensitive measure to identify participants with non-adherence (Liu et al., 2006; Berg & Arnsten, 2006).

Adherence assessments were obtained from adolescent participants and not from the caretakers of youth less than 18 years of age. Although partial or full responsibility for self administration of antiretroviral treatment has been described in HIV-infected youth less than 18 years (Martin et al., 2007), adherence support from a primary caregiver or other household member may have been present and was not measured in this current study.

Participant medical records in this study comprised both paper charts and electronic records and the medical record system had been recently converted. Many of the paper charts were not available for review, thus preventing a complete review of a participant's health history. Hence,

as with any study which uses data from the medical record, there are limitations in what factors are recorded and the potential for recording errors. Finally, no data regarding academic achievement (e.g., being retained at a grade level or placed in special education) were available.

Conclusions

In conclusion, although the results of this study must be interpreted in light of the methodological limitations of small sample size and low power, to the best of my knowledge, this research is the first to describe the relationships among health and functional literacy levels, beliefs about antiretroviral treatment, and media use in HIV-infected youth. The evidence generated also adds to the current body of literature by describing characteristics of contemporary perinatally and horizontally HIV-infected youth, a vital step in the development of tailored interventions and focused care.

Although the mainstay of HIV treatment has been highly active antiretroviral therapy, ongoing treatment for this population will need to include expanded models of clinical and research practice. Further assessment of the literacy skills and health beliefs of HIV-infected youth needs to be conducted in clinical and research practice, so that appropriate referrals are made and related interventions developed. Finally the beneficial aspects of media may offer the potential for new and improved methods to deliver health education, especially in HIV-infected youth with low literacy skills.

References

Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association-AMA(1999). Health Literacy: Report of the Council on Scientific Affairs. *The Journal of the American Medical Association,* 281(6), 552-557. doi: 10.1001/jama.281.6.552

Adams, S., Pill, R., & Jones, A. (1997). Medication, chronic illness and identity: the perspective of people with asthma. *Social Science and Medicine,* 45, 189-201. doi: 10.1016/s0277-9536(96)00333-4

Alcoba. (2003). Assessment of adherence to triple antiretroviral treatment including Indinavir: role of the determination of plasma levels of Indinavir. *Journal of Acquired Immune Deficiency Syndromes* (1999), 33(2), 253-258.

Ali, R., Awwad, E., Babor, T., Bradley, F., Butau, T., Farrell, M., et al. (2002). The alcohol, smoking and substance abuse involvement screening test (ASSIST): development, reliability and feasibility. *Addiction,* 97(9), 1183.

American Academy of Pediatrics (2010). Media education. *Pediatrics, 126*(5), 1012-1017. doi: 10.1542/peds.2010-1636

Andrulis, D. P., Brach, C., Andrulis, D. P., & Brach, C. (2007). Integrating literacy, culture, and language to improve health care quality for diverse populations. *American Journal of Health Behavior,* 31 Suppl 1, S122-133.

Arnsten, J. H., Demas, P. A., Farzadegan, H., Grant, R. W., Gourevitch, M. N., Chang, C.J., et al (2001). Antiretroviral therapy adherence and viral suppression in HIV-Infected drug users: comparison of self-report and electronic monitoring. *Clinical Infectious Diseases,* 33(8), 1417-1423. doi: 10.1086/323201

Attia, S. Egger, M., Muller, M., Zwahlen, M., & Low, N. (2009). Sexual transmission of HIV according to viral load and antiretroviral therapy: systematic review and meta-analysis. *AIDS,* 23(11), 1397-1404.

Baker, D.W., Parker, R. M., Williams, M.V., Pitkin, K., Parikh, N.S., Coates, W., & Imara, M. (1996). The health care experience of patients with low literacy. *Archives of Family Medicine,* 5(6), 329-334. doi: 10.1001/archfami.1996.01850430019010

Baker, D. W., Parker, R. M., Williams, M. V., Clark, W. S., & Nurss, J. (1997). The relationship of patient reading ability to self-reported health and use of health services. *American Journal of Public Health,* 87(6), 1027-1030. doi: 10.2105/ajph.87.6.1027

Baker, D., Parker, R., Williams, M., & Clark, W. (1998). Health literacy and the risk of hospital admission. *Journal of General Internal Medicine,* 13(12), 791-798. doi: 10.1046/j.1525-1497.1998.00242.x

Baker, D. W., Williams, M. V., Parker, R. M., Gazmararian, J. A., & Nurss, J. (1999). Development of a brief test to measure functional health literacy. *Patient Education and Counseling,* 38(1), 33-42.

Baker, D. W., Gazmararian, J. A., Williams, M. V., Scott, T., Parker, R. M., Green, D., Ren, J., & Peel, J. (2002). Functional health literacy and the risk of hospital admission among Medicare managed care enrollees. *American Journal of Public Health,* 92(8), 1278-1283.

Baker, D. W., Gazmararian, J.A., Williams, M.V., Scott, T., Parker, R.M., Green, D., & Peel, J. (2004). Health literacy and use of outpatient physician services by Medicare managed care enrollees. *Journal of General Internal Medicine,* 19(3), 215-220. doi: 10.1111/j.1525-1497.2004.21130.x

Baker, D.W. (2006). The meaning and the measure of health literacy. *Journal of General Internal Medicine*, 21(8), 878-883. doi: 10.1111/j.1525-1497.2006.00540.x

Baker, D. W., Wolf, M. S., Feinglass, J., Thompson, J. A., Gazmararian, J. A., Huang, J., et al. (2007). Health literacy and mortality among elderly persons. *Archives of Internal Medicine*, 167(14), 1503-1509.

Berg, K. M, & Arnsten, J. H. (2006). Practical and conceptual challenges in measuring antiretroviral adherence. *Journal of Acquired Immune Deficiency Syndromes*, 43, S79-S87 10.1097/1001.qai.0000248337.0000297814.0000248366.

Borzekowski, D. L. G., & Rickert, V. I. (2001). Adolescent cyber surfing for health information: A new resource that crosses barriers. *Archives of Pediatric and Adolescent Medicine*, 155(7), 813-817.

Brackis-Cott, E., Kang, E., Dolezal, C., Abrams, E. J., & Mellins, C. A. (2009). The impact of perinatal HIV infection on older school-aged children's and adolescents' receptive language and word recognition skills. *AIDS Patient Care & STDS*, 23(6), 415-421.

Ridgeland, J.M., Dilulio, J.J., & Morison, K.R. (2006). The silent epidemic: perspectives of high school drop outs. Retrieved from, www.gatesfoundation.org/nc/downloads/ed/thesilentepidemic3-06final.pdf.

Brown, L. K., Lourie, K. J., & Pao, M. (2000). Children and adolescents living with HIV and AIDS: A review. *Journal of Child Psychology & Psychiatry & Allied Disciplines*, 41(1), 81.

Brown, J. D., & Bobkowski, P. S. Older and Newer Media: Patterns of use and effects on adolescents' health and well-being (2011). *Journal of Research on Adolescence*, 21(1), 95-113.

Brown, S. L., Teufel, J. A., & Birch, D. A. (2007). Early adolescents perceptions of health and health literacy. *Journal of School Health,* 77(1), 7-15.

Bryan, K., Freer, J., & Furlong, C. (2007). Language and communication difficulties in juvenile offenders. . *International Journal of Language & Communication Disorders,* 42(5), 505-520. doi: 10.1080/13682820601053977

Centers for Disease Control and Prevention (2011). Disparities in diagnoses of HIV Infections between Blacks/African American and other racial/ethnic populations-37 states, 2005-2008. Morbidity and Mortality Weekly Report (MMWR), 60 (4), 93-98.

Centers for Disease Control and Prevention (2008). Revised surveillance case definitions for HIV Infection among adults, adolescents, and children aged < 18 Months and for HIV Infection and AIDS among children 18 months to < 13 Years – United States, 2008. Morbidity and Mortality Weekly Report (MMWR), 57 (RR-10).

Chesney, M. A., Chambers, D. B., Ickovics, J. R., Gifford, A. L., Neidig, J., Zwickl, B., & Wu, A. W. (2000). Self-reported adherence to antiretroviral medications among participants in HIV. *AIDS Care,* 12(3), 255.

Chesney, M. A. (2006). The elusive gold standard: Future perspectives for HIV adherence assessment and intervention. *Journal of Acquired Immune Deficiency Syndromes,* 43, S149-S155.

Chisolm, D. J., & Buchanan, L. (2007). Measuring adolescent functional health literacy: A pilot validation of the Test of Functional Health Literacy in Adults. *Journal of Adolescent Health,* 41(3), 312-314. doi: 10.1016/j.jadohealth.2007.04.015

Comulada, W. S., Swendeman, D. T., Rotheram-Borus, M. J., Mattes, K. M., & Weiss, R. E. (2003). Use of HAART among young people living with HIV. *American Journal of Health Behavior,* 27(4), 389-389.

Connor, E. M., Sperling, R. S., Gelber, R., Kiselev, P., Scott, G., O'Sullivan, M. J. & Balsley, J. (1994). Reduction of maternal-infant transmission of human immunodeficiency virus Type 1 with zidovudine treatment. *New England Journal of Medicine,* 331(18), 1173-1180. doi:10.1056/NEJM199411033311801

Davis, T. C., Crouch, M. A., Long, S. W., Jackson, R. H., Bates, P., George, R. B., & Bairnsfather, L. E. (1991). Rapid assessment of literacy levels of adult primary care patients. *Family Medicine,* 23(6), 433-435.

Davis, T.C., Long, S.W., Jackson, R.H., Mayeaux, E.J., George, R.B., Murphy, P.W., et al. (1993). Rapid estimate of adult literacy in medicine: a shortened screening instrument. *Family Medicine,* 25(6), 391-395.

Davis, T. C., Byrd, R. S., Arnold, C. L., Auinger, P., & Bocchini Jr, J. A. (1999). Low literacy and violence among adolescents in a summer sports program. *Journal of Adolescent Health,* 24(6), 403-411. doi: 10.1016/s1054-139x(98)00148-7

Davis, T.C., Kennen, E.M., Gazamararian, J.A., et al. (2004). Literacy testing in health care research. In: Schwartzberg, J.G., VanGreest, J.B., Wang, C.C. (Eds). Understanding Health Literacy: Implications for Medicine and Public Health. Chicago, Il: AMA Press.

Davis, T. C., Wolf, M. S., Arnold, C. L., Byrd, R. S., Long, S. W., Springer, T.& Bocchini, J. A. (2006). Development and validation of the Rapid Estimate of Adolescent Literacy in Medicine (REALM-Teen): A tool to screen adolescents for below-grade reading in health care settings. *Pediatrics,* 118(6), e1707-1714. doi: 10.1542/peds.2006-1139

Derogatis, L.R. & Spencer, P.M. (1982). The brief symptom inventory (BSI): administration, scoring and procedures manual. Baltimore, MD: Clinical Psychometric Research.

DeWalt, D. A., Berkman, N. D., Sheridan, S., Lohr, K. N., & Pignone, M. P. (2004). Literacy and health outcomes. *Journal of General Internal Medicine,* 19(12), 1228-1239. doi: 10.1111/j.1525-1497.2004.40153.x

DeWalt, D. A., & Hink, A. (2009). Health literacy and child health outcomes: A systematic review of the literature. *Pediatrics,* 124(Supplement 3), S265-274. doi: 10.1542/peds.2009-1162B

Doak, C.C., Doak, L.G., & Root, J.H. (1985). Teaching patients with low literacy skills, 2nd ed. Philadelphia, PA: J.B. Lippincott.

Elo, Irma T., & Preston, Samuel H. (1996). Educational differentials in mortality: United States, 1979-1985. *Social Science & Medicine,* 42(1), 47-57. doi: 10.1016/0277-9536(95)00062-3

Evans, R., Barer, M., & Marmor, T. (1994). Why are some people healthy and others not? The determinants of health of populations. NY, USA: Aldine de Gruyter.

Festa, R. S., Tamaroff, M. H., Chasalow, F., & Lanzkowsky, P. (1992). Therapeutic adherence to oral medication regimens by adolescents with cancer. *The Journal of Pediatrics,* 120(5), 807-811. doi: 10.1016/s0022-3476(05)80256-2

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-mental state: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research,* 12(3), 189-198. doi: 10.1016/0022-3956(75)90026-6

Fortenberry, J. D., McFarlane, M. M., Hennessy, M., Bull, S. S., Grimley, D. M., St Lawrence, J., & VanDevanter, N. (2001). Relation of health literacy to gonorrhea related care. *Sexually Transmitted Infections,* 77(3), 206-211. doi: 10.1136/sti.77.3.206

Frey, M. A., & Denyes, M. J. (1989). Health and illness self-care in adolescents with IDDM: A test of Orem's theory. *Advances in Nursing Science,* 12(1), 67-75.

Garvie, P. A., Wilkins, M. L., & Young, J. C. (2010). Medication adherence in adolescents with behaviorally-acquired HIV: Evidence for using a multimethod assessment protocol. *The Journal of Adolescent Health,* 47(5), 504-511.

Garvie, P. A., Flynn, P. M., Belzer, M., Britto, P., Hu, C., Graham, B., & Gaur, A. H. (2011). Psychological factors, beliefs about medication, and adherence of youth with human immunodeficiency virus in a multisite directly observed therapy pilot study. *Journal of Adolescent Health,* 48(6), 637-640. doi: 10.1016/j.jadohealth.2010.09.014

Gatti, M. E., Jacobson, K. L., Gazmararian, J. A., Schmotzer, B., Kripalani, S., Gatti, M. E. & Kripalani, S. (2009). Relationships between beliefs about medications and adherence. *American Journal of Health-System Pharmacy,* 66(7), 657-664.

Gazmararian, J., Baker, D., Parker, R. & Blazer, D. G. (2000). A multivariate analysis of factors associated with depression: Evaluating the role of health Literacy as a potential contributor. *Archives of Internal Medicine,* 160(21), 3307-3314. doi: 10.1001/archinte.160.21.3307

Gazmararian, J. A., Curran, J. W., Parker, R. M., Bernhardt, J. M., & DeBuono, B. A. (2005). Public health literacy in America: An ethical imperative. *American Journal of Preventive Medicine,* 28(3), 317-322. doi: 10.1016/j.amepre.2004.11.004

Glynn M. & Rhodes, P. (2005). Estimated HIV prevalence in the United States at the end of 2003. National HIV Prevention Conference; June 12–15, 2005; Atlanta. Abstract T1-B1101.

Golbeck, A. L., Ahlers-Schmidt, C. R., Paschal, A. M., & Dismuke, S. E. (2005). A definition and operational framework for health numeracy. *American Journal of Preventive Medicine*, 29(4), 375-376. doi: 10.1016/j.amepre.2005.06.012

Golbeck, A., Paschal, A., Jones, A., & Hsiao, T. (2010). Correlating reading comprehension and health numeracy among adults with low literacy. *Patient Education and Counseling,* 84, *132-134.*

Golin, C. E., Liu, H., Hays, R. D., Miller, L. G., Beck, C. K., Ickovics, J., Kaplan, A.H., & Wenger, N. (2002). A prospective study of predictors of adherence to combination antiretroviral medication. *Journal of General Internal Medicine*, 17(10), 756-765.

Graham, J., Bennett, I. M., Holmes, W. C., Gross, R., Graham, J., Bennett, I. M., & Gross, R. (2007). Medication beliefs as mediators of the health literacy-antiretroviral adherence relationship in HIV-infected individuals. *AIDS & Behavior,* 11(3), 385-392.

Gray, N. J., & Klein, J. D. (2006). Adolescents and the Internet: health and sexuality information. *Current Opinion in Obstetrics & Gynecology,* 18(5), 519-524.

Green, J., Bianco, J. L., & Wyn, J. (2007). Discourses in Interaction: The intersection of literacy and health research internationally. *Literacy & Numeracy Studies*, 15(2), 19-37.

Grossberg, R., Zhang, Y., Gross, R. (2004). A time to prescription refill measure of antiretroviral Adherence predicted changes in viral load in HIV. *Journal of Clinical Epidemiology*, 57, 1107-1110.

Hall, H. I., Song, R., Rhodes, P., Prejean, J., An, Q., Lee, L. M., & Janssen, R. S. (2008). Estimation of HIV incidence in the United States.*: The Journal of the American Medical Association,* 300(5), 520-529. doi: 10.1001/jama.300.5.520

Haller, D. M., Sanci, L. A., Sawyer, S. M., & Patton, G. (2008). Do young people's illness beliefs affect healthcare? A systematic review. *The Journal of Adolescent Health,* 42(5), 436-449.

Hammer, S. M., Eron, J. J., Reiss, P., Schooley, R. T., Thompson, M. A., Walmsley, S., & Volberding, P. A. (2008). Antiretroviral treatment of adult HIV infection. *The Journal of the American Medical Association,* 300(5), 555-570. doi: 10.1001/jama.300.5.555

Hawthorne, G. (1997). Preteenage drug use in Australia: The key predictors and school-based drug education. *The Journal of Adolescent Health , 20*(5), 384-395.

Hazra, R. (2010). Growing up with HIV: children, adolescents, and young adults with perinatally acquired HIV infection. *Annual Review of Medicine,* 61(1), 169-185. doi: 10.1146/annurev.med.050108.151127

Howard, D. H., Gazmararian, J., Parker, R. M., Howard, D. H., Gazmararian, J., & Parker, R. M. (2005). The impact of low health literacy on the medical costs of Medicare managed care enrollees.[Erratum appears in Am J Med. 2005 Aug;118(8):933]. *American Journal of Medicine,* 118(4), 371-377.

Institute of Medicine (2008). Standardizing medications labels: Confusing patients less. Washington, DC: The National Academy Press.

Institute of Medicine (2009). Toward health equity and patient-centeredness: Integrating health literacy, disparity reduction, and quality improvement: workshop summary. Washington, DC: The National Academy Press.

Ishikawa, H., & Yano, E. (2008). Patient health literacy and participation in the health-care process. *Health Expectations,* 11(2), 113-122. doi: 10.1111/j.1369-7625.2008.00497.x

Jay, S., Litt, I.F., & Durant, R.H. (1984).Compliance with therapeutic regimens. *Journal of Adolescent Health Care,* 5, 124-136.

Jordan, J. E., Osborne, R. H., & Buchbinder, R. (2011). Critical appraisal of health literacy indices revealed variable underlying constructs, narrow content and psychometric weaknesses. *Journal of Clinical Epidemiology*, 64(4), 366-379. doi: 10.1016/j.jclinepi.2010.04.005

Kalichman, S.C., Ramachandran, B., & Catz, S. (1999). Adherence to combination antiretroviral therapies in HIV patients of low health literacy. *Journal of General Internal Medicine,* 14(5), 267-273. doi: 10.1046/j.1525-1497.1999.00334.x

Kalichman, S. C., & Rompa, D. (2000). Functional health literacy is associated with health status and health-related knowledge in people living with HIV-AIDS. *Journal of Acquired Immune Deficiency Syndromes*, 25(4), 337-344.

Kalichman, S. C., Cherry, J., & Cain, D (2005). Nurse-delivered antiretroviral treatment adherence intervention for people with low literacy skills and living with HIV/AIDS. *Journal of the Association of Nurses in AIDS Care*, 16(5), 3-15.

Kaiser Family Foundation (2010). Generation M2. Media in the lives of 8 – 18 year olds. A Kaiser Family Foundation Study. Retrieved from, Http://www.kff.org/entmedia/upload/8010.pdf

Kalichman, S. C., Pope, H., White, D., Cherry, C., Amaral, C. M., Swetzes, C., & Kalichman, M. O. (2008). Association between health literacy and HIV treatment adherence: Further evidence from objectively measured medication adherence. *Journal of the International*

Association of Physicians in AIDS Care (JIAPAC), 7(6), 317-323. doi: 10.1177/1545109708328130

Kamil, M.L. (2003). Adolescents & Literacy: Reading for the 21st Century. Retrieved from, www.all4ed.org/pulications/adolescentsandliteracy.pdf

Kirsch, I., Jungeblut, A., Jenkins, L., & Kolstad, A.(1993). Adult Literacy in America: A first look at the findings of the National Adult Literacy Survey. Washington, DC: National Center for Educational Statistics, US Dept. of Education.

Kirsch, I., Braun, H., & Yamamoto, K. (2007). America's perfect storm: Three forces changing our nation's future. Princeton, NJ: Educational Testing Service.

Kitigawa, E. & Hauser, P.M. (1973). Differential Mortality in the United States: A study in socioeconomic epidemiology. Cambridge, MA: Antiretroviral Treatment University Press.

Knight, J. R., Shrier, L. A., Bravender, T. D., Farrell, M., Vander Bilt, J., & Shaffer, H. J. (1999). A new brief screen for adolescent substance abuse. *Archives of Pediatric and Adolescent Medicine*, 153(6), 591-596. doi: 10.1001/archpedi.153.6.591

Kuller, L. H., Tracy, R., Belloso, W., Wit, S. D., Drummond, F., & Lane, H. C. (2008). Inflammatory and coagulation biomarkers and mortality in patients with HIV infection. *PLoS Medicine, 5*(10), e203.

Kutner, M., Greenberg, E., Baer, J. (2006). The health literacy of America's adults: Results from the 2003 National Assessment of Adult Literacy. Washington, DC: National Center for Education Statistics, 2006. US Department of Education Publication No. 2006-483.

Kyngas, H., Hentinen, M., Koivukangas, P., & Ohinmaa, A. (1996). Young diabetics' compliance in the framework of the mimic model. *Journal of Advanced Nursing,* 24(5), 997-1005. doi: 10.1111/j.1365-2648.1996.tb02936.x

Lindau, S. T., Tomori, C. & Lyons, T., Langseth, L., Bennett, C., & Garcia, P. (2002). The association of health literacy with cervical cancer prevention knowledge and health behaviors in a multiethnic cohort of women. *American Journal of Obstetrics & Gynecology,* 186(5), 938-943.

Liu, H., Golin, C., Miller, L., Hays, R., Beck, K., Sanandaji, S., et al. (2001). A comparison study of multiple measures of adherence to HIV protease inhibitors. *Annals of Internal Medicine,* 134(10), 968-977.

Liu, H., Miller, L. G., Hays, R. D., Wagner, G., Golin, C. E., Hu, W., & Wenger, N. S. (2006). A practical method to calibrate self-reported adherence to antiretroviral therapy. *Journal of Acquired Immune Deficiency Syndromes,* 43, S104-S112 110.1097/1001.qai.0000245888.0000297003.a0000245883.

Low-Beer, S., Yip, B., O'Shaughnessy, M. V., Hogg, R. S., & Montaner, J. S. G. (2000). Adherence to triple therapy and viral load response. *Journal of Acquired Immune Deficiency Syndromes,* 23(4), 360-361.

Lyon, M. E., McCarter, R., & D'Angelo, L. J. (2009). Detecting HIV associated neurocognitive disorders in adolescents: What Is the best screening tool? *The Journal of Adolescent Health,* 44(2), 133-135.

Malee, K., Williams, P., Montepiedra, G., McCabe, M., Nichols, S., Sirois, P. A., et al. (2011). Medication adherence in children and adolescents with HIV infection: Associations with behavioral impairment. *AIDS Patient Care & STDs,* 25(3), 191-200. doi: 10.1089/apc.2010.0181

Manganello, J. A. (2008). Health literacy and adolescents: a framework and agenda for future research. *Health Education Research,* 23(5), 840-847. doi: 10.1093/her/cym069

Markwardt, F.C. (1989). Peabody Individual Achievements Test Revised. Circle Pines, MN: American Guidance Service.

Martin, S., Elliott-DeSorbo, D. K., Wolters, P. L., Toledo-Tamula, M. A., Roby, G., Zeichner, S., & Wood, L. V. (2007). Patient, caregiver and regimen characteristics associated with adherence to highly active antiretroviral therapy among HIV-infected children and adolescents. *Pediatric Infectious Disease Journal,* 26(1), 61-67.

Maturo, D., Powell, A., Major-Wilson, H., Sanchez, K., De Santis, J. P., & Friedman, L. B. (2011). Development of a protocol for transitioning adolescents with HIV infection to adult care. *Journal of Pediatric Health Care,* 25(1), 16-23.

McMahon, J. H., Jordan, M. R., Kelley, K., Bertagnolio, S., Hong, S. Y., Wanke, C. A., et al. (2011). Pharmacy adherence measures to assess adherence to antiretroviral therapy: Review of the literature and implications for treatment monitoring. *Clinical Infectious Diseases,* 52(4), 493-506.

Mellins, C. A., Brackis-Cott, E., Leu, C.-S., Elkington, K. S., Dolezal, C., Wiznia, A., & Abrams, E. J. (2009). Rates and types of psychiatric disorders in perinatally human immunodeficiency virus-infected youth and seroreverters. *Journal of Child Psychology and Psychiatry,* 50(9), 1131-1138. doi: 10.1111/j.1469-7610.2009.02069.x

Miller, L., & Hays, R. (2000). Measuring adherence to antiretroviral medications in clinical trials. *HIV Clinical Trials,* 1(1), 36-46.

Murphy, D. A., Wilson, C. M., Durako, S. J., Muenz, L. R., & Belzer, M. (2001). Antiretroviral medication adherence among the REACH HIV-infected adolescent cohort in the USA. *AIDS Care,* 13(1), 27-40.

Murphy, D. A., Belzer, M., Durako, S. J., Sarr, M., Wilson, C. M., Muenz, L. R., & for the Adolescent Medicine HIV/AIDS Research Network. (2005). Longitudinal antiretroviral adherence among adolescents infected with human immunodeficiency virus. *Archives of Pediatric and Adolescent Medicine,* 159(8), 764-770. doi: 10.1001/archpedi.159.8.764

Murphy, D. A., Lam, P., Naar-King, S., Robert Harris, D., Parsons, J. T., & Muenz, L. R. (2010). Health literacy and antiretroviral adherence among HIV-infected adolescents. *Patient Education and Counseling,* 79(1), 25-29.

Naar-King, S., Templin, T., Wright, K., Frey, M., Parsons, J. T., & Lam, P. (2006). Psychosocial Factors and medication adherence in HIV-positive youth. *AIDS Patient Care & STDs,* 20(1), 44-47. doi: 10.1089/apc.2006.20.44

National Institute for Literacy (2009). Definition of literacy. Accessed on 2/13/10 from: http://www.nifl.gov/about/definition.html

National Library of Medicine (2000). Current bibliographies in medicine: Health literacy. National Institutes of Health, US Department of Health and Human Services, Bethesda, MD.

Nieuwkerk, P. T., & Oort, F. J. (2005). Self-reported adherence to antiretroviral therapy for HIV-1 infection and virologic treatment response: A meta-analysis. *Journal of Acquired Immune Deficiency Syndromes,* 38(4), 445-448.

Nurss, J.R., Parker, R.M., Williams, M.V., & Baker, D.W. (2001). Test of Functional Health Literacy in Adults (TOFHLA). Hartford, MI: Peppercorn Books & Press.

Nutbeam, D. (1998). Health promotion glossary. *Health Promotion International,* 13(4), 349-364.

Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International,* 15(3), 259-267. doi: 10.1093/heapro/15.3.259

Orfield, G. (2004). Dropouts in America: Confronting the graduation rate crisis. Cambridge, MA: Antiretroviral Treatment Education Press.

Paasche-Orlow, M., Cheng, D., Palepu, A., Meli, S., Faber, V., & Samet, J. (2006). Health literacy, antiretroviral adherence, and HIV-RNA suppression. *Journal of General Internal Medicine,* 21(8), 835-840. doi: 10.1111/j.1525-1497.2006.00527.x

Paasche-Orlow, M.K. & Wolf, M. (2007). The causal pathways linking health literacy to health outcomes. *American Journal of Health Behavior*, 31, S19-S26.

Parker, R., Baker, D., Williams, M., & Nurss, J. (1995). The test of functional health literacy in adults. *Journal of General Internal Medicine,* 10(10), 537-541. doi: 10.1007/bf02640361

Parker, R. (2000). Health literacy: a challenge for American patients and their health care providers. *Health Promotion International,* 15, 277-283.

Parker, R.M. Ratzen, S.C., Lurie, N. (2003). Health literacy: a policy challenge for advancing high quality health care. *Health Affairs*, 22(4), 147.

Parker, R.W., Wolf, M.S., & Kirsch, I. (2008). Preparing for an epidemic of limited health literacy: Weathering the perfect storm. *Journal of General Internal Medicine,* 23(8), 1273-1276. doi: 10.1007/s11606-008-0621-1

Paterson, D. L., Swindells, S., Mohr, J., Brester, M., Vergis, E. N., Squier, C.,Wagener, M., & Singh, N. (2000). Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. *Annals of Internal Medicine, 133*(1), 21-30.

Pearson, C. R., Simoni, J. M., Hoff, P., Kurth, A. E., & Martin, D. P. (2007). Assessing antiretroviral adherence via electronic drug monitoring and self-report: An examination of key methodological issues. *AIDS and Behavior,* 11(2), 161-73. doi:10.1007/s10461-006-9133-3

Peerson, A. & Saunders, M.. (2009). Health literacy revisited: what do we mean and why does it matter? *Health Promotion International,* 24(3), 285-296. doi: 10.1093/heapro/dap014

Powers, B.J. & Bosworth, H.B. (2006). Revisiting literacy and adherence: Future clinical and research directions. *Journal of General Internal Medicine,* 21(12), 1341-1342.

Rapoff, M.A. (1989). Compliance with treatment regimens for pediatric rheumatic diseases. *Arthritic Care Research,* 2, S40-S47.

Reisner, S.L., Mimiaga, M., Skeer, M., Perkovich, B., Johnson, C., & Safren, S. (2009). A review of HIV antiretroviral adherence and intervention studies among HIV-infected youth. *Topics in HIV Medicine,* 17(1), 1-25.

Reynolds, N. R., Sun, J., Nagaraja, H. N., Gifford, A. L., Wu, A. W., & Chesney, M. A. (2007). Optimizing measurement of self-reported adherence with the ACTG adherence questionnaire: A cross-protocol analysis. *Journal of Acquired Immune Deficiency Syndromes,* 46(4), 402-409 410.1097/QAI.1090b1013e318158a318144f.

Riekert, Kristin A., & Drotar, Dennis. (2002). The beliefs about medication scale: development, reliability, and validity. *Journal of Clinical Psychology in Medical Settings,* 9(2), 177-184.

Rudd, R., Moeyknes, B. A., & Colton, T. A. (2000). Health and literacy: A review of the medical and public health literature, Volume 1, Chapter 5. In Coming, Garner, & Smith, Eds. The Annual Review of Adult Learning and Literacy. Retrieved from, http://www.ncsall.net/?id=522

Rudd, R.E. (2002). Literacy and health: a maturing partnership. Focus on basics: *Connecting Research and Practice*, 5, 1-8.

Rudd, R.E., Kirsch, I., & Yamamoto (2004). Literacy and health in America. Policy information report. Educational Testing Service (ETS). Retrieved from, http://www.ets.org/Media/Research/pdf/PICHEATH.pdf

Rudy, B. J., Murphy, D. A., Harris, D. R., Muenz, L., & Ellen, J. (2009). Prevalence and interactions of patient-related risks for non adherence to antiretroviral therapy among perinatally infected youth in the United States. *AIDS Patient Care & STDs*, 23(3), 185-194.

Sanders, L. M., Federico, S., Klass, P., Abrams, M. A., & Dreyer, B. (2009). Literacy and child health: A systematic review. *Archives of Pediatric and Adolescent Medicine,* 163(2), 131-140. doi: 10.1001/archpediatrics.2008.539

Scott, T. L., Gazmararian, J. A., Williams, M. V., Baker, D. W., Scott, T. L., Gazmararian, J. A., & Baker, D. W. (2002). Health literacy and preventive health care use among Medicare enrollees in a managed care organization. *Medical Care,* 40(5), 395-404.

Schillinger, D., Grumbach, K., Piette, J., Wang, F., Osmond, D., Daher, C., & Bindman, A.B. (2002). Association of health literacy with diabetes outcomes. *JAMA: The Journal of the American Medical Association,* 288(4), 475-482. doi: 10.1001/jama.288.4.475

Sethi, A.K., Celentano, D. D., Gange, S.J., Moore, R. D., & Gallant, J. E. (2003). Association between adherence to antiretroviral therapy and human immunodeficiency virus drug resistance. *Clinical Infectious Diseases,* 37(8), 1112-1118. doi: 10.1086/378301

Shaw, S. J., Huebner, C., Armin, J., Orzech, K., Vivian, J., Shaw, S. J., & Vivian, J. (2009). The role of culture in health literacy and chronic disease screening and management. *Journal of Immigrant & Minority Health,* 11(6), 460-467.

Simoni, J., Kurth, A., Pearson, C., Pantalone, D., Merrill, J., & Frick, P. (2006). Self-report measures of antiretroviral therapy adherence: A review with recommendations for HIV research and clinical management. *AIDS and Behavior,* 10(3), 227-245. doi: 10.1007/s10461-006-9078-6

Speros, C. (2005). Health literacy: concept analysis. *Journal of Advanced Nursing,* 50(6), 633-640.

United States Department of Health and Human Services (USDHHS). Office of Disease Prevention and Health Promotion (2000). Healthy People 2010. Retrieved from, http://www.healthypeople.gov/Document/HTML/Volume1/toc.htm

United States Department of Health and Human Services (USDHHS). Office of Disease Prevention and Health Promotion (2009). Developing Healthy People 2020. Retrieved from, http://www.healthypeople.gov/hp2020/Objectives/CommentByView.aspx?cmd=sc

United States Department of Health and Human Services (USDHHS). Panel on Antiretroviral Guidelines for Adults and Adolescents. (January 10, 2011). Guidelines for the use of antiretroviral agents in HIV- infected adults and adolescents. Retrieved from, http://aidsinfo.nih.gov/contentfiles/AdultandAdolescentGL.pdf

Van Dyke, R. B., Lee, S., Johnson, G. M., Wiznia, A., Mohan, K., Stanley, K., et al. (2002). Reported adherence as a determinant of response to highly active antiretroviral therapy in children who have human immunodeficiency virus infection. *Pediatrics,* 109(4), e61. doi: 10.1542/peds.109.4.

Van Dyke, R. B., Patel, K. D., Siberry, G. K., Burchett, S. K., Spector, S. A., Chernoff, M. C. P., et al. (2011). Antiretroviral treatment of US children with perinatally acquired HIV infection: Temporal changes in therapy between 1991 and 2009 and predictors of immunologic and virologic outcomes. *Journal of Acquired Immune Deficiency Syndromes,* 57(2), 165-173.

Wagner, J. H., Justice, A. C., Chesney, M., Sinclair, G., Weissman, S., & Rodriguez-Barradas, M. (2001). Patient- and provider-reported adherence: toward a clinically useful approach to measuring antiretroviral adherence. *Journal of Clinical Epidemiology,* 54(12, Supplement 1), S91-S98. doi: 10.1016/s0895-4356(01)00450-4

Waite, K.R., Paasche-Orlow, M., Rintamaki, L.S., Davis, T.C., & Wolf, M.S. (2008). Literacy, social stigma and HIV medication adherence. *Journal of General Internal Medicine,* 23(9), 1367-1372.

Weiss, B. D., Mays, M. Z., Martz, W., Castro, K., DeWalt, D.,A., Pignone, M. P., & Hale, F. A. (2005). Quick assessment of literacy in primary care: The Newest Vital Sign. *Annals of Family Medicine*, 3(6), 514-522.

Williams, M. V., Parker, R. M., Baker, D. W., Parikh, N. S., Pitkin, K., Coates, W. C., & Nurss, J. R. (1995). Inadequate functional health literacy among patients at two public hospitals. *JAMA: The Journal of the American Medical Association,* 274(21), 1677-1682. doi: 10.1001/jama.1995.03530210031026

Williams, M.V., Baker, D.W., Parker, R.M., & Nurss, J. R. (1998). Relationship of functional health literacy to patients' knowledge of their chronic disease: A study of patients with hypertension and diabetes. *Archives of Internal Medicine,* 158(2), 166-172. doi: 10.1001/archinte.158.2.166

Williams, P. L., Storm, D., Montepiedra, G., Nichols, S., Kammerer, B., & Sirois, P. A (2006). Predictors of adherence to antiretroviral medications in children and adolescents with HIV infection. *Pediatrics,* 118(6), e1745-e1757. doi: 10.1542/peds.2006-0493

Wolf, M. S., Davis, T. C., Cross, J. T., Marin, E., Green, K., & Bennett, C. L. (2004). Health literacy and patient knowledge in a Southern US HIV clinic. *International Journal of STD & AIDS,* 15(11), 747-752. doi: 10.1258/0956462042395131

Wolf, M. S., Williams, M. V., Parker, R. M., Parikh, N. S., Nowlan, A. W., & Baker, D. W. (2007). Patients' shame and attitudes toward discussing the results of literacy screening. *Journal of Health Communication: International Perspectives,* 12(8), 721 - 732.

Wolf, M. S., Davis, T. C., Osborn, C. Y., Skripkauskas, S., Bennett, C. L., & Makoul, G. (2007). Literacy, self-efficacy, and HIV medication adherence. *Patient Education and Counseling,* 65(2), 253-260. doi: 10.1016/j.pec.2006.08.006

World Bank (2000). World development report 1999/2000. Entering the 21st century. The changing development landscape. New York, USA: Oxford University Press.

World Health Organization (1998). Division of Health Promotion, Education and Communication. Health Promotion Glossary. World Health Organization, Geneva; 1998. Retrieved from, http://www.who.int/hpr/NPH/docs/hp_glossary_en.pdf.

World Health Organization (WHO) Commission on Social Determinants of Health (2007). Achieving health equity: From root causes to fair outcomes. Geneva: World Health Organization. Retrieved from, http://www.who.int/social_determiants/resources/interim_statement/enindex.html

Yin, H. S., Forbis, S. G., & Dreyer, B. P. (2007). Health literacy and pediatric health. *Current Problems in Pediatric and Adolescent Health Care,* 37(7), 258-286. doi: 10.1016/j.cppeds.2007.04.002

Zarcadoolas, C., Pleasant, A., & Greer, D. S. (2005). Understanding health literacy: an expanded model. *Health Promotion International,* 20(2), 195-203. doi: 10.1093/heapro/dah609

Appendix A
Pilot Testing Script

"My name is (name of PI or RA). As explained to you by _____, we are going to perform a trial run of some questionnaires that will be used at a later time. "

"And by trial run, I am trying to be certain that these questionnaires work well for young people like yourself. You are not part of any research study but are instead helping me to be better prepared when I begin interviewing teenagers in a future research project."

"After we complete each questionnaire, please give me your feedback. "

"One questionnaire involves your feelings and beliefs about taking medications. Do you take any medicines every day? "

If no, skip BAMS.

"Any questions? OK so we will begin with the Media Use Questionnaire."

"We know that some young people are involved with different types of media activities….and some of examples are talking on the cell phone, texting, using computers and video games. In our study we are trying to better understand if media activities influence the health of teens such as taking their medicines."

Administer Media Questionnaire.

"So what did you think about this questionnaire?"

"The next questionnaire is the Beliefs about Medications Scale. This is a questionnaire that was made to try and understand if a teenager's beliefs and feelings affect taking medicines prescribed by a doctor or nurse practitioner."

Administer BAMS

"So what did you think about this questionnaire?"

Other: After completion of each page of the BAMS state, "**you are doing great. "** After completion of page 3, say **"we are almost finished with this questionnaire."**

"Doctors and nurses use many medical terms and instructions with patients. So the next two questionnaires were designed to help figure out if patients understand the words and directions we use a lot of the time."

"The first one that I will administer is called the Rapid Estimate of Adult Literacy in Medicine-teen version. "

- We are trying to get an idea of what health words people your age are familiar with.
- What I need you to do is say each of the words out loud to me starting here [point to first word with a pencil].
- Say all the words you know. If you come to a word you don't know, you can sound it out or just skip it and go on.

Administer REALM

"So what did you think about this questionnaire?"

"The final questionnaire is the TOFHLA or Test of Functional Health Literacy Assessment."

Administer TOFHLA as per the directions

"So what did you think about this questionnaire?"

Other: In the numeracy section, after each response from the participant, the administrator will say **"fine" or "great".**

"So any final thoughts about using these questionnaires in teens? "

Appendix B
Clinical Research Protocol

Aim l
The primary objective of this study is to examine the relationship between health literacy, functional literacy, beliefs about medication, media use and adherence to antiretroviral treatment among HIV-infected adolescents (ages 13 – 24 years).

There are three stated hypotheses under this aim.
H1. Heath literacy is associated with adherence to antiretroviral treatment in HIV-infected adolescents.
H2. Higher functional literacy is positively associated with treatment adherence in HIV-infected adolescents.
H3. Individual beliefs about medications influence patterns of adherence to medications in HIV-infected adolescents.

Aim II
The second aim is to explore the association between beliefs about medications and health literacy in HIV-infected adolescents.

There is one stated hypothesis under this aim.
H4. Beliefs about medications are associated with health literacy in HIV-infected adolescents.

Aim lll
The third aim is to describe the association between media use and health literacy in HIV-infected adolescents.

There is also one stated hypothesis under this aim.
H5. Media use is associated with health literacy in HIV-infected adolescents.

Recruitment
Following approval from the Institutional Review Board at Columbia University and Weill Cornell Medical Centers, efforts to recruit patients will begin during the regularly scheduled clinic hours for youth followed at both locations. Ann-Margaret Navarra and a RA will visit both study sites weekly during regularly scheduled clinic hours (Fridays at Project STAY & Thursdays at the Center for Pediatric Special Studies). The nature and purpose of this study will be discussed with any potential study candidate by Ann-Margaret Navarra. Communication with the medical staff at both study locations will ensue during the recruitment phase and throughout the duration of the study. (Recruitment was modified to include two additional sites in February 2011, Nyack Hospital Immunotherapy Clinic and Morgan Stanley Children's Hospital Pediatric HIV Clinic).

Sample
Participants will be recruited from Columbia University Medical Center, Project Services to Assist Youth (S.T.A.Y.), the Center for Pediatric Special Studies at Weill Cornell Medical Center, Morgan Stanley Children's Hospital – HIV Clinic and Nyack Hospital Immunotherapy Clinic. All settings provide comprehensive medical, psychosocial, and case management services to adolescents and young adults living with HIV/AIDS. Clients aged 13-24 who have been receiving antiretroviral therapies for six months or longer at the time of trial enrollment will be offered the opportunity to participate in the study ***(see complete list of eligibility criteria on page 2).***

Screening for cognitive status will be done with the Folstein Mini Mental Health State Exam. This screening measure has been validated in the HIV-infected adolescent population. Participants with normal cognitive status will then be asked to complete the study survey instruments.

The target accrual for this study is 80 participants.

Compensation
Participants will be compensated with a $20.00 GAP gift card for their time at the completion of the study.

Eligibility criteria for participation in this study will include:
1) HIV seropositive status
2) fully disclosed of HIV diagnosis
3) English speaking
4) age range of 13-24 years
5) currently receiving antiretroviral treatment for six months or longer
6) no cognitive or visual deficits which might prevent survey completion*

Exclusion criteria will include:
1) HIV seronegative status
2) youth not disclosed of their HIV diagnosis
3) non-English speaking
4) <13 years or >24 years of age
5) receiving antiretroviral medications for less than 6 months
6) cognitive or visual deficits interfering with completion of the survey instruments*

* The Mini Mental Health State Exam (MMSE) will be used to assess cognition and is a measure designed to screen for cognitive impairment. The range of scores is from 0-30 and **scores > 24 are indicative of normal cognitive status** (Folstein, 1975). The estimated time for completion of this measure is five minutes or less.

*If a potential subject scores **less than 24 on the MMSE**, the PI will communicate this information to the participant's medical provider and ineligibility will be briefly discussed with the potential participant.*

**Vision screening will be performed with a handheld vision card. If a respondent cannot read a simple majority at the 20/100 line, consultation with the medical provider will be performed to determine extent of visual deficits and eligibility.*

Informed Consent Process

Institutional review board (IRB) approval was granted at each participating clinical site, New York Presbyterian Hospital-Columbia University Medical Center, New Presbyterian Hospital-Weill Cornell Medical College, and Nyack Hospital.

Informed consent and assent when indicated were obtained on all study participants in accordance with the regulations specific to the protection of study volunteers of the IRB at each institution. Participants were informed of their right to withdraw participation from this study at any time.

The research study was described in detail to eligible participants and their parent(s), if the candidate was between the ages of 13 to 17 years. Signed written and verbal consent was obtained from HIV-infected participants ages 18 years and older by Ann-Margaret Navarra or the physician collaborators at each site.

Signed written and verbal assent was obtained for HIV-infected participants ages 13-17 years of age receiving medical care at New York Presbyterian's Project STAY, Weill Cornell Medical College's Center for Pediatric Special Studies, the Pediatric HIV clinic at MS CHONY and Nyack Hospital's Family Centered Immunotherapy Clinic by Ann-Margaret Navarra or the physician collaborator designated from each clinical site.

This research study involved no more than minimal risk and therefore a waiver/alteration request of the standard written consent procedures was granted from each of the corresponding IRB boards. If the parent or guardian of a potential participant ages 13 – 17 years of age was not present during the time of recruitment, verbal telephone consent was obtained from the guardian by either the physician collaborator or one of the co-investigators at the designated site. Verbal assent was obtained from the participant as described above.

Data Collection

Once a client has been enrolled in the study, study personnel will administer the instructions. The survey and questionnaires are paper based and will be completed by the participant on-site. The order of the survey instruments will be randomly selected as follows:

Group 1: Media, BAMS, REALM, TOFHLA
Group 2: BAMS, Media, REALM, TOFHLA
Group 3: TOFHLA, REALM, BAMS, Media
Group 4: TOFHLA, REALM, Media, BAMS
Group 5: BAMS, Media, TOFHLA, REALM

Completed surveys will be kept in client medical files, which are stored in locked cabinets in a locked office.

The self reported 3 day adherence estimate will be collected prior to administration of the survey questionnaires

Study Procedures

l. Introduction to the participant: include your name, title and role in the study.
Be sure to thank the participant and the parent (if present) for volunteering in this research study.

ll. Eligibility Screening: *"To be sure that there are no heath issues that could possibly affect your completion of the questionnaires in this study, I will ask you to complete a five minute screening test called the Mini Mental Health State Exam. We will also complete a vision screen that will take less than one minute."*

Administer Vision Screen and then MMSE

lll. Review the course of events for the participant:

"We are ready to begin. I would like to explain to briefly explain to you what we will be doing over the next hour. I want you to know that during this time period, I will be reading most of the instructions to you to be sure that you and every person participating in this study will receive the same information."

"There are four questionnaires that I will administer to you. "

Media Use Questionnaire:
"The media questionnaire is a tool designed to measure media activities such as using computers, cell phones and video games.

Beliefs about Medications Scale:
"This is a questionnaire that was made to try and understand if a teenager's beliefs and feelings affect taking medicines prescribed by a doctor or nurse practitioner."

"Doctors and nurses use many medical terms and instructions with patients. So the next two questionnaires were designed to help figure out if patients understand the words and directions we use much of the time."
These questionnaires are called the:

Rapid Estimate of Adult Literacy in Medicine-teen version, also known as the REALM-teen *and* TOFHLA or Test of Functional Health Literacy in Adults

- "I want you to know that these questionnaires are not a series of tests like what you would receive in school. There are no wrong or right answers. Do you have any questions before we begin?"

- **Before beginning the questionnaires, "could you tell me how many doses of your medicines you missed yesterday?"**
  "How many doses did you miss on _____(name day 2 days ago)?"
  "How many doses did you miss on _____(name day 3 days ago)?"

- **"**OK so let's start the questionnaires and we will begin with the _____"(order of instruments is determined by random selection).

- Now we will move on to _____."

- "You are doing great. Now we are moving on to the _____."

- "We are almost finished. You are doing terrific. The last questionnaire is the _____."

- *For the BAMS and Media Use questionnaires-be sure to indicate that we are reading this questionnaire together."*

Instructions for use of REALM-teen (use laminated card)

To begin: Give the teen the laminated version of the REALM-teen word list. Attach the examiner record form to the clipboard. Hold the clipboard at an angle such that the patient is not distracted by your scoring procedure.

- Before Administration of the **REALM-teen**, state the following:

  "We are trying to get an idea of what health words people your age are familiar with."

  "What I need you to do is say each of the words out loud to me starting here [point to first word with a pencil]."

  "Say all the words you know. If you come to a word you don't know, you can sound it out or just skip it and go on."

  "Be sure to pause for a second between each word read."

- *Do not use the words **read** and **test** when administering or introducing the REALM-teen. These words may make the teen unwilling to participate.*

- If the patient stops, say "Look down at this list, [point] are there any other words you recognize?

Instructions for use of TOFHLA

TOFHLA-Numeracy: Hand the patient the prompt for each question, then read each question and record the responses of participants (timed test –max time 10 minutes).

Begin the administration with the following scripted instructions (also available on TOFHLA).

- **"These are directions you or someone else might be given at the hospital."**
- **"Please read each direction to yourself."**
- **"Then I will ask you some questions about what it means."**

Preface each succeeding question with:

"**Have a look at this one 'OR' Here is another direction you may be given."**

If the patient asks about his or her performance, respond as follows:
"You are doing very well."

TOFHLA-Reading Comprehension: It is important to present the reading comprehension section verbatim from the scripted instruction on the TOFHLA (timed test – max time 12 min).

- This is a timed test but do not tell the participant in advance that it is a timed test. When 12 minutes has elapsed, tell the participant:

  "That should give us what we are looking for. Thank you for your participation."

REALM-teen version
Complete Instructions for Administration/Scoring

Testing Materials Needed
Laminated Patient Word List
Examiner Record Form
Clipboard
Pencil

To begin: Give the teen the laminated version of the REALM-teen word list. Attach the examiner record form to the clipboard. Hold the clipboard at an angle such that the patient is not distracted by your scoring procedure.
Before Administration of the REALM-teen, state the following:

- We are trying to get an idea of what health words people your age are familiar with.
- What I need you to do is say each of the words out loud to me starting here [point to first word with a pencil].
- Say all the words you know. If you come to a word you don't know, you can sound it out or just skip it and go on.

Do not use the words read and test when administering or introducing the REALM-teen. These words may make the teen unwilling to participate.

If the patient stops, say "Look down at this list, [point] are there any other words you recognize?

Scoring
Place a check mark next to each word pronounced correctly.
Dictionary pronunciation is the scoring standard.
Count a word correct, if the word is pronounced correctly and no additions or deletions have been made to the beginning or ending of the word.
Words pronounced with a dialect or accent should be counted as correct provided there are no additions or deletions to the word.
If the patient takes more than 5 sec on a word, encourages the patient to move on by saying…."Let's try the next word."

If the patient begins to miss every word or appears to be struggling/frustrated, tells the patient, "look down at the list, are there any other words on this list that you recognize?"

Count as an error, any word that is not attempted or mispronounced.
Scoring should be strict but take into account any problems which could be related to dialect or articulation difficulties. Count as correct, any self corrected word.

Score Interpretation

Raw Score	Grade level
0-37	3rd grade & <
38-44	4th to 5th grade
45-58	6th to 7th grade
59-62	8th to 9th grade
63-66	10th grade and >

Test of Functional Health Literacy in Adults
Complete Instructions for Administration/Scoring

Preparation

Be sure that testing is completed in a quiet and private area. The testing conditions must be consistent for all participants.

Visual Acuity: *Check with a member of the patient's medical team that visual acuity was tested within one year of TOFHLA administration and is 20/50 or less. If corrective lenses have been prescribed, they need to be worn for testing with the TOFHLA.*

I. Numeracy

Begin with questions on numeracy. Since this is a **10 minute timed assessment,** have the prompts arranged in order before beginning.

1. Hand the patient the prompt for each question, then read each question and record the responses of participants.

2. Begin the administration with the following scripted instructions.

- **"These are directions you or someone else might be given at the hospital."**
- **"Please read each direction to yourself."**
- **"Then I will ask you some questions about what it means."**

3. Preface each succeeding question with:

"Have a look at this one 'OR' Here is another direction you may be given."

4. Special directions for uniform administration:

- Prompt 1: **Be sure you read 7:00 a.m. and not "in the morning."** Part of the test intention for this prompt is to determine if the patient understands that "a.m." means morning.

- Prompt 2: Some respondents have difficulty separating directions for their own medication from the information printed on the vial label. In this case, repeat the first sentence form the general introduction, but do not tell the respondent that this is only an example.

- Prompt 4: Some patients will give their own blood sugar status. All you can do is repeat the question. The respondent must figure out independently if the data provide the basis for the answer.

- Prompt 5: Some respondents will incorrectly give the date for their next appointment.

- Prompt 10: The questions about financing health care will elicit some anecdotal information from the patient.

5. If the patient asks about his or her performance, respond as follows:
"You are doing very well."

II. Reading Comprehension

1. It is important to present the reading comprehension section verbatim from the scripted instruction on the TOFHLA.

2. This is a timed test but do not tell the participant in advance that it is a timed test. When **12 minutes** has elapsed, tell the participant:

"That should give us what we are looking for. Thank you for your participation."

III. Scoring of the TOFHLA

Level	**TOFHLA Score**
Inadequate functional health literacy	0-59
Marginal functional health literacy	60-74
Adequate functional health literacy	75-100

Other: See TOFHLA Manual from Peppercorn Books for any questions not covered in this protocol.

Appendix C

Scoring of the Beliefs about Medication Scale (BAMS)

PID #_____ **Examiner_____**

Date_____ **Clinic_____**

Perceived Threat
Sum items for perceived threat: 3(reverse coded) +6 +10 +18 +19 +23 +25 +29 +37 +42 +43 +46 +50
Reverse code question: 3

3 (reverse coded)	_____
6	_____
10	_____
18	_____
19	_____
23	_____
25	_____
29	_____
37	_____
42	_____
43	_____
46	_____
50	_____

Subscale Score **_____ (Perceived Threat)**

Positive Outcome Expectancy
Sum items for positive outcome expectancy: 1 +7 +9 +20 +22 +24 +27 +30 +32 +34 +35 +36 +39 +40 +41 +44 +45 +48 +49 +51

1	_____
7	_____
9	_____
20	_____
22	_____
24	_____
27	_____
30	_____
32	_____
34	_____
35	_____
36	_____
39	_____
40	_____
41	_____
44	_____
45	_____
48	_____
49	_____
51	_____

Subscale Score **_____(Pos. Outcome Expectancy)**

Negative Outcome Expectancy
Sum items for negative outcome expectancy: 4 +5 +11 +13 +16 +17 +21 +26 +28 +31 +33 +38 +47

4 _____
5 _____
11 _____
13 _____
16 _____
17 _____
21 _____
26 _____
28 _____
31 _____
33 _____
38 _____
47 _____

Subscale Score _____(Neg. Outcome Expectancy)

Intent
Sum items for intent: 53 +54(reverse coded) +54 +55 +56 +57(reverse coded) +58 +59(reverse coded)
Reverse code questions: 54, 57, & 59

53 _____
54(reverse coded) _____
55 _____
56 _____
57(reverse coded) _____
58 _____
59(reverse coded) _____

Subscale Score _____ (Intent)

Handling Missing Data
The subscale should be considered missing if the adolescent is missing more than 25% of the items on the subscale. Missing item data should be replaced by the group mean for the item.
** Other: the following items were not included on any subscale- 2, 8, 12, 14, 15, & 52 **

Reverse coding:	1=7	2=6	3=5
	7=1	6=2	5=3