A Review of The Medical Aspects of Adolescent Sleep Patterns

A Report for York County School Division

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Introduction and Overview

Historically, public school bell times across the nation evolved as a result of economic, social, legal and political pressures on school districts and municipalities—not from sleep science pertaining to adolescents (which essentially did not exist until the 1970's) or concerns about the health, safety and academic performance of students. Recognizing the critical importance of the situation and in keeping with the York County School Division's interest in improving the health, safety and academic and athletic opportunities of its student body, the Division engaged the services of the midAmr Group and Dr. Robert Vorona of Eastern Virginia Medical School and Division of Sleep Medicine to undertake a number of steps to review and communicate the scientific literature on the impact of healthy sleep on teenagers and to identify and summarize lessons learned from other school districts that have successfully changed their start times. The team worked with the staff of the York County School Division (YCSD) to accomplish the following:

1. **Conduct a limited analysis of current medical research and the latest literature regarding adolescent biology, circadian rhythms and the impact of sleep loss on academic and athletic performance, mood and health, driving safety, and work productivity.** The team identified and reviewed relevant scientific literature and existing information from a variety of sources including discussions with Administration officials, Board Members and other community members.

2. **Develop and provide educational materials regarding adolescent sleep patterns for posting on the Division's website.** The team created educational materials for the community covering sleep health, sleep disorders, drowsy driving, and the benefits of adequate sleep on academics, athletics, mood, and mental and physical health. These materials are currently posted on the Division's website at www.yorkcountyschools.org.

3. **Conduct a community informational session.** The team worked with the School Division to plan and hold an educational town hall meeting on November 28, 2016 with presentation by Dr. Robert Vorona of Eastern Virginia Medical School and Darrel Drobnich of The midAmr Group. The presentations covered sleep science, adolescent biology, sleep health, common myths about the challenges of changing school start times, and the successful experiences of other school districts. The town hall was filmed and is available at www.yorkcountyschools.org.

This document provides an overview of the current state of the science related to sleephealth and the impact early school start times has on teenagers as well as specific recommendations on how York County School Division might go about educating it's community about the importance of sleephealth, safety and academic performance and move toward changing current start times.

The State of The SleepHealth of Students in America

"Insufficient sleep is a public health epidemic"— The Centers for Disease Control and Prevention.

Good sleep promotes good health, safety, productivity, and wellbeing. It's that simple! Sleep represents a third of every person's life and it has a tremendous impact on how we live, function and perform during the other two-thirds of our lives. It is indeed as vital as the air we breathe and the food we eat, especially for those with chronic medical conditions or compromised immune systems.

Getting enough continuous quality sleep contributes to how we feel and perform the next day and it also has a big impact on the overall quality of our lives. Getting enough sleep refers to the amount of sleep we need to feel alert and able to function at our best the next day. Sleep experts generally recommend an average of about nine hours per night for teenagers. If sleepiness makes it more difficult to do your daily activities or if you depend on caffeine to get through the day, you probably are sleep deprived. The following chart shows the sleep duration recommendations by age according the Centers for Disease Control and Prevention (CDC):

Planning your day so that you allow enough time to sleep is essential to your overall well-being and allowing enough time to awaken naturally—without an alarm clock—so you get as much sleep as you need!

Sleep problems, whether in the form of chronic medical issues such as pain or depression, sleep disorders or related to work or school schedules and a 24/7 lifestyle, are pervasive. In America, 70% of adults report that they obtain insufficient sleep at least one night a month, and 11% report insufficient sleep every night (1).

The odds of being sleep deprived (less than six hours a night for adults) has increased significantly over the past 30 years as the lines between work and home have become blurred and digital technology has firmly become part of our lifestyles, especially for our children. National data shows that poor sleep health is a common problem with 25% of American adults, reporting insufficient sleep or rest at least 15 out of every 30 days (2). And, the National Institutes of Health (NIH) predicts that America's sleep debt is on the rise and that by the middle of this century more than 100 million Americans will have difficulty falling asleep. This is probably an underestimate, especially given the explosion of computers, gaming, smart phones and other electronic devices and energy drinks that children are engaging with at very early ages. Just like everything else, it's important that parents and other influential adults set a good example and make sleep a priority in the household.

In 1993, the National Commission on Sleep Disorders Research loosely estimated that sleep-related problems affect over 70 million Americans of all ages and socioeconomic classes. Sleep disorders are common in men and women; however, important disparities in prevalence and severity of certain sleep disorders have been identified in minorities and underserved populations (3). More than 50 million Americans (including children) already suffer from over 80 different sleep disorders and another 20 to 30 million suffer intermittent sleep problems each year related to issues such as pain, anxiety or grief.

At least 30 million Americans (1 in 5 adults) suffer from sleep apnea, a serious sleep and breathing condition linked to hypertension, cognitive impairment, heart disease, and stroke. It affects about 3% of children and has increased over the years with the obesity epidemic. Sleep apnea in children occurs for different reasons in two primary periods during childhood, with enlarged adenoid and/or tonsils the primary cause for children two to eight years old and weight gain the primary cause during adolescence.

Sleep disorders affect members of every race, socioeconomic class and age group. Despite the high prevalence of sleep disorders, the overwhelming majority of sufferers remain undiagnosed and untreated, creating unnecessary public health and safety problems, as well as increased health care expenses. National surveys show that more than 60% of adults have never been asked about the quality of their sleep by a physician, and fewer than 20%--have ever initiated such a discussion (4).

Additionally, people are chronically sleep deprived as a result of demanding lifestyles and a lack of education about the impact of sleep loss. Sleepiness affects vigilance, reaction times, learning abilities, alertness, mood, hand-eye coordination, and the accuracy of short-term memory. Sleepiness has also been identified as the cause of a growing number of on-the-job accidents, sports injuries, automobile crashes and multi-model transportation tragedies.

The contribution of sleep health to living free of preventable disease, disability, injury, and premature death has been recognized by its inclusion for the first time as a whole segment in Healthy People 2020, a Department of Health and Human Services Initiative. Healthy People 2020 challenges communities of researchers to provide the evidence and knowledge needed to improve practices with regard to sleep health and over 40 other topics identified as nationwide health improvement priorities.

Untreated sleep disorders and chronic sleep loss are associated with a significant increased risk of heart disease, high blood pressure, obesity, diabetes, anxiety and depression, substance abuse, certain types of cancer, automobile crashes, on-the-job accidents, and total mortality along with impaired work productivity, academic performance, and reduced quality of life (5). Additionally, there are a number of significant pain

conditions that affect the sleep quality of individuals; these include: restless legs syndrome, irritable bowel, gastric ulcer, cancer, musculoskeletal disorders, dental and orofacial pain, spinal cord damage, burns, and other trauma (6). Good sleep helps prevent the development of certain conditions and can help better manage and improve existing conditions. The earlier children develop good sleep habits, the better the chances they will be healthier later in life.

More than 133 million Americans live with a chronic disease or disability. **The 2006 Institute of Medicine (IOM) report, *Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem*, found the cumulative effects of sleep loss and sleep disorders represent an under-recognized public health problem and have been associated with a wide range of negative health consequences, including hypertension, diabetes, depression, heart attack, stroke, and at-risk behaviors such as alcohol and drug abuse—all of which represent long-term targets of the United State's Department of Health and Human Services and other public health agencies.** Moreover, the personal and national economic impact is staggering. The Rand Corporation recently estimated that the direct and indirect costs associated with sleep disorders and sleep deprivation costs the United States (U.S.) over 400 billion dollars annually (7).

Sleep and Adolescent Development

"You are not healthy if your sleep is not healthy"

Insufficient sleep is just as common among high school students with more than two-thirds of high school students in the U.S. failing to get sufficient sleep on school nights, according to a 2016 study by the Centers for Disease Control and Prevention. **This study also found that students who reported sleeping less than seven hours on school nights were more likely to report several injury-related risk behaviors including less bicycle helmet use, infrequent seatbelt use, riding with a driver who had been drinking, drinking and driving, and texting while driving compared with students who sleep nine hours (8).** Furthermore, the study confirmed the findings of previous studies in demonstrating that teens who get less than seven hours of sleep on school nights were more likely to engage in risky behaviors such as texting and driving, drinking and driving, riding with a driver who was drinking, and not wearing a seat belt in a car or a helmet while on a bicycle—than teens who sleep nine hours a night.

On a practical level, this means that the average adolescent cannot fall asleep before 11 pm and has significant difficulty in waking before 8 am.

Key among the many changes in brain function that occur during adolescence is a significant alteration in sleep patterns. From a biological perspective, at about the time of the onset of puberty, teens begin to experience a sleep-wake "phase delay" (later sleep onset and wake times), as a result of well-documented changes in circadian rhythms. This is manifested as a shift in the fall-asleep time to about two hours later relative to middle childhood. At the same time, adolescent sleep needs do not decline significantly from pre-adolescent levels, and optimal sleep amounts remain in the range of 8.5 to 9.5 hours per night for most teens (9). On a practical level, this means that the average adolescent cannot fall asleep before 11:00 pm and has significant difficulty in waking before 8:00 am (10).

Many studies, professional medical association policy statements, and federal reports have documented that the average adolescent in the United States is chronically sleep deprived and pathologically sleepy. As a result, many high school students are at risk for adverse consequences of insufficient sleep including impairments in mood, affect regulation, attention, memory, behavior control, executive function, and impulse control. In particular, many studies have shown an association between decreased sleep duration and lower academic achievement at the middle school, high school and college levels, as well as higher rates of absenteeism and tardiness, and decreased motivation to learn (11, 12). Other documented specific health-related effects of sleep loss in adolescents include increased use of stimulants (e.g., caffeine, prescription medications) to counter the effects of chronic sleepiness, which in turn may increase the risk of substance use later in adolescence and emerging adulthood (13). Adolescents are also at greater risk for fatigue-related crashes, as well as athletic and other injuries, due to insufficient sleep (14). Chronic sleep loss increases subsequent risk of both cardiovascular disease and metabolic dysfunction such as type 2 diabetes (15). An association between short sleep duration and obesity in children and adolescents has been demonstrated in several substantial studies, underscoring how chronic sleep loss can undermine the health of our nation's youth (16). As a result, every significant federal agency and professional association, medical and educational, have endorsed moving school start times for high school students to at least 8:00 or later, with 8:30 being preferable. **Most importantly, in a comprehensive policy statement published in 2014, the American Academy of Pediatrics urged that all middle and high schools should aim for start times that allow students to receive 8.5 to 9.5 hours of sleep a night to ensure their "health, safety, performance and well-being" (17).**

> **"Regularly sleeping fewer than the number of recommended hours is associated with attention, behavior, and learning problems," according to the statement. "Insufficient sleep also increases the risk of accidents, injuries, hypertension, obesity, diabetes and depression."**
> **— The American Academy of Pediatrics**

While a number of factors, including biological changes in sleep, lifestyle choices and academic demands impact sleep in students, the evidence strongly supports early school start times (i.e., before 8:00 am) as a key modifiable contributor to sleep loss in high school students (18-20). Numerous studies have demonstrated that early start times seriously impede middle and high school students' ability to obtain sufficient sleep (21, 22).

Furthermore, a substantial body of research now demonstrates that delaying school start times is an effective countermeasure to chronic sleep loss and has a wide range of potential benefits for students in regards to physical and mental health, safety, academic achievement, and athletic performance. Studies comparing high schools with start times as little as 30 minutes earlier to those with later start times demonstrate adverse consequences such as shorter sleep duration, increased sleepiness, difficulty concentrating, behavior problems, and more school absences (23-25). Additionally, research has confirmed that delaying high school start times results in increased sleep, decreased tardiness rates and absenteeism, improved performance on standardized tests, reduced self-reported depression, and fewer automobile collisions (26, 27). The sleep health of adolescents has been recognized as an important issue by the U.S. Department of Health and Human Services with the inclusion of a specific objective regarding improving the duration of teen sleep in Healthy People 2020; the nation's health agenda.

School Start Times Are Not Based on What is Best For Our Kids

Historically, public school bell times across the nation evolved as a result of economic, social, legal and political pressures on school districts and municipalities—not from sleep science pertaining to teenagers (which essentially did not exist until the 1970's) or concerns about the health, safety and academic performance of students. While a number of factors, including biological changes in sleep, lifestyle choices and academic demands impact upon sleep in students, the evidence strongly supports that early school start times (i.e., before 8:00 am) are a key contributor to sleep loss in high school students (28-30).

Numerous studies have shown that early start times significantly hurt high school students' abilities to obtain sufficient sleep (31, 32). From a biological perspective, at about the time of the onset of puberty, teens begin to experience a sleep-wake "phase delay" (later sleep and wake times), as a result of well-documented changes in circadian rhythms. This leads to a shift in the fall-asleep time to about two-hours later relative to middle childhood. At the same time, adolescent sleep needs do not decline significantly from pre-adolescent levels, and optimal sleep amounts remain in the range of 8.5 to 9.5 hours per night for most teens (33). On a practical level, this means that the average teen cannot fall asleep before 11:00 pm and has significant difficulty in waking before 8:00 am (34).

A large body of research has now demonstrates that delaying school start times is an effective countermeasure to chronic sleep loss and has a wide range of potential benefits for students in regard to health, safety, and academic achievement. Studies comparing high schools with start times even just 30 minutes earlier to those with later start times demonstrate adverse consequences such as shorter sleep duration, increased sleepiness, difficulty concentrating, behavior problems, and more school absences (35-37). Scientific literature has confirmed that delaying high school start times results in increased total sleep time, decreased tardiness rates and absenteeism, improved performance on standardized tests, reduced depression, and fewer automobile crashes (38, 39).

"School administrators would serve students and teachers better by moving the opening bell later. The weight of the evidence from decades of studies suggests that creating conditions to encourage student sleep would improve the students' mood, energy, alertness, and academic performance….The result would be happier, healthier, more attentive, and better performing students in high school."
—Mary Carskadon, Ph.D., Professor of Psychiatry & Human Behavior, Brown University

It is an important but under-appreciated fact that early high school start times are a relatively recent phenomenon that evolved as a result of factors, which had little to do with academics or what is best for the health and wellbeing of students. The overwhelming majority of modern day bell schedules in public high schools are historically based on such "adult" considerations as school budgets, transportation logistics, parent work schedules, athletics, staff commute times, and community use of fields and facilities. By and large, districts did not take into consideration the evolving scientific sleep literature associated with puberty and the evidence linking early school start times with detriments in the

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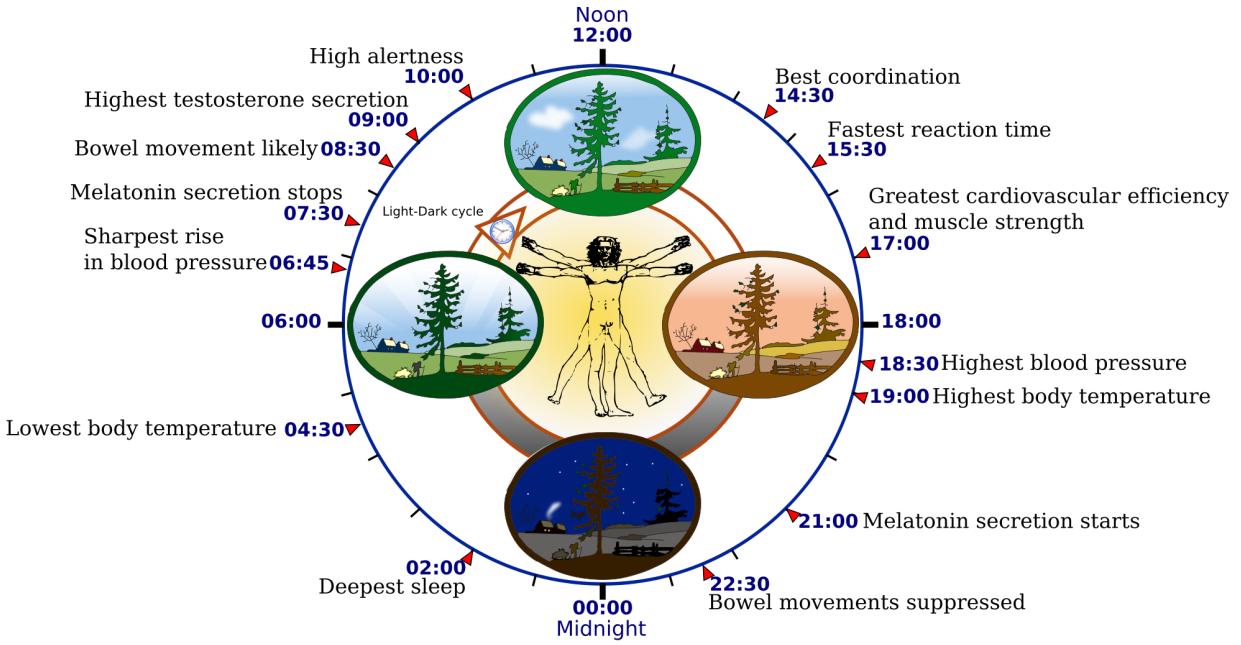
health, safety and well-being of students. While there are no systematic national databases of school start times, historical and media sources suggest that school districts in the U.S. began advancing school start times, especially at the high school level, first in the late 1950's and 1960's and then increasingly so during the 1970's. The move to earlier start times was likely in reaction to a number of increasing pressures (e.g., fiscal, political, sociological) faced by school districts to cut costs, to close neighborhood schools in favor of larger "feeder" schools, and basically to "do more with less."

However, it should be noted that there are many school districts in the U.S., which have never succumbed to the same political, budgetary and social pressures described above and have maintained healthy start times for their high school students over the years. For example, Loudon County, Virginia has had the same bell schedule since 1954, with high schools starting at 9:00 am. Similarly, some large Texas districts, such as Dallas and Austin, have started their high schools at 9:00 am or later since the early 1990's. According to the U.S. Department of Education's National Center for Education Statistics, a majority (60%) of the 19,000 public high schools in the U.S. currently start at 8:00 am or later, with 45% starting between 8:00 and 8:30 a.m., and 15% starting 8:30 a.m. or later (40, 41).

The Biological Clock

Most people notice that they naturally experience different levels of sleepiness and alertness throughout the day, but what causes these patterns? Sleep is regulated by two body systems: sleep/wake homeostasis and the circadian biological clock. When we have been awake for a long period of time, sleep/wake homeostasis tells us that a need for sleep is accumulating and that it is time to sleep. It also helps us maintain enough sleep throughout the night to make up for the hours of being awake. If this restorative process existed alone, it would mean that we would be most alert as our day was starting out, and that the longer we were awake, the more we would feel like sleeping. In this way, sleep/wake homeostasis creates a drive that balances sleep and wakefulness.

Our internal circadian biological clocks, on the other hand, regulate the timing of periods of sleepiness and wakefulness throughout the day. The circadian rhythm affects many dimensions of cognitive performance but the most obvious change is an increase in reaction time and tendency to have lapses in attention often associated with short sleep attacks (micro-sleeps). The circadian rhythm also modulates the ability to obtain restorative sleep, with sleep during the daylight hours being more difficult than nighttime sleep. The circadian rhythm dips and rises at different times of the day, so adults' strongest sleep drive generally occurs between 2:00-4:00 am and in the afternoon between 1:00-3:00 pm, although there is some variation depending on whether you are a "morning person" or "evening person." The sleepiness we experience during these circadian dips will be less intense if we have had sufficient sleep, and more intense when we are sleep deprived. The circadian rhythm also causes us to feel more alert at certain points of the day, even if we have been awake for hours and our sleep/wake restorative process would otherwise make us feel sleepier.



Changes to this circadian rhythm occur during adolescence, when most teens experience a sleep phase delay. This shift in teens' circadian rhythm causes them to naturally feel alert later at night, making it difficult for them to fall asleep before 11:00 pm. Since most teens wake up early for school and other commitments, this sleep phase delay can make it difficult to get the sleep teens need—an average of 91/4 hours, but at least 81/2 hours. **This sleep deprivation can influence the circadian rhythm; for teens the strongest circadian "dips" tend to occur between 3:00-7:00 am and 2:00-5:00 pm, but the morning dip (3:00-7:00 am) can be even longer if teens haven't had enough sleep, and can even last until 9:00 or 10:00 am.**

The biological clock is controlled by a part of the brain called the Suprachiasmatic Nucleus (SCN), a group of cells in the hypothalamus that respond to light and dark signals. From the optic nerve of the eye, light travels to the SCN, signaling the internal clock that it is time to be awake. The SCN signals to other parts of the brain that control hormones, body temperature and other functions that play a role in making us feel sleepy or awake.

In the mornings, with exposure to light, the SCN sends signals to raise body temperature and produce hormones like cortisol. The SCN also responds to light by delaying the release of other hormones like melatonin, which is associated with sleep onset and is produced when the eyes signal to the SCN that it is dark. Melatonin levels rise in the evening and stay elevated throughout the night, promoting sleep. In teenagers, research has shown that melatonin levels in the blood naturally rise later at night than in most children and adults. Since teens may have difficulty going to bed early to get enough sleep, it can help to keep the lights dim at night as bedtime approaches. It can also help to get into bright light as soon as possible in the morning.

Circadian disruptions such as jet lag put us in conflict with our natural sleep patterns, since the shift in time and light cues on the brain forces the body to alter its normal pattern to adjust. This is why jet lag can leave travelers feeling poorly and having more difficulty thinking and performing well.

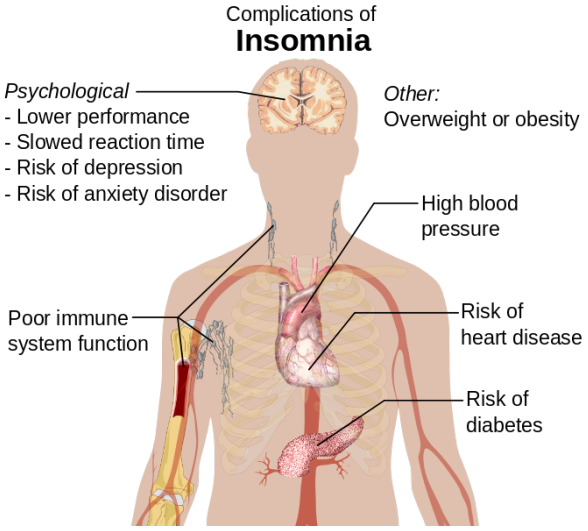
However, these symptoms can also occur in everyday life as when one's circadian rhythm is disrupted by staying awake for long and irregular hours. Because of this, it is important to keep a regular sleep schedule and allow plenty of time for quality sleep, allowing these two vital biological components—the sleep/wake restorative process and the circadian rhythm—to help you perform at your best.

Sleep and Health

Sleep disorders consist of a broad range of conditions that affect people of all ages. They are serious but treatable conditions. Two of the most common types of sleep disorders are insomnia and obstructive sleep apnea. Other sleep problems are related to chronic loud snoring and depression.

Insomnia and Sleep Loss

Difficulty falling or staying asleep is a very common problem for both adults and children. Occasional insomnia is experienced by more than one third of American adults, and chronic insomnia is known to affect more than one in ten. Approximately 25% of adolescents have some form of sleep problem on a regular basis. Additionally, sleep loss of varying severity is reported by 10% to 40% of high school students with as many as 12.4% of teens reporting symptoms of insomnia nearly every day in the previous month, with higher rates for girls and children with lower socio-economic status (42-44). Researchers, federal agencies and professional medical associations have increasingly identified an epidemic of sleep deprivation in young people that needs to be addressed (45-47).



Symptoms of Insomnia

Insomnia is characterized by one or more of the following sleep complaints:

- Difficulty falling asleep
- Difficulty staying asleep
- Waking too early in the morning
- Experiencing non-restorative sleep

Types of Insomnia

There are two types of insomnia based on the regularity and duration of the sleep disturbance and daytime symptoms:

- **Short-term insomnia:** This type of brief insomnia lasts for up to three months. It occurs in 15 to 20% of people.

- **Chronic insomnia:** This type of insomnia occurs at least three times per week and lasts for at least three months. About 10% of people have chronic insomnia.

Common Causes of Insomnia

Insomnia can often be traced to an underlying cause; therefore, it is critical to identify and treat this problem. Problems or conditions that can lead to insomnia are:

- A life crisis or stress
- Poor sleep habits
- Environmental noise
- Side effects of medicine
- Depression
- Chronic illness
- Jet lag
- Caffeine or nicotine

Sleep deprivation and insomnia have significant and severe negative impact on overall health, safety, concentration, productivity, and mood. Studies also suggest a strong link between sleep disturbance and behavioral problems in young people, in part because sleep loss undermines emotion regulation the following day (48-51). Sleep problems and insomnia in teens has been associated with suicidal thoughts, attempts and suicide completion along with tobacco and substance abuse and stress on relationships. **Teenage insomnia and sleep deprivation also contributes to school absenteeism, tardiness and even dropout as well as diminished performance, productivity, cognitive performance, learning, memory, and attention (52-57).**

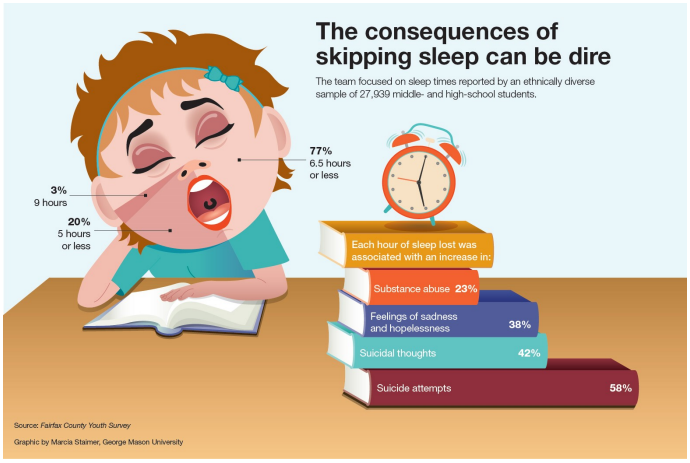
The most common health issue related to insomnia is depression. Numerous studies have found a bidirectional association between depression and bipolar disorder and insomnia with about 50% of people with insomnia experiencing a mental health issue while 90% of adults with depression experiencing sleep problems. It is now known that insomnia contributes to the onset of the first bout of depression. An estimated 20% of adolescents will have had a depressive episode by age 18 (58). Sleep problems can create a vicious cycle that slows treatment and recovery to mental health issues. People who experience insomnia are also more likely to have a relapse of depression as well as engage in substance abuse (59-62).

Depression

Both depression and sleep deprivation can interfere with our ability to think, work, socialize, and enjoy life. Both have a number of symptoms in common. These include lack of energy, difficulty concentrating and making decisions, moody behavior, unusual sleep patterns, loss of interest in activities, as well as weight and appetite changes. In addition, interrupted sleep is very common among people who are depressed. Over 90% of those with depression complain about difficulty falling asleep, frequent nighttime awakenings and early morning awakenings. Others may sleep much more than usual and still feel tired (63).

Teens need at least 8.5 hours—and on average 9.25 hours—of sleep each night to function at their best. In addition, biological sleep patterns shift toward later times for both sleeping and waking

during adolescence, so it is natural to not be able to fall asleep before 11:00 pm or later. Teens also tend to have irregular sleep patterns across the week—they typically stay up late and sleep in late on the weekends, which can affect their biological clocks and hurt the quality of their sleep. Some teens experience sleep problems such as sleep apnea and insomnia, which keep them from getting the sleep they need. These factors during adolescence can contribute to sleep deprivation in teens, which can greatly impact performance in school and other areas, as well as overall quality of life (64).



It is normal for teens to have times when they feel tired, sad, and moody or have difficulty focusing on school and other important things in their lives. If these feelings linger, intensify and begin to interfere with life at school and at home; however, it may be time to talk with a doctor to find an appropriate treatment.

Depression is an illness that involves the body, mood and thoughts. In 2015, an estimated three million Teens aged 12 to 17 in the United States had at least one major depressive episode in the past year. This number represented 12.5% of the U.S. population aged 12 to 17 (65). Half of the teenagers who go untreated for depression may attempt suicide, which is the third leading cause of death among teens. While it can disrupt life by affecting a person's ability to function, relate well to others and experience pleasure, it is a treatable illness (66, 67).

A three-year study funded by the CDC and involving over 9,000 students in eight public high schools in three states found that teens that get less than eight hours of sleep reported significantly higher rates of symptoms of depression, greater use of caffeine and engaging in substance abuse (68).

Symptoms That May Indicate Depression

- Persistent sadness, anxiousness or hopelessness
- Sleeping more/less than usual—insomnia, fatigue
- Lack of energy or motivation
- Anger and rage
- Weight changes and appetite disturbances
- Feeling guilty, helpless or worthless
- Difficulty concentrating or remembering things
- Withdrawal from friends, family and activities
- Irritability, moodiness and restlessness
- Frequent headaches, stomach aches or other pains
- Poor school performance
- Substance abuse
- Thoughts of death and suicide

Diagnosis & Treatment

If teens feel they are experiencing symptoms of depression or a sleep disorder they should keep a sleep diary (journal of symptoms and sleep patterns) for two weeks and set up an appointment with their doctor. Share the sleep diary with the doctor or other health professional to help them identify any sleep problems or other medical issues he or she may have and determine appropriate treatment options including behavioral options. Most sleep disorders can be successfully diagnosed and treated. Proper treatment can lead to good sleep and improve their overall health, safety and well-being.

Snoring

Snoring is a breathing noise that occurs during sleep and can be very disruptive to other family members. While breathing in, the air passage between the upper soft palate and the throat or base of the tongue opens and closes. As muscles relax, there is a partial obstruction to the air passage, causing the tissues to vibrate and make the snoring noise.

This abnormal breathing causes sleep disruptions and affects approximately 90 million adults; 37 million on a regular basis. Those most at risk are males and those who are overweight. Snoring often increases with age. Loud snoring is particularly serious as it can be a symptom of sleep apnea and can be associated with high blood pressure and other health problems.

Potential Effects of Snoring

- Daytime sleepiness
- A risk factor for hypertension
- Daytime dysfunction due to fragmented sleep
- Headaches
- Difficulty in concentration
- Fatigue and reduced school performance

What To Do If Your Child Snores?

The most important thing you can do for your child is to observe their daily and nightly habits and report share any concerns with their doctor. Depending on the cause of your child's snoring, your health care provider may recommend one or more of the following solutions:

- Remove possible allergen triggers such as: stuffed animals, pets, mold, or feathery down pillows and comforters.
- Prescribe sinus congestion and allergy medications.
- Suggest that you elevate your child's head or mattress at night with a special pillow, which can help relieve congestion and clear up their nasal passages.
- Refer you to a specialist to see if your child's tonsils and adenoids need to be removed.
- Refer you to a sleep specialist to determine if your child suffers from obstructive sleep apnea.

Obstructive Sleep Apnea

Obstructive sleep apnea (OSA) is a serious sleep and breathing disorder that affects over 30 million Americans. Sleep apnea not only interrupts breathing, it also reduces oxygen levels in the blood stream and causes frequent brief awakenings—a lifesaver, since that is when the person starts breathing again. These pauses in breathing or "apneic events" may last 10-60 seconds and occur as often as 20-60 or more times per hour. Snoring and choking sounds usually accompany them. The person may not be aware of these awakenings, but they significantly reduce the quality of sleep leaving one unrested and very sleepy throughout the day.

People most likely to have or develop obstructive sleep apnea include those who snore loudly, are overweight, have high blood pressure, or have a physical abnormality in the nose, throat, or other parts of the upper airway. Sleep apnea requires treatment, particularly as it lowers blood-oxygen levels, and is associated with high blood pressure, heart attacks, stroke, headaches, depression, daytime sleepiness, and motor vehicle crashes.

Risk Factors for Sleep Apnea in Adults

Sleep apnea occurs in all age groups and both sexes, but there are a number of factors that increase one's risk, including:

- A family history of sleep apnea
- Being overweight
- A large neck size (17 inches or greater)
- Being age 40 or older
- Ethnicity (African-Americans, Pacific-Islanders and Hispanics)

Sleep Apnea in Children

Sleep apnea can occur in children of any age, but it is most common in children between the ages of three and six years when the tonsils and adenoids are large compared to the throat. Roughly 3% of children ages one to nine and about 10% of children that snore have sleep apnea. It appears to occur at the same rate in both young boys and girls. How often it occurs in infants and teens is unknown. OSA also is common in children who are obese, which has tripled in the past 30 years (69).

Children with an abnormal facial structure or neuromuscular diseases such as cerebral palsy are at a much greater risk for OSA. At least two thirds of children with Down syndrome will develop sleep apnea (70). Studies have suggested that as many as 50% of children diagnosed with attention-deficit hyperactivity disorder (ADHD) may actually have symptoms of sleep apnea and that much of

their learning difficulty and behavior problems can be the consequence of chronic fragmented sleep (71).

Risk Factors for Sleep Apnea in Children

- A recessed chin, small jaw, cleft palate or a large overbite
- A small upper airway (large tongue or uvula)
- Enlarged adenoids and/or tonsils
- A deviated septum
- Certain medical conditions such as Down syndrome or cerebral palsy

Signs of Sleep Apnea in Children

- Daytime sleepiness
- Loud snoring
- Mouth breathing
- Night sweats
- Hyperactivity
- Morning headaches
- Irritability, crankiness
- Dry mouth or throat in the morning
- Lack of concentration
- Poor performance in school
- Bed wetting
- Sleep walking
- Stunted growth
- Behavioral problems
- Night terrors
- Sleeping with head in unusual positions

Long-Term Consequences of Untreated Sleep Apnea

Consequences include increased risk of:

- Drowsy driving and school and workplace injuries
- High blood pressure (hypertension)
- Coronary artery disease
- Heart attack
- Stroke
- Diabetes
- Dementia and memory loss
- Cognitive and behavioral problems
- Delays in development
- Poor school performance

Diagnosing Sleep Problems

If you believe your child might have a sleep disorder or chronic problem, a discussion with your doctor can help you rest easy. Most sleep problems and disorders are easily diagnosed and effectively treated. However, left untreated, sleep problems can lead to daytime sleepiness and put your child at higher risk for on-the-job or school accidents, fall-asleep motor-vehicle crashes, and other health problems.

In addition to a complete medical history and physical examination, your doctor may refer your child to a specialist, such as a sleep specialist, an otolaryngology (ear, nose and throat) physician, or a pulmonary (lung) doctor for further evaluation. If your child is diagnosed with a sleep disorder, they may benefit from both lifestyle changes and specific medical treatment. Here are some suggestions on how to help convey your concerns to your child's health care provider:

Be Knowledgeable About Your Child's Sleep:

- Keep a sleep diary for one to two weeks, recording your child' sleep and wake times, caffeine consumption, exercise, and nighttime awakenings.

Be Prepared for Your Doctor Appointment by Bringing:

- Your child's medical history.
- A list of medications and natural supplements—prescription and over-the-counter—he or she takes for all medical conditions.
- Any information you have gathered about sleep disorders.

Be Communicative:

- Be open, honest, and prepared to talk with your doctor about your child's habits, concerns, and health. The more information you share with your doctor, the more he or she will be able to help you and your child.

Sleep, Memory and Learning

Over more than a century of research has established the fact that sleep benefits the memory retention, but the relationship of sleep to memory and learning is extremely complex. Sleep directly affects memory, and memory must be present for learning to occur. Research suggests that the learning process—moving memories into long-term storage—requires actual changes in the connections between neurons in the brain that happens during deep rapid eye

Research shows that sleep deprivation impairs:

- **Ability to pay attention**
- **Motor skills**
- **Reaction time**
- **Abstract thinking**
- **Verbal creativity and effective communication**
- **Creative problem-solving and innovation**
- **Decision-making involving the unexpected**
- **Adaptive learning that involves retrieving knowledge from long-term memory**
- **Overall mood and motivation**

movement (REM) sleep (72). Some research has found that REM sleep increases on nights after people are taught a new cognitive skill, and that interfering with REM sleep or denying it completely interferes with being able to remember what was learned (73). It has been firmly established that both sleep quality and quantity are closely related to learning capacity and academic performance (74). Furthermore, creativity is dependent on learning and memory, which can be strongly affected by sleep or lack of sleep, and finally, a lack of sleep depletes the very basic motivation to learn in the first place (75).

With the amount of homework, stress, activities, and schedules teens have to deal with these days, who can afford inefficient studying? Teens often re-read the same page while being too tired to focus, nod off in class, or stay up late to study, only to be unable to recall the information the next day? It can be tempting for teens to sacrifice sleep to squeeze studying and other activities into an already full day. But less sleep does not equal more time. **Research shows that sleep deprivation in teens—even if they are consistently getting just a few hours less than they need each night—can impair their ability to learn and hurt their overall performance (76).**

Studies also show that when learning certain types of tasks, those who get a good night's sleep afterward perform better when tested the next day than those who get insufficient sleep (77). In fact, researchers have found that after a person learns new information, there is activity in the same area of the brain during sleep, and there is improvement in memory performance when the person is tested the next day. So getting a good night's sleep after learning something new is a crucial step in organizing new information and strengthening recent memories (78).

Chronically sleep-deprived teens can become so used to the sensation of sleepiness that they "settle" for less than they are capable of in creativity, academic performance, and communication both in and out of the classroom. Certain tasks, especially those that are rule-based, logical, or very exciting and engaging, can be less sensitive to sleep deprivation and give the misperception that a person's overall learning and performance is at its best. For example, a sleep-deprived person may be able to memorize facts but then be unable to use that information in a constructive and innovative way. A person may be able to say something logical, but be unable to come up with spontaneous ideas or handle unpredictable situations.

Since so much of what teens are learning is important for school, sports and other activities, as well as for discovering the strengths and interests that can shape their lives in the short and long term, it is important to make sure teens are getting enough sleep to feel, look and act their best!

Sleep and Athletic Performance

Healthy sleep is extremely beneficial to teen athletic performance and competitive results. The quality and amount of sleep athletes get is often the key to winning, increasing the repair of the wear and tear on muscle and tissues from practice and overuse as well as lowering risk of significant injury. If a young athlete is experiencing sleep deprivation their performance may suffer. Sleep deprivation does not mean just pulling an all-nighter, even though that will impact mood,

"Fatigue makes cowards of us all."
— Vince Lombardi

alertness, motivation and performance as well. Building a cumulative sleep debt—getting less sleep than you need on a nightly basis—even over just a couple weeks can have tremendous impact. **One study found that adolescent athletes who slept 8 or more hours each night were 68% less likely to be injured than athletes who regularly slept less (79).**

Each year, about 38 million children participate in organized sports and about 10% experience injuries that require medical treatment. Approximately half of all the injuries are believed to be the result of the overuse of muscles, ligaments and bones during practice and play. At least 50% of these injuries are thought to be preventable (80). Given that about 69% of teens get inadequate sleep, your star quarterback is probably suffering from sleep deprivation and stifling his true athletic potential. Encouraging young athletes to get optimal amounts of sleep may help protect them against athletic injuries.

Some effects of sleep deprivation on sports performance are physiological, which means they happen in the body. These can include:

- Impaired motor function, which can include tremors, incoordination, blurred vision, and/or prolonged reaction time. In fact, reaction time in sleep-deprived individuals have been shown to be as slow at as those who are legally drunk!
- Delayed visual reaction time so that by the time one sees the ball heading toward them, they may not be able to catch it!
- Delayed auditory reaction time means that one may not hear a teammate calling to them until it is too late.
- Reduced cardiovascular performance can mean that one's fitness may be down by as much as 11%.
- Diminished mental functioning can affect memory so one may not be able to remember the plays learned at practice the day before.
- Reduced endurance that means that one may get tired sooner because glucose storage is slowed with sleep deprivation.

Some of the effects of sleep deprivation are also emotional or psychological. These can be equally harmful to one's performance at a big game and include:

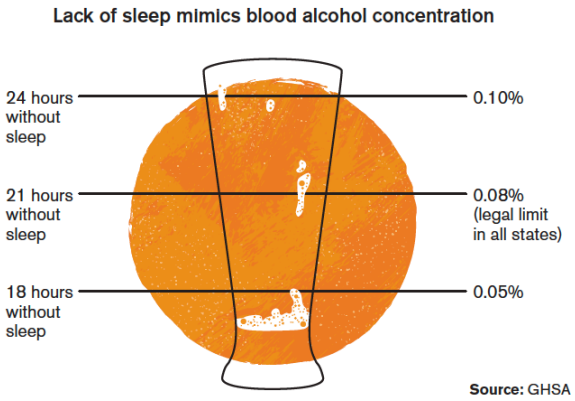
- Increased perceived exertion: even if one can physically perform at similar levels, they will feel tired more quickly and give up.
- Impaired moods: sleep deprivation can leave one in a bad mood, which could lead to more fouls, penalties or conflicts.

On the positive side, getting enough sleep will actually help one to learn new physical skills. In fact, motor skills continue to be learned as someone sleeps. Teens will notice an improvement the next day, even if they have not practiced since. One's body works very hard every day to keep up with all

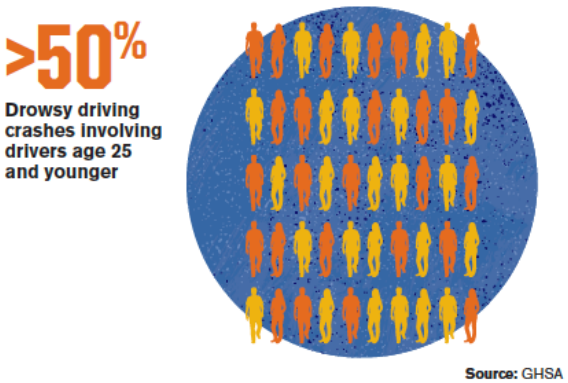
of the things that one does. Teens often push limits putting in a grueling day at school, a few hours of homework, and athletics, band or other extracurricular activities on top of that. They often push the limits of their body and mind. Sleep is absolutely essential to maintaining a level of success in all of these activities, as well as in your relationships, health and appearance.

Driving Safety

Drowsy driving can be as hazardous as driving while drunk (81). Both total and partial sleep deprivation lead to decrements in performance; even as little as two hours of sleep loss will reduce alertness behind the wheel. The degree of impairment is directly related to the amount of sleep loss during the night. In fact, studies have found that after 17 hours of sustained wakefulness, subjects showed impairment comparable to someone with a blood alcohol concentration (BAC) of 0.05%; 0.08% is the standard for being legally drunk in at least 40 U.S. states. After 24 hours of being awake, subjects showed impairment equal to someone with a BAC of 0.10% (82, 83). In addition, even small amounts of nightly sleep loss will accumulate over days to create a "sleep debt," which can also impair driving performance.



Approximately 7.0% of all crashes in the United States involve a drowsy driver and about 16.5% of fatal crashes involve a driver fatigue (84). Unintentional injuries are the leading cause of death for teens, with approximately two thirds of these fatalities related to traffic crashes. In fact, teens are overrepresented in motor-vehicle crash deaths.



Sleep-related crashes are most common among young people, who need more sleep than adults, tend to stay up late, sleep too little, often have erratic sleep schedules, and drive at night (Pack 1995). Insufficient sleep contributes to injury risk directly by slowing reaction time, impairing ability to pay attention, or causing a driver to fall asleep where they hit a stationary object at full speed and/or no breaking (83). Teens also have a higher fatality rate at night, wear seatbelts less often than adults, and are greatly affected by other passengers in their vehicle (86-90).

Factors that drive young peoples' sleep are both external (psychosocial, behavioral, or environmental) and internal (biological). Their circadian rhythm dictates that even with adequate sleep, adolescents and young adults experience midday sleepiness. Furthermore, sleep specialists indicate that during puberty, a shift in the biological clock occurs, pushing peak alertness to later in the day and making it difficult for teenagers to fall asleep before 10:00 PM (91). During the morning

hours, the accumulation of sleep debt and the circadian rhythms combine to shorten sleep latencies (the amount of time to fall asleep), but in the evening adolescents and young adults have a biological drive to wakefulness. In fact, research indicates that the average high school student biologically cannot fall asleep until around midnight (92).

Lifestyle further complicates the problem of sleep debt among young drivers. Currently, many teenagers attend early morning classes and participate in after-school functions while they are chronically sleep deprived. This pervasive sleepiness affects their health, safety, productivity and ability to learn. Teens who are heavily involved in school and community activities, jobs and other responsibilities appear to be at greater risk for excessive sleepiness compared to those who are less involved in activities and who either do not hold jobs or who work fewer hours (93). Additional issues that make young people at particular risk for fall-asleep crashes include the fact that they often are less experienced, drive at a time of day associated with greater sleepiness, drive after extended periods of wakefulness, have a tendency for risk-taking behavior, experiment with alcohol, lack prudence and inappropriately assess risk.

Impact of Sleepiness/Fatigue on Driving

- **Impaired reaction time, judgment and vision**
- **Problems with information processing and short-term memory**
- **Trouble focusing, keeping eyes open, or head up**
- **Daydreaming or wandering and disconnected thoughts**
- **Yawning or repeatedly rubbing eyes**
- **Drifting from the lane, tailgating and missing signs or exits**
- **Feeling restless, irritable and aggressive**

High school start times have been shown to directly impact crash risk amongst teenagers. A 2011 study conducted in Chesapeake and Virginia Beach, which both had different high school start times found that Virginia Beach students, who had the earlier high school start time, had a 40% higher teen crash rate. A follow up study by Dr. Robert Vorona and his team in Henrico and Chesterfield Counties further confirmed that higher crash rates for teenage drivers occurred in the school district that had earlier start times for high schools (94, 95). These findings are similar to others studies on teenagers.

Recommendations to Improve the Sleephealth of Students in York County School Division

As mentioned previously, American public school bell times evolved as a result of economic, social, legal and political pressures and not from the recognition of sleep or child development science and best practices.

In the 1940s, responsibility for financing public education became more regionalized at the state, district and municipality levels. In 1940, local property taxes financed 68% of public school expenses, while state governments contributed 30%. At the same time, most states began to take a more active regulatory role in public education than in the past. Also during this time, many states were consolidating school districts into larger units. In fact, in 1940, there are over 117,000 school districts in the US, but by 1990, there were just over 15,000.

By the early 1960s, there was a rapid increase in the school population due to the consolidation of remaining schools—larger and more complicated school districts were created. This regionalization often resulted in transporting a greater number of students over longer distances. Educators began looking for new ways to deal with the problem of overcrowding, which led to staggered start times being considered and implemented in some school districts. **With little or no sleep science available to guide decision-making, high school start times are typically placed earlier than elementary schools.**

During the 1970s, recession, inflation, increasing fuel costs and budget cuts further contribute to a "do more with less" mentality in school systems and in state and local governments. As a result of waning enrollment and decreasing property tax revenues, many districts look for ways to cut transportation costs and adopt tiered bell schedules so that they could move the same number of students with fewer buses.

In the 1990s, sleep researchers began to describe delayed phase preference in teenagers and the impact of school schedules and employment on their sleep. Researchers also begin to study sleep disorders and the relationship between sleep loss and depression in adolescents. In 1996, Edina, Minnesota became the nation's first school district to delay start times for high school students based on sleep research showing the impact of sleep loss on young people. Shortly thereafter, the National Institutes of Health declared that adolescents and young adults (ages 12 to 25 years) were a population at high risk for problem sleepiness based on "evidence that the prevalence of problem sleepiness is high and increasing with particularly serious consequences." Since then, hundreds of school districts have changed their school start times to protect the health, safety and academic opportunities of their students and staff.

The midAmr Group team has been working with school districts to educate students and staff about the importance of sleep and providing advice on how to change school start times for more than 20 years. Based on an extensive review of school districts of various sizes and characteristics across the country and having reviewed all of the available previous reports and efforts conducted by the York County School Division regarding changing current start times, we provide the following recommendations to further the consideration of ways to promote the health, safety and learning opportunities of students.

1. The Importance of Leadership

After an extensive review of over 100 school districts it is clear that successful change in school start times appears to be associated with strong leadership on the part of the superintendent, district staff and the school board. Specific areas of leadership include valuing the scientific justification for healthy school start times, commitment to working with key community organizations to address logistical and financial challenges, and promoting the benefits to student health, safety, and academic and athletic performance. **It is extremely important that the superintendent sets the tone for changing school start times for the health and safety of students**. This individual can bring along other staff, and can direct communications, planning, logistics and community engagement. The relationship and trust (i.e., political capital) that the superintendent has established in the community and with the school board is also extremely important. If the superintendent and district officials do not communicate their strong support for the bell time change and do not keep discussions focused on the health, safety and academic performance of students, then the process may get bogged down with special-interest concerns.

The school board's public support for the superintendent and for school start time change is also critical. The school board's support is especially vital in communicating to the broader public both the justification (e.g., health and safety benefits) for changing bell schedules and the message that any challenges can be addressed and most likely overcome.

Too often, school districts want to survey students, staff and the community about their opinions in changing school start times. We have seen school leadership who may have personally opposed changing bell times use some results to justify not moving forward. **It should be noted that school systems never poll students or parents about other public health and safety problems and should not do so regarding whether or not to change start times. Successful school districts have focused on surveying interested parties on which bell time options they prefer or how to make such changes less disruptive on their personal schedules rather than whether changes to the bell times should be made at all. People should be encouraged to focus on how to make potential changes work for the health and safety of students.**

2. Education of the Entire Community

York County School Division should consider providing appropriate targeted education for the entire community (e.g., students, parents, teachers, school nurses) about the justification for healthy school start times and approaches to optimizing student health and safety. Change agents and stakeholders should have a working knowledge of the research on adolescent sleep and early start times in order to effectively communicate the rationale for changing bell schedules. It also is important for School Division leadership to refute misconceptions (e.g., "if school starts later, teens will just stay up later and won't get more sleep") while also responding to legitimate concerns of students, parents, and teachers. Partnering with health experts is one possible strategy. **It is extremely important to emphasize the health and safety benefits associated with providing students the opportunity to get more sleep and that the potential benefits go far beyond academic improvements.** When communicating the short and long-term consequences of chronic sleep loss (and, by implication, the potential dangers associated with failing to delay high school start times), it should be emphasized that these extend not only beyond

the school grounds (e.g., drowsy driving, depression, obesity) but very well may set students up for debilitating (e.g., insomnia) or life-threatening medical conditions (e.g., cardiovascular consequences such as hypertension or metabolic dysfunction such as type 2 diabetes) in the future.

Teachers and other school personnel, especially health and counseling professionals, should be well educated about adolescent sleep needs and patterns, taught to recognize the signs of sleep-related difficulties among their students, and report such symptoms to parents and school health providers. **The School Division should consider integrating sleep-related education into curricula so students can learn about the physiology of sleep, the consequences of sleep deprivation, and the importance of sleep to their overall health.** This education can be provided in science, health and athletic classes. Finally, it is particularly important that information be provided to support families throughout the implementation phase in culturally sensitive ways. This includes translating basic print educational materials into multiple languages, providing translation services at community-wide online forums and reaching out to local press venues that serve minority communities.

3. Consensus Building Among Stakeholders

It is important to inform and engage all stakeholders early in the process to understand potential concerns and to seek potential solutions. This includes community members or organizations that use school fields and facilities on a regular basis as well as other city or county agencies that provide programs and services to students (i.e., libraries, parks and recreation, police, employers). **The Division should notify these groups of any changes once the decision is made in order to allow them time to adjust their schedules and for planning, and should continue to engage them throughout implementation in a spirit of partnership.**

The school system should consider the views of school staff and teachers in decision-making about implementation and develop policies that provide flexibility for teachers and other staff to adapt to the changes (e.g., easing periods to make transfer requests). It is also important to involve principals from all three levels (elementary, middle and high schools) in internal discussions because it is likely that all schools and students in the Division will be impacted to some degree, whether or not their own bell times change. Engagement of the students themselves is also critical in garnering support for the change, and often they can be the most passionate and articulate voices in the community.

For all stakeholders, it should be noted that expressed concerns are most often based on contractual or personal issues rather than what is good for the health, safety and well-being of students. In these situations, the superintendent, school board and stakeholder group leaders' public support for start time change will be critical in overcoming any staff or community opposition.

Early in the process of considering bell time changes, the Division should bring together key staff representing several areas (e.g., transportation, curriculum, special or health services, athletics) to do their own fact-finding before engaging additional outside consulting groups. This allows internal staff to identify logistical issues early and begin to develop potential solutions before opening up the debate to the wider community.

In regard to process, it may be prudent to engage the leadership of key community groups in face-to-face meetings in order to build trust, air mutual concerns, and establish an open dialogue prior to engaging the broader community. In general, smaller working groups focused on unique concerns

and specific tasks may be more efficient and productive than large groups that include many stakeholders.

Often times, a superintendent or school board initiate the formation of a working group to review the research and efforts of other school districts. The two most important factors in determining the success of such a working group and implementation of good proposals or options are the commitment of the school leadership and the diversity of the working group. **Ideally, any working group should be organized and chaired by an outside party that has the ability to challenge long-held beliefs or assumptions and play a role in pushing people to think outside the box and find solutions to challenges not just barriers.** It is important that this party have the ability to build trust amongst stakeholders, find where common ground exists while encouraging all members to focus on solutions rather than just problems. **It is extremely important that this independent person or team identify real issues of concern and separate them from myth or unsubstantiated claims in order to figure our where there are items to negotiate or address and where flexibility is available.** In the school districts that we have reviewed, it is very common for school leadership to form working groups consisting of staff and other members that have a vested interest in keeping the status quo. In most cases, this is the first step to failure in achieving change to school start times. Any working groups should be carefully established and challenged to find a path forward that achieves the greatest good for the most students as budgets allow.

4. Transportation as a Major Logistical and Cost Factor

In most districts, transportation logistics are a key factor in determining start time schedules and typically represent the largest cost. In fact, in many districts, transportation is actually the main driver for seeking changes in an attempt to lower costs by moving from a delivery system where all students are transported at the same time to a multi-tiered bus schedule where the bell times are staggered. **The York County School Division has such a system. In speaking with staff, board members and other stakeholders it does not appear that transportation is an insurmountable issue for the Division in changing start times later for its middle and high school students.** The Division should be encouraged to seek more creative strategies to find transportation savings. One strategy that is commonly used to overcome potential transportation costs is what is commonly referred to as “flipping” secondary/high school and elementary bell schedules. This may have the added benefit of being more “in sync” with circadian rhythms in both groups (e.g., younger children typically fall asleep earlier and wake earlier).

5. The Role of Athletics and Community Use of Recreational Facilities

Community members in districts contemplating school start time changes frequently are concerned about the impact on after-school programs, and athletics practices and competitions; however, most of these concerns do not actually materialize or can easily be mitigated by scheduling or policy changes (e.g., game day early dismissal, more flexible instruction time and scheduling). From discussions with York County stakeholders and staff, it appears that any concerns can be dealt with fairly easily since most if not all coaches are NOT employees of the School Division and come from other jobs, thus practices don’t start until at least an hour after the current high school bell schedule.

In our review, we identified no districts in which athletic programs were cancelled or adversely affected by changing start times. To the contrary, a number of districts found that more students participated in athletics and that sports programs grew after high school bell times were delayed. They also reported that their teams performed better following the change. **Thus, it is important for Division officials, coaches and student athletes not only appreciate the likely lack of negative impact on athletics of delayed start times, but to also understand the potential repercussions on relevant health (e.g., metabolic dysfunction, weight gain), performance and safety (e.g., increased sport-related injuries) outcomes related to chronic sleep loss in student athletes.**

6. Consider Broader Community Impacts

In some school districts, start times can impact traffic patterns and other community schedules. Any issues that arise can usually be overcome with planning and communication with other county agencies. Based on discussions, traffic patterns do not seem to be a significant issue. **One issue that does seem to warrant significant review and analysis is bus routes from the northern part of the County, where children appear to need to be at bus stops earlier than what is considered reasonable.**

Among the other myriad of variables that may need to be considered include average (and range of) student commute times, number and length of school bus routes, availability of public transportation, traffic patterns, community use of school recreational facilities, the number of students enrolled in free breakfast programs, and the impact of later dismissal times on after-school programming both for disadvantaged students and for high-achieving students seeking additional academic enrichment opportunities.

7. Prioritizing Sleep Health is an Important Corollary to School Start Time Change

Despite the best of efforts, there is likely to be some variability in how much individual students within a district benefit from start time change. While studies definitively show that students overall obtain more sleep when start times are delayed, there will be families and students who choose not to take advantage of the additional sleep opportunity (96, 97). **This underlines the importance of providing education about sleep health behavior and time management to both parents and students in conjunction with schedule changes. In addition, schools may undermine the benefits of delayed start times by rescheduling after-school programs and activities to before school (e.g., early morning sports practices).** Excessive homework, an issue frequently raised by students and parents, may also diminish students' abilities to obtain optimal sleep. The Division should consider using any change in start times as an opportunity to make other adjustments that are in the best health interests of students and which complement the benefits associated with increased sleep and health.

8. Adjustments Take Time

It is critical to allow adequate time prior to implementing changes for families and other community members to become informed and make sufficient plans (e.g., childcare, transportation, family time). Once finalized, District leadership should communicate the details of the new schedules as early as possible, along with information on the rationale for making changes. **Division-level organized**

and comprehensive communication and outreach efforts are absolutely key in conveying information in a timely manner to the community and in addressing the misinformation and misconceptions that often circulate in the advent of such an important changes.

9. Anticipation is Often Worse than the Reality

Similar to concerns regarding the impact of delayed start and dismissal times on athletic practices and games, many of the other potential problems typically raised in the community prior to the change are often not substantiated. **For example, studies have shown that participation by students in extracurricular activities does not decline when start times are delayed (98, 99). Teacher retention (related to their own childcare and commuting times) is another commonly expressed concern that may not be realized; in Arlington VA, for example, this district offered teachers the opportunity to change school or tiers to aid retention, and the predicted mass exodus of teachers in the District never occurred.** Communities often make adjustments to accommodate changes in schedule; for instance, employers shift work hours for working students and parents shift from before-school to after-school childcare arrangements for elementary school students. Finally, some problems dissipate over time; for example, traffic may temporarily worsen when bus routes are changed, until drivers in the community adjust their commuting patterns. To address concerns and ease the impact of change, school districts have set up hotlines, resource guides, and community meetings to assist adjustment for parents, staff and the community.

10. Monitoring Outcomes is Crucial

Should the York County School Division decide to change its school start times, it should monitor the results and outcomes following the change, communicate positive results to the community and seek ways to mitigate or address any negative or unforeseen impacts. **Ideally, the Division should work with county health professionals or local university or medical centers to design pre- and post-surveys and other methods to measure the impact of changing school start times on student health, safety and academics.** School districts that have conducted outcomes research have been able to communicate the findings to the community to foster further acceptance of changing school start times. Additionally, they have been able to provide important data for the growing scientific literature in this area as well as invaluable resources for other districts contemplating school start time change.

V. Conclusions

Establishing healthy school start times has a clear scientific rationale, but can introduce considerable challenges for communities, including school administrators, families, students, and other stakeholders. While the potential benefits to the health, safety and performance of students are irrefutable, many school districts remain reluctant to “take the plunge” and commit time, effort, resources and political capital to this important effort. It is our hope that providing this informational document with general recommendations regarding the process involved in changing school start times will be an impetus for the Division to take the next step in improving the health, safety and educational opportunities of its students.

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