What's so Bad About Blue Light?

by
Thaddeus W. Bartles, O.D. and Sherry Van Liere

Do you own a smart phone? A tablet? A computer? A flat-screen television? If you are like 90% of Americans, you probably own two or more of these devices. But more importantly, you most likely use these devices for five or more hours a day; according to the Vision Council, 60% of Americans do.

These devices are wonderful, they keep everyone connected, informed and entertained, but how safe are they? New research suggests that they may not be as harmless as we once thought. The problems stem from the way the displays create their images. A flat screen display is a grid of tiny solid state light emitting diodes (LEDs). These diodes pose problems to the human eye because they emit High Energy Visible (HEV) or blue light, which has been shown to be harmful to retinal cells. In addition to LEDs, we are exposed to HEV from an increasing number of sources such as the new energy efficient compact fluorescent lights (CFLs) and the high-energy discharge lamps (HDLs) used in lighting large areas like parking lots, stadiums and indoor sports arenas.

To understand the problems, let’s go back to the basics. Light is energy. All the energy that reaches us from the sun is called the electromagnetic spectrum. This energy travels in waves and ranges from very long radio waves to very short gamma rays. The shorter the wave length, the more energy it contains. Somewhere in the middle of this spectrum, from 390 nm to 700 nm, is a portion our eye can see – this is called visible light or white light.
For years, eye care professionals have warned patients about the dangers of ultra-violet light. These high-energy wavelengths, just below visible light are broken up into three categories, UVA, UVB and UVC. UVC (200-290 nm) is the shortest wavelength and is absorbed by the earth’s ozone layer. UVB (290-320 nm) and UVA (320-400 nm) penetrate to the earth’s surface and both have long and short term negative effects on the eyes and vision. Together, they are known to cause cataracts, macular degeneration, pterygia and photokeratitis (snow blindness). Practitioners offered patients protection ranging from lens coatings to UV blocking contact lenses to UV protective IOLs. Doctors and opticians suggested the use of sunglasses and broad brimmed hats or visors for times outdoors for our patients aged 1 day to 110 years. Most of our patients are aware of the dangers caused by Ultraviolet light.

Recent studies have shown that there is a new bad boy on the block, thanks to the growth in electronic devices. In 2008 Essilor teamed up with the Paris Vision Institute to find the wavelength of light most harmful to the eyes. They discovered that light between the wavelengths of 415 nm to 455 nm were the most harmful to retinal pigment epithelial cells. This light is termed High Energy Visible (HEV) blue light. For the first time, researchers had discovered that a portion of the visible spectrum posed a problem for human eye health.

Blue light is not all bad—it has some important functions. It sets our circadian rhythms which regulate our sleep cycles. It improves cognitive performance and can act as a mood booster. Not all the photoreceptors in the eye control vision. Some send a signal to the
pineal gland in our brain which regulates the production of the hormone melatonin (not to be confused with the pigment melanin). Melatonin slows our body down and makes sleep attractive. Blue light inhibits the production of melatonin. As our bodies evolved, we got our blue light from the sun. When it was daylight, our ancestors were active; when the sun set the release of melatonin caused a slowdown of activity and our ancestors slept.

Now we are in the age of electronic devices. Per the 2013 census, 83.8% of all American households own a computer. In April of 2015, the Pew Research Center reported that 64% of all adults owned a smartphone. USA Today reported in 2006 the average American home had more TVs than people and the television was turned on more than one third of the day. All the displays on these devices emit HEV blue light. We wake up to the alarm on our smartphone, and many 18-34 year olds check Facebook even before getting out of bed. In fact, 80% of smartphone users check their phone within 15 minutes of waking up per IDC Research. Computers have transformed our workplaces, our schools and our daily lives. We are constantly exposed to HEV blue light. And, while some blue light is necessary for maintaining normal body health, we are becoming overexposed to blue light. This overexposure is of concern to eye care professionals for three reasons.

1. Because blue light is the shortest wave length and highest energy visible light, it is scattered by the atmosphere. Therefore, the sky is blue, not red. Blue light is also scattered by the optics of our eyes causing annoying glare. Perhaps the best example of this glare is the reaction to the fancy LED headlights of some newer cars. Annoying, yes, but short-term.

2. Because of its short-wave length and high energy blue light penetrates to the back of the eye more readily than other colors. This energy can increase oxidation of the retinal pigment epithelium, raising the risk of age related macular degeneration (AMD). As the population ages this is a public health concern of the highest level. AMD is the resultant condition of a life time of exposure to both UV and HEV blue radiation.

As we age, our bodies produce lens pigment which helps filter some of this radiation. This is called cataract formation. Children have no lens pigment until around age 18 when their bodies begin production. Physiologically, children’s pupils are larger and their arms are shorter, translating into a higher level of blue light exposure as they hold devices closer to their eyes. According to the vision council, children under age 18 use their devices 2 hours per day.

Adolescents and young adults in their 20s use their devices for social media, entertainment and information gathering. This group is also most likely to check social media after lights out at night. Lens pigment production is in its early stages and not at levels to provide acceptable protection.

Adults in their 30s and 40s are firmly entrenched in the workplace, using laptops and computers daily. Per the vision council, 65% spend more than five hours daily on digital devices. Outside the workplace, this group will use smartphones and tablets for
such things as shopping, tracking professional sports, finding a recipe or finding directions. People in this age group often struggle with digital eyestrain.

People in their 50s have been using digital technology since the 1990s starting with PC Computers and have adapted to advancing technologies. They have amassed 25 years of blue light exposure and although their intraocular lenses are more efficient at blocking blue light thanks to the beginning of cataracts we know that retinal damage is cumulative.

Older adults, 60+, are embracing technology at a fast rate as they seek to keep in touch with family and friends all over the country. Many within this group are experts at Facebook and Skype. Since cataract surgery is being done at an earlier age, surgeons are removing the body’s natural blue light filter and inserting an IOL that may not block any blue light. This presents a problem for a high-risk AMD population.

3. Finally, as noted earlier, HEV blue light inhibits the production of melatonin by the pineal gland. This can lead to sleep deprivation which has been linked to certain conditions such as diabetes, obesity and certain types of cancers.

As eye care professionals, we have a duty to warn patients of the potential dangers of HEV blue light exposure and to offer solutions to counteract these effects on their eyes and ultimately on their bodies.

The first solution is avoidance; not something that is likely to happen, but we can offer patients some advice on the proper usage of electronic devices. The intensity of the light is a function of distance, so holding electronic devices further away will lessen the amount of radiation entering the eye. Keeping ambient lighting roughly equal to screen brightness creates a smaller pupil size which in turn allows less light into the eye. While the 20-20-20 rule (for every 20 minutes of device use, focus on something 20 ft. away for 20 seconds) is more to relieve eye strain, it is applicable in this discussion. And finally, we should suggest that our patients avoid using their electronic devices in the hour before going to bed. In recent months, Apple has been touting its new Night Shift technology which reduces screen brightness at night to keep up with android apps that already offer this technology. For I-phone users, the screen display turns to an amber hue, while android-based users have a gray or red screen. While these apps represent an awareness of the problems caused by electronic devices at night, independent research has yet to prove their effectiveness.

We can also offer a variety of lens options and treatments that can lower the blue light exposure for our patients. Several manufacturers offer an anti-glare lens treatment that reduces the transmission of blue light. Hoya Vision’s solution is the Recharge AR coating. Essilor offers Crizal Prevencia AR. There are several other proprietary AR coatings on the market, such as Nikon’s SeeCoat and Zeiss’ Duravision® BlueProtect. These options are lens coatings that deflect blue light from the lens surface, minimizing the amount that passes through the lens.
Another option is a lens that has ocular lens pigment (OLP) built into the lens material. Manufactured in an indoor material and a polarized outdoor material, The BluTech lens from Eye Solution Technologies is available in a variety of lens designs.

Because the OLP is combined with melanin, this lens has a yellow/brown or champagne tint, and filters HEV blue light while blocking UV radiation. These lenses effectively block wavelengths below 430 nm and reduce transmittance of wavelengths below 500 nm. This is considered the safest option for protection from harmful HEV.

More research needs to be done, but eye care professionals should start today to educate patients about HEV and offer solutions. Remember, 90% of all patients use some type of digital device on a regular basis, yet per the Vision Council 90% of today’s patients do not discuss digital device use with their eye care providers.