

LimeAid breaks the sound barrier for young athletes with Autism Spectrum Disorder (ASD). Approximately 1 in 54 children aged 8 years in the U.S. has a form of ASD ([Maenner et al.](#)), and it is becoming increasingly prevalent ([Baio et al.](#)). Children with ASD often struggle to participate in physical activities — particularly team sports — due to overstimulation. This overstimulation is caused by hyperacusis, a hypersensitivity to sound present in 18% of people with ASD. LimeAid is designed to significantly reduce overstimulation while being comfortable and durable for athletes. While consulting with experts to better develop LimeAid, the director of Special Olympics Northern California mentioned a recent situation that she believes LimeAid would have prevented.

To optimize LimeAid for fit and comfort, we went through a series of designs before prototyping and testing the selected design with younger children. This prototyping and implementation of wearer feedback ensure that a poor fit does not create additional distractions for athletes during play, a crucial detail in a device meant to reduce overstimulation.

The LimeAid app facilitates communication between the coach and the athlete during activity. The child can control the coach's voice volume, ambient noise level, and button haptics using the app on their parent's or coach's phone to allow for customizability. The ability for any athlete to change settings to fit their needs ensures that LimeAid assists as many athletes as possible. The app was also designed with the goal of maximizing impact by allowing the same coach to interact with multiple athletes.

The “call-for-help” button notification on the coach's screen allows the coach to immediately respond to an athlete who is overstimulated or otherwise in need of help. The coach can also communicate with their athletes through the “push-to-talk” button for personalized feedback and encouragement during practices and games. These features help coaches to quickly and discreetly address the unique needs of athletes with ASD.

To ensure that price is not a barrier preventing children in need from using LimeAid, we plan to donate one earpiece set to local organizations and national partners for every three sold. In addition, sales reports, along with sports participation and customer surveys, allow us to observe how well LimeAid addresses the needs of the target audience. This feedback will be used to improve LimeAid and create updated versions to make LimeAid even more impactful for future athletes.

The increases in exercise generated by LimeAid will have wide ranging mental and physical health benefits for users. People with ASD are four times more likely to experience depressive disorders ([Hudson et al.](#)), and 55% of children with ASD experience anxiety disorders ([de Bruin et al.](#)). In addition to the intuitive reduction in obesity rates, exercise has been shown to help with depression and anxiety, as well as low self-esteem and social withdrawal. By encouraging active play and movement in this underrepresented population, LimeAid will have a significant positive impact on the physical and mental health of children with ASD.

LimeAid's unique design enables children with hyperacusis to participate in team sports. With its compact packaging and innovative features, it can be comfortably and effectively used in various active environments. Through LimeAid's integration of its internal technology, app, and physical components, children with hyperacusis and other forms of noise sensitivity no longer face this barrier in team sports.

The LimeAid earpiece has been specifically designed to optimize user comfort. Its internal technology is packaged inside a plastic case designed to fit in and around the user's ear. The 'call for help' button is located on the exterior face of the earbud for quick and easy access. For increased stability during activity, one end of the earpiece features a hook worn over the ear. On the other end is a removable tip, which is inserted into the ear to provide a secure seal for noise cancellation. Both of these components are made of silicone in order to conform to varying ear shapes and sizes. Additionally, a removable strap fastens to each earpiece to provide an extra layer of security.

The internal technology of the LimeAid earpiece enables premium noise cancellation, as well as the wireless system of communication with the coach. Sound input from the environment is first received by a microphone in both earbuds, and is then transferred to an analog-to-digital converter via a pre-amplifier. The input is processed by the central processing unit and digital signal processor of the earpiece, and is adjusted to a preferred decibel level. The resulting sound is sent to a digital-to-analog converter and released through a speaker. Additionally, when the 'call for help' button is pressed, a sensor sends a signal to the coach via a bluetooth transmitter. Each earpiece is powered by a battery, regulated by the power management and central processing units which extend battery life.

Certain sports require the use of headgear, helmets, or other protective equipment which obstruct the athlete's ability to use the nonverbal help buttons located on the earbuds. In addition, many people who have ASD struggle with fine motor skills. To account for these issues, Team 1678 designed an optional wristband to communicate with the coach. The wristband features the same 'call for help' button that is on the exterior of the earpieces and an elastic strap that is adjustable and detachable for convenient cleaning.

The app consists of features that allow athletes to adjust settings to fit their needs, such as volume control of the coach's voice and the level of noise cancellation. Users can also adjust the tactile feedback of the help buttons to maximize usability. Coaches are notified when the athletes press their 'call-for-help' button and can also use the app to communicate with different athletes.

The unique incorporation of multiple features into one innovative device sets LimeAid apart from any other product. LimeAid will revolutionize active play for children with autism, providing everyone with a fun way to play team sports.