5-2017

Attention Deficit Hyperactivity Disorder in Appalachia: proposed methods to analyze and solve social and medical issues surrounding the disorder

Alexis Rae Prillhart
aprillha@vols.utk.edu

Attention Deficit Hyperactivity Disorder in Appalachia: proposed methods to analyze and solve social and medical issues surrounding the disorder

Alexis Prillhart

The University of Tennessee, Knoxville

Introduction to Appalachia, Its Health Disparities, and Overall Reasons They Exist

The Appalachian Regional Commission (ARC) defines the Appalachian Region as, "The 205,000-square-mile region that follows the spine of the Appalachian Mountains from southern New York to northern Mississippi. It includes all of West Virginia and parts of 12 other states: Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia." The Appalachian Region is home to over 25 million people ("Appalachian Region", 2015). Appalachian people hold a culture of their own, a culture that not many outsiders know much about. In fact, only recently, due to technology and communication improvements, has information about this unique culture started to emerge. Appalachia is historically known as a region that is lacking in healthcare and home to many unhealthy inhabitants. Currently, many studies are emerging, focusing on improving healthcare and understanding the environmental, social, and cultural distinctions in the region that may lead to limitations (Couto, 2012). There are several broad factors that may contribute to the unhealthiness of the region as a whole including poverty, rurality, and the various cultures and beliefs of the region.

There are several factors that may lead to disparities in healthcare. One main factor in the lack of healthcare may be contributed to poverty. Poverty, although not evenly distributed throughout the region, is rampant. The ARC reports that from 2009-2013 the Appalachia region had a poverty rate of 17.0%, compared to the national poverty rate of 15.4% ("Poverty Rates in Appalachia", 2014). As stated, poverty is not universal, and is

usually found in clusters throughout. Poverty may prevent Appalachians from seeking out healthcare due to affordability and even transportation costs (Couto, 2012).

In addition to poverty, rurality may also prevent Appalachians from receiving healthcare. In the past several years Appalachia has transformed from a rural to an urbanized region. However, there are still several areas, primarily in central Appalachia, that are mostly rural. Many Appalachians consider rurality a stereotype, but it is reality that more rural areas do not have healthcare access close by. Hospitals and doctors' offices are more concentrated in metro, urban areas than in rural regions of Appalachia. Lack of transportation and money to travel may impede the possibility of seeking a professional's health advice (Couto, 2012).

Lastly, and more broadly, the social culture of the region may have an impact of the ability to receive healthcare. Appalachians are hesitant to describe their culture as a whole entity, as each area in the region has distinct cultural differences. They are also afraid that stereotypes may be derived. However, there are a few broad topics that are mostly true for the entire region (Couto, 2012). Appalachian people consider taking care of oneself and family a priority, meaning they will put taking care of the family through work before taking the time to visit a health professional (Gessert, 2015). It is this independent focus that leads to many healthcare providers to discriminate. Providers may be likely to lackadaisically treat the patient due to the belief the patient will not listen them and will disagree on the treatment (Puhl, 2010). Appalachians generally do not trust with ease, and are hesitant to trust people, like doctors, that live a different and more educated lifestyle. They may also see the help from doctors as a charity, and thus, be less receptive of advice (Beringer, 2006).

Another aspect of Appalachian social culture is family. Family plays an important role in the culture and health of Appalachians. The Appalachian family is more than the nuclear family; it includes the parents, children, grandparents, and the parents' siblings and children. In a broader sense it can even include the community. Children are usually taken care of by grandparents and other family members instead of attending daycare while their parents work. This leaves the family in charge of noticing any healthcare ailments in the child. The family also depends on each other to raise money to attend healthcare visits annually. This leads back to the discussion on poverty in the family (Welch, 2014). The family also usually shares traditions and faith. The Appalachian region is known for having strong ties to religion and faith. While religion is not universal in the region, it does have an impact in some areas pertaining to healthcare. The Appalachian people are more likely to believe in faith-based fatalism, or the concept that illness is a part of God's plan and He will heal the patient. This thought process might lead to Appalachians to believe that all illness is "in God's hands" and medication is not necessary (Welch, 2011). Healthcare providers must be aware of religious beliefs in an area as they can drastically affect how a patient acts towards taking medication and even attending appointments.

The social, economic, and cultural aspects of the Appalachian region are very broad and specific to the area. It is hard to account for every factor, and even harder to determine which ones to include, when studying how they may impact the healthcare in a specific Appalachian city. Each Appalachian town must cater to its own social and cultural beliefs when developing a healthcare plan. Poverty, the urbanization of the area, and the cultural attitudes of the area are among the factors that must be accounted for. As

stated, these are broad attitudes of the Appalachian people, and do not apply to the whole population. However, these attitudes are important to note as crafting a health plan to include them may improve communication, education, and overall health in the Appalachian region.

Potential Reasons for Health Disparities in Appalachian Pediatric Patients

Not much is known about Appalachia as a whole, and even less is known about the children that reside in the region. Social scientists and healthcare providers are just beginning to develop systems to help the region, but not many of these developments focus on the health of the Appalachian child. The Appalachian lifestyle can have an affect on the health of youth in the region, as they are dependent on the family and the overall system to meet their needs. While the previously mentioned aspects of the region will affect everyone in the region, there are a few more characteristics of Appalachia that affect youth more specifically in healthcare including lack of managed care, education and social distance, and the social environment of the child.

Managed care is a health system that is designed to deliver quality health care at a reduced cost and high availability. More simply stated, managed care is the implementation of health insurance programs. There is a severe lack of managed care in the Appalachian region. Managed care rates are less than 15% in half of the states in the Appalachia region, and only four states have rates above 25%, which is still below the national average. Insurance plans are held by 75% of Appalachian children, significantly lower than the 85% of non-Appalachian children that possess insurance plans (“Child Well-being Survey”, 2011). Low rates of managed care in the region has a major impact on the healthcare of pediatric patients. Lack of insurance may lead to use of emergency

room visits as the primary or source of healthcare. Parents that do not have insurance plans are less likely to have a primary care physician for their child, meaning the child will usually not participate in regularly scheduled appointments (Couto, 2012). Parents that do not have insurance plans are often low-income, which will have other implications to be discussed shortly. Lack of managed care will also lead restrictions on access to preventative and educational resources. Without managed care plans Appalachian children are less likely to receive care early on in life. They are also less likely to grow up attending regular appointments; this will likely carry over into adult life. The decreased levels of insurance plans is lessening the opportunities of healthcare for Appalachian children, and negatively impacting their health.

Low education levels in the Appalachian region may negatively impact the healthcare of pediatric patients in the region. In a consensus report in 2010 the ARC reported that 17.1% of the Appalachian population has no high school diploma, while in non-Appalachian regions, only 15% of residents do not have a high school diploma ("The Appalachian Region: A Data Overview from the 2006-2010 American Community Survey", 2011). This statistic shows that Appalachians are not completing high school studies comparable to non-Appalachians, and thus will not continue on to receive secondary education. Uneducated populations are more likely to become ill and develop disease than educated populations. They are also less likely to notice and understand the severity when an illness arises, especially mental illness, and seek medical attention when needed (Turiano, 2014). Parents lacking education may not understand the complex medical terminology that is utilized to explain the health of their child and the importance of basic medical care, such as vaccinations and how to understand and read prescriptions.

Part of this issue may arise from the social distance that is created among educated health professionals and uneducated patients. A language barrier often exists, leading to confusion on the patients' end. This is partly due to an education gap between the health practitioner and the patient, but is also caused by the numerous doctors that are from outside Appalachia, who are unfamiliar with the colloquialisms of the region (Hutson,2007). The education gap and language barrier both add confusion to a parent, leading to hesitation when seeking care for their child. Uneducated parents are less likely to take their children to doctors' appointments than more educated parents. This may be due to the fact that lack of education usually leads to career paths that do not produce a great income and lead to increased hours on the clock (Cutler, 2006). Many parents in the Appalachian region are working long hours to provide for their family and they do not have the time, resources, such as income and transportation, or the knowledge to understand general health and assure their child is receiving medical care on a scheduled basis.

Although it is impossible to define the social environment of Appalachian children as a whole, social trends can be determined to aid in understanding the health of Appalachian children. The Child Well-Being Survey, conducted by the Cincinnati Children's Hospital, reported that Appalachian children are more likely to live in single-parent homes than non-Appalachian children (2011). Single-parent families may find difficulty in finding the time and resources to attend health appointments. Children in single-parent homes are likely to experience less health care than other children. Parents of Appalachian children are more likely to work full time and longer hours than parents outside the region ("Child Well-Being Survey", 2011). Because of this, Appalachian

children often possess part time caregivers. At a young age the children are watched by other family members, and are not socialized with children outside the family unit. The lack of a parental figure increases the independence in many Appalachian children, but often leads to increased behavioral issues and defiance. As a child matures, the absence of parental supervision increases the chances of alcohol and substance abuse (Couto, 2012). Substance abuse is another issue that Appalachian children encounter often. Alcohol and drug abuse is extremely common in rural Appalachia, and often children mimic abuse behaviors they learn from observing parental actions. Sometimes parents even take advantage of access to their child's medications, and the child does not receive the medication they are prescribed (Zhang, 2008). The social environment of a child can lead to a decrease in the quality of the healthcare he receives. Providers should pay special attention to the social environment of the child, which revolves mainly around parental involvement and quality of care, and adjust interactions to account for the environment the child faces on a day to day basis.

References

The Appalachian Region. (2015). Retrieved February 20, 2016, from http://www.arc.gov/appalachian_region/TheAppalachianRegion.asp

The Appalachian Region: A Data Overview from the 2006-2010 American Community Survey. (2011). Retrieved February 23, 2016, from http://www.arc.gov/research/researchreportdetails.asp?REPORT_ID=96

Behringer, B., & Friedell, G. H. (2006). Appalachia: where place matters in health. *Prev Chronic Dis*, *3*(4), A113.

Child Well-Being Survey. (2011). Retrieved March 01, 2016, from http://www.cincinnatichildrens.org/service/j/anderson-center/health-policy/well-being/

Couto, R. A. (2012). *Appalachian health and well-being*. R. L. Ludke, & P. J. Obermiller (Eds.). University Press of Kentucky.

Cutler, D. M., & Lleras-Muney, A. (2006). *Education and health: evaluating theories and evidence* (No. w12352). National Bureau of Economic Research.

Gessert, C., Waring, S., Bailey-Davis, L., Conway, P., Roberts, M., & VanWormer, J. (2015). Rural definition of health: a systematic literature review. *BMC public health*, *15*(1), 1.

Hutson, S. P., Dorgan, K. A., Phillips, A. N., & Behringer, B. (2007, November). The mountains hold things in: the use of community research review work groups to address cancer disparities in Appalachia. In *Oncology nursing forum* (Vol. 34, No. 6, p. 1133). ONCOLOGY NURSING SOCIETY.

Poverty Rates in Appalachia, 2009-2013 - Appalachian Regional Commission. (2014).

Retrieved February 20, 2016, from http://www.arc.gov/research/MapsofAppalachia.asp?MAP_ID=114

Puhl, R. M., & Heuer, C. A. (2010). Obesity stigma: important considerations for public health. *American journal of public health*, *100*(6), 1019-1028.

Welch, W. (Ed.). (2014). *Public health in Appalachia: Essays from the clinic and the field* (Vol. 35). McFarland.

Welch, W. (2011). Self control, fatalism, and health in Appalachia. *Journal of Appalachian Studies*, 108-122.

Zhang, Z., Infante, A., Meit, M., English, N., Dunn, M., & Bowers, K. (2008). An analysis of mental health and substance abuse disparities & access to treatment services in the appalachian region. *Final report. Washington: Appalachian Regional Commission*.

ADHD in Appalachia and Tennessee

Cases of ADHD in the southern and Appalachian regions of the United States are rampant. The Appalachian region has high percentages of children diagnosed with ADHD between the ages of 4-17. Out of the 12 Appalachian states 7 had 13.1% or more parents report their child had been diagnosed with ADHD. The other 5 states had 11.1%-13.0% of parents report a child with an ADHD diagnosis (Figure 1). The percentage of youth taking medication for ADHD is also high in the Appalachian region as a whole. Four of the 12 states have 5.1%-7.0% of youth taking ADHD medications, and another 4 states have 7.1-9.0%. Of the 6 states in the US that have a 9.1% or greater youth population on ADHD medications, 2, Kentucky and North Carolina, are Appalachian states (Figure 2). It is clear through this data that the Appalachian region has a high amount of ADHD cases and it is important for further research to understand why it is so prevalent in these areas.

Tennessee has exceptionally high rates of diagnosed and medicated pediatric ADHD patients. According to the National Survey of Children's Health conducted by the CDC in 2011, 15.2% of parents in Tennessee reported that a health care provider had told them their child had ADHD while the average in the U.S. was 11.0% of parents. 11.1% of parents in Tennessee reported their child currently has ADHD compared to an average of 8.8% in the US. The national average for pediatric patients taking medication for ADHD is 6.1%, and the report shows that 8.5% of Tennessee parents stated that their children were on medication for ADHD (State Profile: Tennessee, 2014).

Medications are also dispensed at a high rate in Tennessee, with little to no behavior management in place. In the same survey, when parents were asked if their child had

taken ADHD medication in the past week, nationally 74% of parents reported their child had. 80% of Tennessee parents reported their child had taken ADHD medications in the past week; this placed Tennessee as the 12th highest state out of all states and D.C.. The survey also asked parents if their child had received behavior therapy, such as in class aid, peer counseling, or classroom management therapy, in the past year. Nationally 44% of parents reported their child had received behavior therapy. Only 33% of children in Tennessee had received behavior therapy; this was the lowest average nationally ranking Tennessee 51st out of all states and D.C. for patients receiving behavior therapy. Lastly the survey asked parents if their child had taken medication in the last week *and* received behavior therapy in the last year. The national average was 31%, and Tennessee was once again ranked 51st with an average of 22% (State Profile: ADHD, 2014).

These findings do not focus on the Appalachian region of Tennessee specifically, in which this study aims to focus on, but instead shows the data for the state as a whole. Very little data exists for Appalachian Tennessee health, and even less exists for mental health in Appalachia as a whole. However, this data does show that Tennessee overall has a high amount of ADHD patients and medication treatment. The data shows the importance of implementing more studies into ADHD in the Appalachian Tennessee region to combat this widespread disorder. Further studies should focus on why ADHD is a problem in Tennessee compared to other states and why medications are the preferred treatment method. This research project hopes to understand how factors in the Appalachian region lead to increased diagnosis and medication treatment for ADHD in pediatric patients throughout the region and specifically in the state of Tennessee.

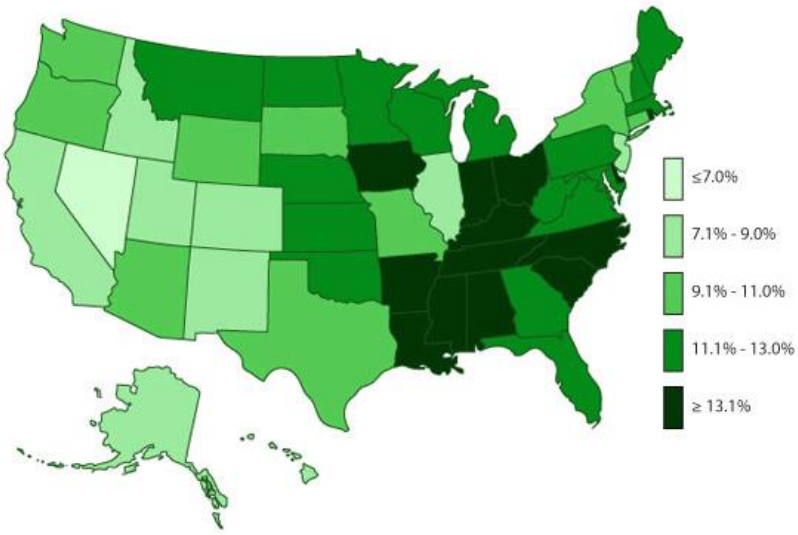

Figure 1. Percent of Youth 4-17 Ever Diagnosed with Attention-Deficit/Hyperactivity Disorder by State: National Survey of Children's Health. Reprinted from Centers for Disease Control and Prevention. Retrieved April 15, 2016, from http://www.cdc.gov/ncbddd/adhd/prevalence.html

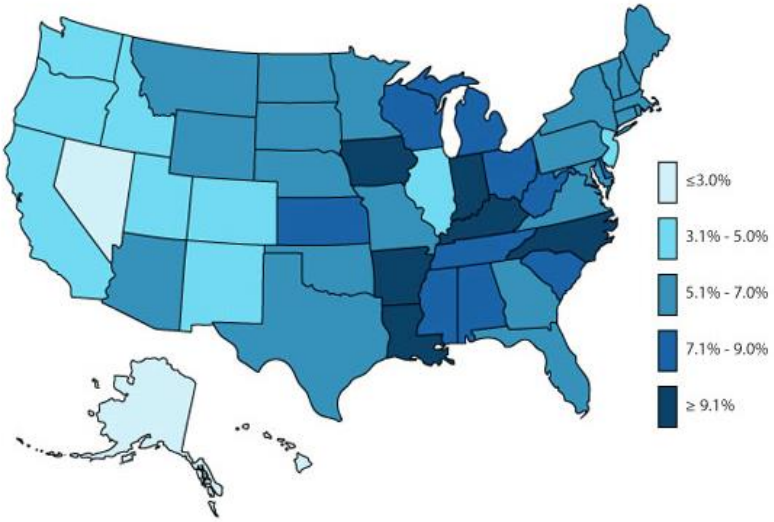

Figure 2. Percent of Youth Aged 4-17 Years Currently Taking Medication for ADHD by State: National Survey of Children's Health. Reprinted from Centers for Disease Control and Prevention. Retrieved April 15, 2016, from, http://www.cdc.gov/ncddd/adhd/medicated.html

References

State Profile: ADHD Treatment in Tennessee. (2014). Retrieved March 20, 2016, from http://www.cdc.gov/ncbddd/adhd/stateprofiles-behavioral/stateprofile-behavioral-tennessee.pdf

State Profile: Tennessee, Parent-Reported Diagnosis of ADHD by a Health Care Provider and Medication Treatment Among Children 4-17 Years: National Survey of Children's Health* – 2003 to 2011. (2014). Retrieved March 20,2016, from http://www.cdc.gov/ncbddd/adhd/stateprofiles/stateprofile_tennessee.pdf

Overview of ADHD

Attention Deficit Hyperactivity Disorder (ADHD) has likely been permeating society since the beginning of time, although it was not until 1998 that the United States recognized it as genuine medical condition (Moghadam, 2006). ADHD, often referred to by its former name Attention Deficit Disorder (ADD), is a complex mental and neurodevelopmental disorder that is often characterized by the inability to focus and avoid distractions appropriate to the age level of the person (Adler, 2015). Impulsiveness is also a common trait in ADHD patients, and this often leads to the inability to control temptations. ADHD was once viewed as a childhood illness, but is now seen as a disorder that can impact all age groups (McGough, 2014). While inattentiveness in a specific environment, such as church, school, or home, is a common element of childhood, children diagnosed with ADHD usually have difficulty with attentiveness in all environments (Moghadam, 2006). In recent years, focus on ADHD has increased and led to the development of a more accurate working definition. Medical professionals now recognize ADHD as a developmental disorder of the brain, instead of a strictly behavioral disorder (Brown, 2013).

As stated, ADHD is a severely complex disorder. No two patients exhibit the same complications and issues, and currently medical professionals are recognizing the importance of individuality in this condition. There are three forms of ADHD, inattentiveness, hyperactivity, and a combinational form. Patients can exhibit inattentive behavior with no hyperactivity, and others will exhibit hyperactivity but will still have the ability to focus on assignments they are interested in. ADHD patients with a combination

of the first two forms will have an exceptionally difficult time focusing and managing restless behavior (Hinshaw, 2016).

Patients with ADHD suffer with two types of cognitive impairments: working memory and executive functions. Working memory is simply the ability to remember and act on several components at once. The ability to turn on the sink and remember why it was turned on is a fine example of working memory and how an individual might use it to complete simple daily tasks. The individuality of ADHD is mostly represented by the executive function impairment in the patient. Executive functions are the functions of the brain that plan, prioritize, strategize, and act. Lack of these functions may be why ADHD children arrive late to appointments, cannot keep track of assignments, and have social difficulty (Hinshaw, 2016). Lack of executive functions is not a lack of intelligence, but it does have everything to do with independence and self-care for ADHD patients. Executive functions may be impaired throughout a person's life through head trauma accidents or Alzheimer's, but ADHD patients have a developmental disorder of executive functions, meaning they simply never form. Some executive functions do develop and others do not, and that is why ADHD patients are so strikingly different and why treatment must start to cater to the individual's needs and interests (Lezak, 2004).

Causes of ADHD

The cause of ADHD has been debated since the illness was discovered. Over time the medical and scientific community has determined that the cause of ADHD is biological, however, social and environmental factors may fuel negative or positive effects of ADHD. The basic cause of ADHD comes down to a small neurotransmitter called dopamine. Dopamine travels across synapses in the brain, allowing the brain to

decipher messages to produce functions. Too much dopamine can cause a manic state while too little can paralyze a person. Patients with ADHD either make too much of it or do not have enough receptors to use it efficiently. Norepinephrine is another neurotransmitter that is responsible for causing the impulsivity issues in patients with ADHD, however, dopamine is the more largely studied neurotransmitter (Hinshaw, 2016).

While the above is the basic physiological cause of ADHD, many still wonder why this occurs. This section of the introduction aims to discuss the biological causes and the social and environmental risks that may impact a patient with ADHD in a negative or positive manner.

Genetics

Twenty to thirty percent of children diagnosed with ADHD have at least one other affected family member (McGough, 2014). There is no specific gene that is related to the inheritance of ADHD, but there may be as many as 50-100 alleles involved in influencing how the brain reads signals (Hinshaw, 2016). One of the most studied alleles is the DRD4-7 allele, which may cause the brain to develop fewer dopamine receptors. Dopamine is a neurotransmitter that causes excitement and stimulation. The lack of dopamine receptors causes the brain to feel tired and boredom to ensue, and in response the patient's body begins to act fidgety and hyperactive to escape the lack of stimulation (Faraone, 2005).

While genetics may play a heavy role in the development of ADHD, there are several other factors that may influence how the patient responds to the condition.

Prenatal and Perinatal Factors

While genetics and biology are the ultimate contributors to ADHD, other environmental and social factors are studied to see how they contribute. Prenatal refers to the time period of a fetus between conception and before birth, or during pregnancy. Perinatal refers to the time period a few weeks before birth, during birth, and a few weeks after birth. During the prenatal and perinatal time frame there are a number of events that may occur to increase ADHD-like symptoms (McGough, 2014).

Prenatal conditions including maternal cigarette consumption, lead, pesticides, and maternal alcohol abuse and dependence may aggravate ADHD symptoms (Brown, 2013). These conditions in prenatal and perinatal terms can have an effect on the already sensitive brain conditions of an ADHD patient (Hinshaw, 2016). Children with mothers that abused alcohol during pregnancy are twice as likely to develop ADHD, and children with mothers who are dependent on alcohol during pregnancy are three times as likely to develop ADHD like symptoms (Banerjee, 2007). It is important to note that many of the mothers in this study also had ADHD, so it is hard to tell whether the environment or genetics increased the risk of childhood ADHD development; many studies are trying to study which of the factors are playing a higher role (McGough, 2014).

Perinatal conditions such as toxemia, eclampsia, maternal age and health, and duration of labor may also play a role in increased ADHD risk (Brown, 2013). Halmoy, et al (2012) studied a population of adults with ADHD and proved that low birth weight and preterm birth increased the risk of ADHD and the lack of executive functions. Perinatal conditions are often associated with increased developmental disorders and that is why ADHD may appear more common in these births as it is a developmental disorder.

Psychosocial Risks

Psychosocial refers to the interaction between social factors and thought and behavior. A famous study by Rutter, et al. (1975) stated that there are six factors that are associated with increased risk of psychiatric disabilities with pediatric patients: marital discord, low social status, large family size, paternal criminality, maternal mental disorder, and foster placement. It is important to emphasize that social factors *do not* cause ADHD, however, they play a role in how severe the condition becomes and how well the patient develops (McGough, 2014). Typically, the presence of one of these factors will not increase the severity of the condition, but the accumulation of two or more factors usually results in an increased negative effect on the pediatric ADHD patient (Rutter, 1975).

"Authoritative parenting" is a combination of firm consequences, warmth, independence, and guidance. ADHD patients that are under this kind of parenting thrive the best. Children that live in the above mentioned conditions are often not in a environment where authoritative parenting is practiced, and that is why the conditions listed in Rutter et al. (1975) are the most common for negative impacts in ADHD children. Parents that are arguing with the child or others, are not active in the child's life, and are not focused on the needs of the condition are more likely to lead to the increase of the child's symptoms (Hinshaw, 2016). While social status is not a cause of ADHD, it is definitely a strong indicator of the success the patient will have in combating the disability.

Environmental Risks

Environmental factors that may contribute to ADHD are very broad. Some of the most controversial factors include lead in water, academic settings, and diet.

Lead in water has often been associated with ADHD symptoms, however not all patients with ADHD have been exposed to lead and only a small amount of patients that have been exposed to lead have ADHD. Patients that have been exposed to lead usually have other risk factors associated with ADHD including low socio-economic status, low paternal education levels, and poverty. Studies are continuing in this area (Nigg, J.T, 2010).

Many people promote the belief that diet has an effect on causing or and promoting symptoms of ADHD. There have been many studies revolving around sugar intake and ADHD, and none have concluded any significant correlation between the two (Bader, 2012). Caffeine is another food component that may increase the attention in ADHD patients; there are no negligible effects (Leon, 2000). The only component in foods that has been proven to have an effect on ADHD patients is food coloring, especially Yellow No. 5. However, it has not been proven if specific characteristics and genotypes in a person are necessary for food coloring to have an effect on (Nigg, 2012). The studies involved in diet and ADHD have only been conducted with small samples in certain areas; further testing is necessary to confirm a precise conclusion.

Gene-Environmental Interactions and Risks

Gene-environmental interactions are offered by an integrated viewpoint that has emerged with hopes to portray how the environment has an effect on increasing the symptoms of ADHD that are caused by biology. In this perspective biology causes

ADHD and the environment fuels or depresses the disorder (Nigg, J., 2010). Some proponents of this interaction believe that adversity in the environment triggers the genes in a patient to firmly express ADHD characteristics (McGough, 2014).

Several studies discuss how food additives, such as colors, may only increase risk for patients that have or do no have certain genes. Similarly, studies have shown that maternal smoking only increases ADHD risk when certain alleles are present (Farone, 2010). These are just a few examples of how the environment-gene model works in application with ADHD patients.

Diagnosis and Assessment of ADHD in Children

ADHD is a clinically diagnosed disorder. The diagnostic criteria for ADHD is out in detail in the *Diagnostic and Statistical Manual for Mental Disorders* (fifth edition, DSM-5). The DSM-5 is the appropriate guide that physicians should consult during diagnosis of a mental disorder such as ADHD.The DSM-5 focuses on diagnosis through evaluation and assessment of the age appropriateness of inattention, hyperactivity, and impulsivity (McGough, 2014).

The DSM-II viewed ADHD as a hyperkinetic disorder that usually vanished by adolescence. The DSM-III was the first DSM to list a set of symptoms as a guideline broken up into hyperactivity, inattention, and impulsivity; in order to be diagnosed with ADHD a child must have had three of five inattention symptoms, three of six impulsive symptoms, and two of six hyperactive symptoms (McGough, 2014). The DMS-IV introduced 18 symptoms, 9 inattentive and 9 hyperactive/inattentive.

The DSM-5 is the current manual that physicians use to diagnose a patient with ADHD. There have been several changes to the DSM-5 from the DSM-IV. First of all,

ADHD is no longer listed as a disruptive behavioral disorder, showing the changing view of the disorder. While the DSM-IV states that symptoms must show by age seven, the DSM-5 states that the symptoms may show as late as age twelve. Other changes of note includes wording to promote the fluidity of the disorder, changes in subtypes of ADHD, and impairment is no longer a necessity for diagnosis (Adler, 2015).

The DSM-5 retains the 18 symptoms in the DSM-IV (Table 1). According to the DSM-5, a patient must exhibit 6 of the 9 symptoms for inattention (Table 1) and/or 6 of the 9 symptoms for hyperactivity-impulsivity (Table 2) for pediatric patients 16 and under, and 5 of the 9 for one or both groups if 17 and older (McGough, 2014). In addition to the symptom conditions, the condition must have an onset before age 12, the symptoms must be present in two or more settings, the symptoms must have a clear impact on the function of the individual, and the symptoms must not be better explained by another mental disorder (Adler, 2015).

A child is usually assessed by a medical professional if ADHD is suspected. Usually children exhibit symptoms during preschool or early grade school. Often teachers are the first ones to notice ADHD- like symptoms and recommend treatment be sought. If children do not exhibit ADHD signs and symptoms by elementary, they should by middle school due to the increase in workload and their inability to focus on the tasks in class. Most often, parents take their children to pediatricians to be diagnosed, most of which are not trained in mental illness and are quick to prescribe prescription drugs before behavior therapy (Hinshaw, 2016).

A critical part in diagnosing pediatric ADHD patients is the involvement of all or most systems the child is involved in. Usually the child, parent(s), teacher(s), and other

third parties such as coaches are involved in providing information to the medical professional assigned to the case, allowing the doctor to make an informed decision. Before an assessment is scheduled the doctor usually sends out questionnaires, in the form of rating scales, for everyone to rate the performance of the child for specific tasks (McGough, 2014). These questions will provide the best insight for the physician to make a correct diagnosis, however it is important that he take care if the questionnaires differ in opinion. Parents, teachers, and other parties may have bias;for example, a teacher may prefer ADHD medications for a child, simply to improve classroom grades (Nass, 2005).

On the day of the assessment a medical professional meets with the child and usually the parents. The sad truth is that most of these visits last 10-15 minutes, where the physician analyzes the data, makes a diagnosis, and then prescribes medication or other treatment. The assessments from third parties are collected and the physician takes time to interview the parents and the child more thoroughly according to the DSM-5 guidelines. Sometimes doctors have computerized or physical behavioral tests in place to observe the actions of the child. A medical assessment is done in this visit as well, even if a non-medical professional is conducting the diagnosis. A basic health physical is conducted, family information is collected, and previous medical history is taken as well. These procedures are set in place due to the high risk of cardiovascular issues and risks that arise when a pediatric patient is placed on stimulant medications for ADHD (McGough, 2014).

Planning of treatment

Treatment plans for ADHD patients are specific and focus on the individual needs of the patients. The optimal treatment for pediatric ADHD patients is a combination of medications behavior and family therapy and counseling, and classroom management.

ADHD medications were originally introduced for use only when behavior management fails or needs a supplement (Moghadam, 2006). The famous Multimodal Treatment Study of ADHD (MTA) proved that medications lessened symptoms of ADHD but did not improve functionality quality of the patient like behavior therapy and counseling did (Murphy,2005). The emphasis of this paper is to focus on prescription medication use in the Appalachian region as it pertains to ADHD patients, however a discussion of alternative therapies is necessary to understanding all of the therapy options that can be utilized in addition to medications in the Appalachian area.

When a doctor is deciding the correct treatment plan for a ADHD child, the severity of the case and the individual needs of the patient are deciding factors. Treatment of ADHD is a very personal plan and no two patients are the same. Most experts agree that pharmacotherapy should only be considered in cases where behavior therapy cannot be the only source of treatment. However, most patients are placed on medications of some kind. The type of medication selected should be based on severity, age, comorbidities, and reception of medication. It is common for medication to be a go to source of treatment, however no physician should ever believe that medication treatment should be the only source of treatment in pediatric patients (McGough, 2014). All patients and guardians should be in constant contact with a physician and school personnel to monitor treatment and behavior no matter the treatment plan.

Family focused interventions include parent and child therapy counseling sessions. These sessions aim to eliminate barriers to effective parenting. This type of counseling is beneficial to those that are facing stressors in the family home. These sessions are organized into 1-2 sessions for an hour or two a week, and they can be in multiple

settings, individually or in groups. The counselor focuses on teaching the parents how to care for a child with ADHD, and emphasis is placed on relationships, structure, consistency, and health (Forehand, 2013). A more specific type of family intervention is called parent child interaction training (PCIT). This type of counseling focuses on teaching parents with younger ADHD patients how to build lasting relationships early on in the child's life (Charach, 2013).

Another method of behavior therapy for ADHD patients is school-focused interventions. Management of ADHD should be carried over into the classroom through proper classroom placement. The Federal Rehabilitation Act of 1973 states in section 504 that students with mental or physical limitations can receive modifications in the classroom such as preferred seating and extended times on tests to accommodate for the disability (Semrud-Clikeman, 2011). Usually 504 modifications are only given to severe ADHD patients, as a diagnosis alone is not sufficient to gain 504 plans until extensive counseling is completed and the school approves. Most ADHD students can gain behavioral classroom management, which is similar to the home intervention in style and content. This type of management depends on the cooperation of the teacher. Most plans utilize daily report cards and appropriate consequences and limitations in the child's daily routine (Pelham, 2008).

1	Often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or with other activities.
2	Often has trouble holding attention on tasks or play activities.
3	Often does not seem to listen when spoken to directly
4	Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g., loses focus, side-tracked).
5	Often has trouble organizing tasks and activities.
6	Often avoids, dislikes, or is reluctant to do tasks that require mental effort over a long period of time (such as schoolwork or homework).
7	Often loses things necessary for tasks and activities (e.g. school materials, pencils, books, tools, wallets, keys, paperwork, eyeglasses, mobile telephones).
8	Is often easily distracted
9	Is often forgetful in daily activities.

Table 1. Inattentive Symptoms of ADHD described in the DSM-5 for diagnostic purposes

Note. Adapted from *ADHD*, p. 29, by J. McGough, 2014, Oxford American psychiatry library.

1	Often fidgets with or taps hands or feet, or squirms in seat.
2	Often leaves seat in situations when remaining seated is expected.
3	Often runs about or climbs in situations where it is not appropriate (adolescents or adults may be limited to feeling restless).
4	Often unable to play or take part in leisure activities quietly.
5	Is often "on the go" acting as if "driven by a motor"
6	Often talks excessively.
7	Often blurts out an answer before a question has been completed
8	Often has trouble waiting his/her turn.
9	Often interrupts or intrudes on others (e.g., butts into conversations or games)

Table 2. Hyperactive/impulsive behavior Symptoms of ADHD described in the DSM-5 for diagnostic purposes

Note. Adapted from *ADHD*, p. 29, by J. McGough, 2014, Oxford American psychiatry library.

References

Adler, L., Spencer, Thomas J., & Wilens, Timothy E. (2015). *Attention-deficit hyperactivity disorder in adults and children* (Cambridge medicine (Series)).

Bader, A., & Adesman, A. (2012). Complementary and alternative therapies for children and adolescents with ADHD. *Current opinion in pediatrics, 24*(6), 760-769.

Banerjee, T., Middleton, F., & Faraone, S. (2007). Environmental risk factors for attention‐deficit hyperactivity disorder. *Acta Pædiatrica*, *96*(9), 1269-1274.

Brown, T. (2013). *A new understanding of ADHD in children and adults : Executive function impairments*.

Charach, A., Carson, P., Fox, S., Ali, M. U., Beckett, J., & Lim, C. G. (2013). Interventions for preschool children at high risk for ADHD: a comparative effectiveness review. *Pediatrics*, peds-2012.

Faraone, Stephen V., Perlis, Roy H., Doyle, Alysa E., Smoller, Jordan W., Goralnick, Jennifer J., Holmgren, Meredith A., & Sklar, Pamela. (2005). Molecular Genetics of Attention-Deficit/Hyperactivity Disorder. *Biological Psychiatry*, *57*(11), 1313-1323.

Faraone, S. V., & Mick, E. (2010). Molecular genetics of attention deficit hyperactivity disorder. *Psychiatric Clinics of North America*, *33*(1), 159-180.

Forehand, R., Jones, D. J., & Parent, J. (2013). Behavioral parenting interventions for child disruptive behaviors and anxiety: What's different and what's the same. *Clinical Psychology Review*, *33*(1), 133-145.

Halmøy, A., Klungsøyr, K., Skjærven, R., & Haavik, J. (2012). Pre-and perinatal risk factors in adults with attention-deficit/hyperactivity disorder. *Biological psychiatry*, *71*(5), 474-481.

Hinshaw, S., & Ellison, Katherine. (2015). *ADHD: What Everyone Needs to Know (* (What Everyone Needs to Know). New York: Oxford University Press.

Leon, M. R. (2000). Effects of caffeine on cognitive, psychomotor, and affective performance of children with attention-deficit/hyperactivity disorder. *Journal of Attention Disorders*, *4*(1), 27-47.

Lezak, M. D. (2004). *Neuropsychological assessment*. Oxford University Press, USA.

Matza, L. S., Paramore, C., & Prasad, M. (2005). A review of the economic burden of ADHD. *Cost effectiveness and resource allocation*, *3*(1), 1.

McGough, J. (2014). *ADHD* (Oxford American psychiatry library).

Moghadam, H. (2006). *Attention deficit-hyperactivity disorder*. Calgary, Alberta: Detselig Enterprises.

Murphy, K. (2005). Psychosocial treatments for ADHD in teens and adults: A practice‐friendly review. *Journal of clinical psychology*, *61*(5), 607-619.

Nass, R. (2005). Evaluation and Assessment Issues in the Diagnosis of Attention Deficit Hyperactivity Disorder. *Seminars in Pediatric Neurology*, *12*(4), 200-216.

Nigg, J. Nikolas, M., & Burt, S. A. (2010). Measured gene-by-environment interaction in relation to Attention-Deficit/Hyperactivity Disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, 49(9), 836-873.

Nigg, J. T., Nikolas, M., Mark Knottnerus, G., Cavanagh, K., & Friderici, K. (2010). Confirmation and extension of association of blood lead with attention‐deficit/hyperactivity disorder (ADHD) and ADHD symptom domains at population‐typical exposure levels. *Journal of Child Psychology and Psychiatry*, *51*(1), 58-65.

Pelham Jr, W. E., & Fabiano, G. A. (2008). Evidence-based psychosocial treatments for attention-deficit/hyperactivity disorder. *Journal of Clinical Child & Adolescent Psychology*, *37*(1), 184-214.

Rutter, Cox, Tupling, Berger, & Yule. (1975). Attainment and adjustment in two geographical areas. I--The prevalence of psychiatric disorder. *The British Journal of Psychiatry : The Journal of Mental Science*, *126*, 493-509.

Semrud-Clikeman, M., & Bledsoe, J. (2011). Updates on attention-deficit/hyperactivity disorder and learning disorders. *Current psychiatry reports*, *13*(5), 364-373.

Overview of ADHD Medications in Pediatric Patients

Stimulant Medications

Psychostimulant medications are the most effective type of medication prescribed to ADHD patients (Adler, 2015). In fact, 70% of ADHD patients taking stimulants, respond and prefer stimulant medication to other forms of ADHD treatment (McGough, 2014). Psychostimulants are psychopharmacological agents used to enhance behavioral and cognitive functions by stimulating the central nervous system (CNS). Most stimulants are called "amphetamine-like agents" because they are similar to dopamine and noradrenaline, two neurotransmitters that contain amine groups (Gerlach, 2014). While there are several types of stimulant medications available, there are two main classifications of stimulants in ADHD treatment; methylphenidates and amphetamines.

In order to understand the physiological mechanism behind psychostimulants, one must understand basic nervous system anatomy and physiology. The central nervous system is composed of the brain and the spinal cord. The brain and the spinal cord are made of neurons, or nerve cells. A neuron has a cell body, which contains mostly cytoplasm and neurotransmitters, an axon, which is an elongated area of the cell which transports signals to and from the neuron cell body, and dendrites, which serve to sense the environment and tell the cell body to produce a signal along the axon to other neurons. An electrical signal is transported along the axons of neurons to the brain where the signal leads to a response. Signals are passed from neuron to neuron through a structure called a synapse. Most synapse structures are formed where the end of one neuron's axon and the dendrites of another neuron meet. Chemical messengers, called neurotransmitters, are released into the synapse by the pre-synaptic neuron and received by the post-synaptic neuron allowing the signal to continue. There are several types of

neurotransmitters, but some commonly known ones include dopamine, norepinephrine, and epinephrine.

There are several adverse effects that may occur with the use of stimulant medication. The most common effect is loss of appetite, but other effects include dizziness, nausea, dry mouth, tics, and cardiovascular issues (McGough, 2014). The use of stimulant medication neither increases nor decreases the likelihood of abuse (Wilens, 2003). Stimulants are most likely to be abused by college students to increase cognitive abilities, not pleasure; 5% of college students have reported abuse of stimulants (McCabe, 2005).

Methylphenidates

Methylphenidates(MPH) were first produced in 1944 as a lethargy and depression drug. Currently they are one of the most common drugs prescribed for ADHD patients (Barceloux, 2012). MPHs are psychostimulants and act upon the central nervous system to increase activity in the prefrontal cortex of the brain, which is associated with regulating attention, behavior, and cognition. There is one main mechanism of action associated with MPHs. In the neurological synapse of neurons in the brain, there are transporters that release and take up neurotransmitters from the synapse. One of these transporters is the dopamine transporter (DAT), a transporter that reuptakes dopamine from the synapse into the cytosol of the neuron. When MPHs enter the synapse, they compete with dopamine for binding onto DATs. This creates competition and because MPHs have a higher affinity to the DATs, dopamine reuptake is inhibited. This creates a high concentration of dopamine in the synaptic cleft. The increase of dopamine in the synapse creates an increase in dopaminergic neurotransmission increasing the activity in

the prefrontal cortex of the brain (Barceloux, 2012). This, in turn, promotes increased focus and good behavior in ADHD patients.

Methylphenidates are prescribed as tablets, chewable tablets, and oral solutions. Most commonly MPHs are prescribed as immediate effect dosages, meaning the effects will be seen at greatest capacity within 3-5 hours. There are extended release (ER) MPHs as well, that can provide a lasting effect for 10-12 hours after taken. In addition to common tablets, there are beaded preparations that allow a parent to sprinkle the beads over a child's food for ingestion (Adler, 2015). The FDA recommends a maximum dose of 60 mg/day for immediate release forms and 72 mg/day for ER forms. First time patients usually begin on a low dosage of 2.5mg to 5mg and then brought up to a target dose of 0.6 to 2 mg/kg. For pediatric patients it is recommended that medication only be taken once daily, usually in the morning, but this can vary based on social and academic needs (Pliszka, 2007). Pediatric patients must also be evaluated frequently for dosage changes. Many times children are placed on more abrasive medications, when the issue is they have outgrown the recommended dosage for their weight. Methylphenidates have a low tolerance and often require a high dosage adjustment (Wilens, 2005). There are several MPH brand name drugs available including Ritalin, Concerta, Metadate ER, Methylin, and Daytrana. The only differences amongst these are the names, dosage, and release mechanisms (Adler, 2015).

Amphetamines

Amphetamines (AMPHs) have been around for hundreds of years. It was not until the 20th Century that amphetamines became commercially available and popularity spread. In 1929 biochemist Gordon Alles developed a formula for amphetamine. He

utilized his formula to develop a Benzedrine Inhaler for congestion. The inhaler was widely popular, but in 1959 the FDA required a prescription for sale due to mounting abuse (Adamec, 2011). Amphetamines are widely popular drugs for treating symptoms of ADHD. The chemical structure of AMPHs varies, which is why there are several variants. AMPHs have a general chemical structure of a phenethylamine core with methyl groups in the alpha position. Substitutions of the groups on the phenyl core is what creates many types of AMPHs, and often there is a mixture of AMPHs in an ADHD medication (Rincon, 2012) AMPHs are a group of psychostimulants that act on the central nervous system. They increase the amount of dopamine, norepinephrine, and serotonin in the brain. They have a similar mechanism of action to MPHs and act by inhibiting monoamine transporters such as DAT, serotonin transporters, and norepinephrine transporters. (Rincon, 2012)

Amphetamines are prescribed in tablet and capsule forms. They are considered a Schedule II drug due to the high risk of abuse and addiction. The absorption of AMPHs is usually rapid with a peak plasma level usually seen three hours after the medication is taken (Patrick). There are forms of AMPHs in ER form prolonging the effects of the medications and creating a peak blood plasma concentration after seven hours after taking the medication (Millichap, 2011). However, it is not recommended to prescribe ER and long lasting AMPHs to children under the age of six (Gerlach, 2014). For first time patients, a low dose of 2.5mg to 5mg is started and then brought up to 0.3 to 1 mg/kg a day. As stated above with MPHs, a single daily dose is recommended, but multiple doses can be administered up to 40mg a day. There are several AMPH brand name drugs available including Adderall and Adderall XR (mixed amphetamines and

dextroamphetamines), Dexedrine and Spansule (D-amphetamines), Vyvanse (Lisdexamphetamine dimesylate), and Desoxyn (D-methamphetamine).

Non-Stimulant Medications

Non-stimulant medications are prescribed to pediatric ADHD patients as a second or third line drug. If stimulants appear to produce comorbidities, if a risk of abuse is present, or if a response is not seen, non-stimulant medications may be used as a monotherapy or combined with stimulants to produce a more refined response (Adler, 2015). While non-stimulants are generally not as effective, many patients do report increased attention spans. There are two main types of non-stimulant medications that are prescribed to pediatric ADHD patients, norepinephrine reuptake inhibitors and alpha-2 agonists.

Norepinephrine Reuptake Inhibitors

Norepinephrine reuptake inhibitors (NRIs) are a class of drugs that act on the norepinephrine transporter in the prefrontal cortex of the brain. NRIs are second line drugs in the treatment of ADHD. They are prescribed when the patient experiences comorbid tics and, or abuse. NRIs prevent the reuptake of NE into the synapse, thus increasing the concentration in the synaptic cleft allowing for more connections and increased focus and behavior (Gerlach, 2014). While MPHs bind better to DATs, NRIs do not affect the dopaminergic pathway. Because there is not much dopamine present, the potential for abuse is low since high dopamine levels trigger the reward system of the brain promoting abuse (Gozal, 2005).

Norepinephrine reuptake inhibitors are prescribed in tablet and capsule forms mainly. They are not considered a Schedule II drug since the potential for abuse is low.

The absorption of NRIs is rapid with a peak plasma concentration level occurring 1-2 hours after taking the medications. The dosage is weight dependent. Most pediatric patients start at a dose of 0.5mg/kg/ day for the first week, and then work up to the target dose of 1.2mg/kg/day (Adler, 2015). It is recommended to give the medication with food to offset nausea, if necessary. Also, if drowsiness occurs, it is suggested to give the medication at night (Gerlach, 2014). One of the most popular NRIs is Strattera, or generic Atomoxetine (ATMX). Strattera is available in capsules of 10,18, 25,40, 60, and 100 mg (Adler, 2015).

Overall, NRIs are slightly less effective than MPH (Newcorn, 2008), and are significantly less effective than AMPHs (Wigal, 2005). NRIs should still be considered a first line drug for patients who suffer from adverse effects of stimulants(Wigal, 2005). Improvement is generally seen starting around 4 weeks after NRIs are started in a patient, with the full effects displayed in 6-8 weeks. There are several potential adverse effects such as insomnia, irritability, mood swings, and suicidal thoughts (Adler, 2015).

Alpha-2 Agonists

Alpha-2 agonists are the second main type of non-stimulant medication used to combat ADHD. Like NRIs, alpha-2 agonists are considered a second line drug for normal ADHD patients, but a first line drug for ADHD patients that experience abuse and comorbid tics. Alpha-2 agonists were originally developed as antihypertensive medications, and thus are given to patients that may have high blood pressure as well (Millichap, 2011).

An adrenergic alpha- agonist is an agent that stimulates the alpha adrenergic receptors. Adrenergic receptors are receptors that receive signals from neurotransmitters

such as norepinephrine and epinephrine, and then signal to produce a response. The binding of norepinephrine or epinephrine will usually trigger a flight-or-fight response. There are two subtypes of adrenergic receptors, alpha and beta. The alpha subtype is broken down into two more types, alpha-1 and alpha-2. While alpha-1 receptors are found in smooth tissue, alpha-2 receptors are mostly found in the pancreas and neurological synapses. Alpha-2 receptors, when stimulated with norepinephrine and epinephrine, will inhibit the release of more norepinephrine and epinephrine through a mechanism called feedback inhibition(Sinclair, 2003). Alpha-2 agonists mimic the actions of norepinephrine and epinephrine and fool the body into thinking the levels are actually higher than they really are. The body then decreases the amount of norepinephrine and epinephrine released into synapses, thus creating the sedative effects that alpha-2 agonists are associated with (Bidwell, 2010). It might seem strange that a sedative effect would improve ADHD symptoms for a patient. The exact mechanism in which alpha-2 agonists aid ADHD patients is not fully understood, but it is believed that low levels of norepinephrine and epinephrine caused by the agonists have a calming and sedative effect on patients, providing them with improved focus and less hyperactivity (Banaschewski, 2004).

One type of alpha-2 agonist is clonidine. Clonidine is manufactured in two main forms, immediate release (CIR) and extended release (CXR). The immediate release form only has an effect for three to six hours, while the extended release form is released over a twelve hour period. The extended release form of clonidine has been proven to lessen the possibility of adverse effects. CIR is made in 0.1, 0.2, and 0.3mg tablets and CXR is made in 0.1 or 0.2mg tablets (Adler,2015). Pediatric patients are most often prescribed

CXR, as the CIR is associated with adverse effects such as dry mouth and increased sedation. Patients are started on a smaller dose of 0.1mg/day at bedtime, and then brought up to a target dosage around 0.2mg/ day (Gerlach, 2014). Improvement for patients utilizing this drug is usually seen two weeks after the medication is begun (Jain, 2011). Clonidine has been proven as an effective drug in several studies (Jain, 2011) and is also proven to be effective as an adjunctive treatment with stimulant medications (Kollins, 2011). There are several adverse effects that may occur when taking this medication. Increased fatigue and sedation, headaches, dizziness, dehydration, dry mouth, and blood pressure oscillations are just a few of the risks (Adler, 2015). Patients should not stop taking clonidine abruptly due to the possibility of blood pressure elevation, headaches and tics. If a patient needs to stop taking clonidine, a gradual weaning over 4-7 days should occur (Millichap, 2011).

Another alpha-2 agonist used to treat ADHD is guanfacine. The main difference between guanfacine and clonidine is that guanfacine is more specific for alpha-2A receptor subtype (Gerlach, 2014). Guanfacine is also less potent than clonidine, however this is accounted for in the dosage (Adler, 2015). Guanfacine is also manufactured in immediate and extended release forms, and the two are not interchangeable. GIR is made in 1 and 2mg tablets and GXR is made in 1,2,3, and 4 mg tablets. Pediatric patients are usually given GXR and are started on a dose of 1mg/day. This is increased gradually up to 4mg/ day (Gerlach, 2014). Improvement is usually seen in patients between two and four weeks after treatment is started (Jain, 2011). Guanfacine is generally effective in treating hypertensive pediatric patients, although it is still significantly less effective than MPHs. It is also proven to be more effective for some patients when guanfacine is used in

conjunction with MPHs (Spencer, 2009). The adverse effects are similar to clonidine, and include cardiovascular problems, dry mouth, dizziness, and sedation, although dry mouth and sedation are usually less likely with guanfacine. Just like clonidine, guanfacine should not be suddenly discontinued, as withdrawal and cardiovascular complications may arise (Gerlach, 2014).

References

Adamec, C., & Triggle, David J. (2011). *Amphetamines and Methamphetamine*

(Understanding Drugs). New York: Infobase Publishing.

Adler, L., Spencer, Thomas J., & Wilens, Timothy E. (2015). *Attention-deficit hyperactivity disorder in adults and children* (Cambridge medicine (Series)).

Banaschewski, T., Roessner, V., Dittmann, R., Santosh, P., & Rothenberger, A. (2004). Non-stimulant medications in the treatment of ADHD. *European Child & Adolescent Psychiatry, 13 Suppl 1*, I102-16.

Barceloux, D. (2012). Methylphenidate. In *Medical Toxicology of Drug Abuse* (pp. 57-68). Hoboken, NJ, USA: John Wiley & Sons.

Bidwell, L. C., Dew, R. E., & Kollins, S. H. (2010). Alpha-2 Adrenergic Receptors and Attention—Deficit/Hyperactivity Disorder. *Current Psychiatry Reports, 12*(5), 366–373. http://doi.org/10.1007/s11920-010-0136-4

Gerlach, M., Warnke, Andreas, Greenhill, Laurence, & SpringerLink. (2014). *Psychiatric Drugs in Children and Adolescents : Basic Pharmacology and Practical Applications*.

Gozal, David ; Molfese, Dennis. (2005). *Attention Deficit Hyperactivity Disorder* (Contemporary Clinical Neuroscience). Totowa, NJ: Humana Press.

Jain, R., Segal, S., Kollins, S. H., & Khayrallah, M. (2011). Clonidine extended-release tablets for pediatric patients with attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child & Adolescent Psychiatry, 50*(2), 171-179.

Kollins, S. H., Jain, R., Brams, M., Segal, S., Findling, R. L., Wigal, S. B., & Khayrallah, M. (2011). Clonidine extended-release tablets as add-on therapy to psychostimulants in children and adolescents with ADHD. *Pediatrics*, peds-2010.

McCabe, S. E., Knight, J. R., Teter, C. J., & Wechsler, H. (2005). Non- medical use of prescription stimulants among US college students: Prevalence and correlates from a national survey. *Addiction*, *100*(1), 96-106.

McGough, J. (2014). *ADHD* (Oxford American psychiatry library).

Millichap, J. (2011). *Attention Deficit Hyperactivity Disorder Handbook*. New York, NY: Springer New York.

Newcorn, J. H., Kratochvil, C. J., Allen, A. J., Casat, C. D., Ruff, D. D., Moore, R. J., ... & Atomoxetine/Methylphenidate Comparative Study Group. (2008). Atomoxetine and osmotically released methylphenidate for the treatment of attention deficit hyperactivity disorder: acute comparison and differential response. *American Journal of Psychiatry*.

Pliszka, S., & AACAP Work Group on Quality Issues. (2007). Practice parameter for the assessment and treatment of children and adolescents with attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, *46*(7), 894-921.

Rincón, A., & Ebrary, Inc. (2012). *Amphetamines : Neurobiological mechanisms, pharmacology and effects* (Neuroscience research progress series). New York: Nova Biomedical Books.

Sinclair, M. D. (2003). A review of the physiological effects of α2-agonists related to the clinical use of medetomidine in small animal practice. *The Canadian Veterinary Journal*, *44*(11), 885–897.

Spencer, T. J., Greenbaum, M., Ginsberg, L. D., & Murphy, W. R. (2009). Safety and effectiveness of coadministration of guanfacine extended release and

psychostimulants in children and adolescents with attention-deficit/ disorder. *Journal of child and adolescent psychopharmacology*, *19*(5), 501-510.

Wigal, S. B., McGough, J. J., McCracken, J. T., Biederman, J., Spencer, T. J., Posner, K . L., ... & Zhang, Y. (2005). A Laboratory School Comparison of Mixed Amphetamine Salts Extended Release (Adderall XR®) and Atomoxetine (Strattera®) in school-aged children with attention deficit/hyperactivity disorder. *Journal of Attention Disorders*, *9*(1), 275-289.

Wilens, T. E., Faraone, S. V., Biederman, J., & Gunawardene, S. (2003). Does stimulant therapy of attention-deficit/hyperactivity disorder beget later substance abuse? A meta-analytic review of the literature. *Pediatrics*, *111*(1), 179-185.

Wilens, T., MCBurnett, K., Stein, M., Lerner, M., Spencer, T., & Wolraich, M. (2005). ADHD treatment with once-daily OROS methylphenidate: final results from a long-term open-label study. *Journal of the American Academy of Child & Adolescent Psychiatry*, *44*(10), 1015-1023.

Limitations, Proposed Methods, and Expected Results.

Several limitations occurred that prevented this study from being a complete report. The inability to gain access to de-identified personal health information from a local pharmacy was the main limitation. A lack of response created a situation in which the research could not be completed. The goals of this study will be outlined in detail so that they may be completed at a later time.

First, de-identified PHI for pediatric patients on ADHD medication was to be collected from a local independent pharmacy that had three separate locations in vastly different areas of town. A whole year of PHI would have been requested for all patients from each location that are prescribed any of the stimulant and non-stimulant ADHD medications discussed in prior sections. The PHI would have been de-identified before collection. The PHI ideally would have replaced the patient's name with a number in a manner that the patient could not be re-identified. In addition to the patient's name, address, prescribers, and any additional medical information could not be accessed. The only information included on the PHI would have been the medication name, number of scripts written for that medication, the number of times the medication was received by the patient, and the dates the medication was received. If possible, the birthday of the patient would have been collected so that age of the pediatric patient could be included in data analysis.

As stated, the pharmacies were located in three different areas of town. After PHI collection, analysis of each of the pharmacy locations would have occurred. Several websites are available for this information. The Appalachian Regional Commission has data available for personal income, education, unemployment, and poverty for each county and state in the Appalachian region, including Tennessee and Knox County. In

addition, the Center for Disease Control (CDC) also offers many data sheets specifically for ADHD. These sheets show data for medication and treatment plans for ADHD patients in the state of Tennessee as a whole and by region.

The preferred website for use in this study comes from the Online Analysis and Statistical Information System. This is a website devoted to showing health statistics for specific regions. The Social Impact Mapper is an interactive map that shows socioeconomic status and demographics for neighborhoods. It is designed to be used to highlight health disparities and issues. This interactive map allows users the ability to select certain demographics and ranges and the site will highlight the regions that meet the specifications made by the user. Demographics can be changed so that income, poverty, education, single parent household percentages, age, race, and gender can be shown for a specific range. For example, if a user wants to choose an area with a low income, an income range can be selected and the map will highlight areas that have a low income in the range selected.

These resources would have been used to collect information including race, gender, income level, education levels, and poverty, among others, for the people living in neighborhoods surrounding the three pharmacy locations. Information about schools and health institutions in the area surrounding each pharmacy would have also been collected. This data would have then been compared to the PHI data with the purpose to show any correlations between the demographics of the pharmacy location and the patients at that pharmacy. Because each pharmacy was in a different area of Knoxville, it was expected that each location would have a significant difference in patients and demographics of the

area. Results may have shown that specific demographics correlate to trends in ADHD medication usage and prescriptions.

Several assumptions would have been made with this approach, including one that the patients receiving medication from the pharmacy presumably should live in the area around the pharmacy's location. Also, it assumes that the patient is in a certain socio-economic status based on the location of the pharmacy and the neighborhoods surrounding it. In addition, it assumes that the patients coming to the pharmacies in the study are representative of the whole Knoxville population. Lastly, the study does not take into account any personal reasoning behind receiving medications and alternative therapy the patient may be receiving. These assumptions were made based on the nature of the de-identified PHI. If this study were to be completed in a widespread manner, more than three pharmacies should be included to assure that the entire population of Knoxville is accounted for. Also, approval should be sought for a study that may include more patient information to assure that the patient is associated with correct demographics. Perhaps funding and approval should be gained so that large retail pharmacies that are located in more areas throughout town may be able to participate.

This study hoped to find a correlation between ADHD patients, their medication, and certain demographics such as race, socio-economic status, income level, and education among others. It also aimed to show trends in ADHD medication reception over a typical year so that medications given during time in school and time out of school could be analyzed. The data provided could then be used to create plans for enhancing ADHD patient diagnosis, treatment, and medication therapy management.

References to Proposed Resources in Data Analysis

Data Reports. (2016). Retrieved March 28, 2016, from http://www.arc.gov/data

Population Health Mapper. (2016). Retrieved April 19, 2016, from http://www.oasisdataarchive.org/countypopulationhealth/map.cfm

Social Impact Mapper. (2016). Retrieved April 19, 2016, from http://www.oasisdataarchive.org/sdoh/map.cfm

State-based Prevalence Data of Parent Reported ADHD Diagnosis by a Health Care Provider. (2014). Retrieved April 20, 2016, from http://www.cdc.gov/ncbddd/adhd/prevalence.html

State-based Prevalence Data of Parent Reported ADHD Medication Treatment. (2014). Rerieved April 20, 2016, from http://www.cdc.gov/ncbddd/adhd/medicated.html

Discussion

In the United States 3%-10% of children have been diagnosed with Attention Deficit Hyperactive Disorder (McGough, 2014). Western states have a significantly lower rate of ADHD diagnoses than southern and Midwest states. Many southern states have rates of ADHD diagnoses as high as 15% or greater. The same is true for rates of medication for pediatric patients. An ADHD patient in the south is twice as likely as an ADHD patient in California to receive medication for ADHD (Hinshaw, 2016). Many of the southern states that have high rates of diagnoses and medication rates are Appalachian states, and the state of Tennessee is referenced often as having some of the highest rates of ADHD diagnoses in the country.

It is apparent that ADHD has been embraced by the medical community, and thus is becoming a burden to society, especially in southern Appalachian states. The question still is why many of the Appalachian states are suffering with the burden of ADHD more than other states. While studies have shown ADHD is caused by biological sources, the severity of the disorder often has a lot to do with the social and economic environment the child is placed in. The Appalachian certainly has a unique culture, socially and economically, that may contribute to the high rates of diagnoses and medication therapies being received.

It is important to consider all of the possibilities that may factor into a child being diagnosed and receiving medications for ADHD. The Appalachian region has many factors such as school systems with a high focus on testing scores, high unemployment, poverty, high rates of single parents, and low access to medical care and coverage that may affect how ADHD is perceived and diagnosed. This study hoped to be able to look at

various social factors in different regions of an Appalachian town to try and uncover the social and economic factors that create trends in ADHD medications in an Appalachian town. Unfortunately, limitations prohibited the completion of the study.

ADHD causes a significant burden on the family system as well as educational and social systems in a ADHD child's life. Children that have ADHD are more likely to struggle in school, have other mental disorders in addition to ADHD, and have issues later in life with gambling, criminal activity, and substance abuse (Kessler, 2006). ADHD children are also more likely to experience increased emergency room visits and accidents (McGough, 2014). ADHD can cause an extreme burden on a family that is lacking an education and steady income to afford sufficient treatment and therapy. Many Appalachian families are not educated enough to understand the various treatment options and how to manage a child that has ADHD at home and at school. In addition on average an ADHD pediatric patient's parents spend $1,000-$5,000 in medical expenses for appointments and treatment (Doshi, 2012).

ADHD research is necessary in the Appalachian region for a number of reasons. The high costs associated with having an ADHD family member, creates a financial burden on a struggling economic region. Medical costs for a pediatric ADHD patient are three times more than an average child annually. Pediatric patients that do not manage their condition mature into adults with ADHD, and usually struggle to maintain employment to afford treatment (Biederman, 2006). Decreasing the number of ADHD patients in the region, or even defining treatment to include less expensive medications, would reduce the cost for many families and create more successful, productive citizens in the community. Also, gaining support from school systems would be beneficial in creating

curriculums to stimulate the minds of children that struggle with ADHD symptoms; this may also aid in decreasing the number of failing schools in the Appalachian region. ADHD patients are at risk for greater criminal activity. Pediatric ADHD patients will on average spend more time on probation and have higher criminal convictions (Olazagast, 2012). Acknowledging medication trends and crafting behavior therapy plans to accompany or replace them should be the goals of physicians and pharmacists to decrease the counts of criminal activity from ADHD patients. It is important to discuss why ADHD is a problem in the Appalachian region as discussions could promote increasing educational efficiency, decreasing criminal behaviors, and relieving financial burden on families and the community.

There is a correlation between ADHD cases and many of the specific social burdens that Appalachian families experience such as low income, low education levels, unemployment, and family culture. It is apparent through research and statistics that ADHD is a problem in the Appalachian region, and the high rates may be caused by the social and economic issues stemming from the region. Understanding the social factors that may be causing high trends in ADHD medication treatment and diagnoses in the Appalachian region is key to developing a medical plan and educational materials to aid the families financially, emotionally, and physically. It is important to understand that ADHD patients also have many comorbidities, and through research it may be possible to focus on behavior therapy rather than medication so that individuals receive a well-rounded treatment that is not set on specific standards. Perhaps, the solution should be to combat the issues that Appalachian families face, such as poverty and low education, instead of fighting the high ADHD case rate. It might be that if the social issues of the

Appalachian region were aided then ADHD rates may decrease. However, further research is necessary to determining an exact cause. By analyzing the areas that are receiving medication and treatment at a high rate, society can begin to combat the issues and give aid to groups that need it, so ADHD will not become a societal burden to the people of Appalachia.

References

Biederman, J., & Faraone, S. V. (2006). The effects of attention-deficit/hyperactivity disorder on employment and household income. *Medscape General Medicine*, *8*(3), 12.

Doshi, J. A., Hodgkins, P., Kahle, J., Sikirica, V., Cangelosi, M. J., Setyawan, J., ... & Neumann, P. J. (2012). Economic impact of childhood and adult attention-deficit/hyperactivity disorder in the United States. *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*(10), 990-1002.

Hinshaw, S., & Ellison, Katherine. (2016). *ADHD : What everyone needs to know*.

Kessler, R. C., Adler, L., Barkley, R., Biederman, J., Conners, C. K., Demler, O., ... & Spencer, T. (2006). The prevalence and correlates of adult ADHD in the United States: results from the National Comorbidity Survey Replication. *American Journal of Psychiatry*.

McGough, J. (2014). *ADHD* (Oxford American psychiatry library).

Olazagasti, Ramos, Klein, Mannuzza, Belsky, Hutchison, Lashua-Shriftman, & Xavier Castellanos. (2012). Does Childhood Attention-Deficit/Hyperactivity Disorder Predict Risk Taking and Medical Illnesses in Adulthood? *Journal of the American Academy of Child & Adolescent Psychiatry,* Journal of the American Academy of Child & Adolescent Psychiatry.