Aniruddha Deshpande – *Audiology/Speech-Language-Hearing Sciences*

Peer-reviewed Research Publications:

1. **Deshpande, A. K.,** Shimunova, T. (2019). A comprehensive evaluation of tinnitus apps. American Journal of Audiology, 28 (3), 605-616.

ABSTRACT: Purpose: The use of mobile phones is on the rise worldwide. Many people who experience tinnitus often turn to the Internet and applications (apps) on their smartphones to acquire information on tinnitus and solutions to "cure" tinnitus.The aim of this study was to evaluate and summarize features offered by tinnitus-related apps on different mobile platforms.Method: This study was conducted on 3 mobile platforms—Apple iOS, Google Android, and Windows. The key word tinnitus was searched, and all free and paid apps were downloaded. Relevant apps were reviewed in-depth and then classified into 4 categories based on their functionality—"tinnitus education, awareness, and prevention," "tinnitus assessment and measurement," "tinnitus management," and "misinformation." Results: All mobile platforms yielded both free and paid tinnitus apps, allowing individuals to learn more about tinnitus, assess and measure their own tinnitus, gain access to different sounds to help manage their tinnitus, and find strategies to better cope with their tinnitus. The Google Android platform revealed the most number of tinnitus apps. The "tinnitus management" category consistently outperformed the other categories—containing the most number of apps and the most number of features. A small proportion of misinformation apps were detected across platforms. There were no significant differences in the total number of features between free and paid apps (except on the Windows platform). A cost–feature analysis revealed that more expensive apps did not necessarily offer more number of features. Conclusions: This study reveals that a variety of tinnitus-related apps—both free and paid—are available on different mobile platforms. Clinicians should be aware that patients with tinnitus often rely on apps for additional help and should be prepared to direct them to valid apps. Implications for end users are discussed as well.

2. Deshpande, S. B., **Deshpande, A. K.,** O'Brien, C., McMonagle, K. L. (2019). A study of the portrayal of information related to (central) auditory processing disorder on social media. Hearing, Balance, Communication, 17 (2), 134-144.

ABSTRACT: Purpose: Individuals and family members of people with health-related conditions such as suspected or diagnosed (central) auditory processing disorder ((C)APD), often turn to social media to gain information, find support and connect with peers and professionals as they navigate through their challenges. The purpose of this investigation was to study the portrayal of (C)APD related information on social media platforms. Method: Information related to (C)APD on popular social media platforms like Facebook (pages and groups), Twitter, YouTube and Instagram was systematically categorized, quantified and analysed. Keywords 'central auditory processing disorder' and 'auditory processing disorder' were used to identify and categorize posts across the platforms. Social media metrics such as 'likes', 'dislikes', 'members', 'subscribers', 'views' and 'comments' were utilized to study trends. Results: Instagram, YouTube and Facebook Pages were popular among service provides, were used for sharing information as well as personal stories. YouTube was popular for sharing videos of assessment and management of (C)APD. We found significant differences on the Kruskal–Wallis test with post-hoc Bonferroni corrections between different functional categories of YouTube videos based on the number of likes, views, comments and the interaction quotient. Facebook groups served as virtual support groups and we did not find significant differences between public and closed groups with respect to membership on the Mann–Whitney U test (p=0.085). Instagram and Twitter were popular for sharing research. Conclusion: This investigation reveals that people in the (C)APD community leave their digital footprints via popular social media websites. Such information could be utilized by audiologists and speech language pathologists in counselling and for promoting authentic and reliable information. Also, this study provides insights regarding sharing research related findings and communicating with academicians/scientists via social media.

3. **Deshpande, A. K.,** Deshpande, S. B., & O'Brien, C. (2019). Hyperacusis and social media trends. Hearing, Balance, Communication, 17 (1), 1-11.

ABSTRACT: Purpose: In recent years, social media has taken on a new role of helping spread awareness about numerous health conditions, including hyperacusis. Individuals with hyperacusis, which is an atypical response to sound that

individuals with normal hearing would find acceptable, are turning to social media platforms to learn about and seek guidance regarding their condition, to communicate with healthcare providers, as well as to find support in other members of the hyperacusis community. The purpose of this study was to investigate trends of social media portrayal of hyperacusis.Methods: This investigation systematically analyzed and quantified information related to hyperacusis on three currently popular social media platforms – Facebook (pages and groups), Twitter and YouTube. Further, we noted participation trends across the platforms. The keyword 'hyperacusis' was searched on each platform, and results were manually scraped by two reviewers based on numbers of 'likes', 'members', 'followers', 'views', 'comments' and other social media metrics.Results: Over half of the recorded online activity was seen on YouTube, followed by Facebook pages. YouTube was dominated by videos of individuals sharing their experiences with hyperacusis, while Facebook pages were a popular platform for service providers like audiologists. Misinformation and other false claims were found across all platforms, but predominantly on Facebook pages and YouTube. Conclusions: This investigation suggests that individuals in the hyperacusis community turn to social media to learn about their condition and share their experiences. Results of this investigation will equip audiologists with information regarding the current portrayal of hyperacusis online and on social media platforms. Audiologists and other hearing health professionals may use these findings to better counsel patients with hyperacusis.

4. O'Brien, C., **Deshpande, A. K.,** & Deshpande, S. B. (2019) Tinnitus awareness and misinformation on social media. The Hearing Journal, 72 (1), 18-21.

ABSTRACT: As more individuals experience tinnitus, some researchers have labeled the condition a "global burden" (*J Formos Med Assoc.*2016 Mar;115(3):139). As such, social awareness of the condition has spread, in no small part due to the internet and social media. About 75 percent of American adults use the internet, including various social media platforms, to learn about health conditions like tinnitus (PEW, 2014). The World Health Organization has asserted the importance of modern social media platforms, particularly in their ability to provide more people with instant and easy access to health-related information (*Bull World Health Organ.* 2009 Aug;87(8):566). Social media also allow users to discuss health conditions (like tinnitus) and build relationships with others who share symptoms or experiences (*Am J Audiol.* 2017 Mar 1;26(1):1; *J Neurosurg Pediatr.* 2017 Aug;20(2):119). These virtual platforms can encourage communication about and management of disorders, thereby promoting confidence and empowerment. However, the lack of adequate gate-keeping mechanisms on social media may pose a threat to information accuracy. Misinformation can be particularly dangerous to people who are distressed by their condition, like tinnitus, and desperate to find an effective treatment (*J Acad Librariansh.* 2015; 41:583). In fact, billions of dollars are spent each year on items marketed online as "tinnitus cures" (*Otol Neurotol.* 2016 Aug;37(7):991). If tinnitus-related information posted online is systematically analyzed, audiologists and other hearing health care professionals can be better equipped to correct possible patient misinformation. As such, this study assessed the prevalence, quality, and trends of tinnitus-related information across three popular social media platforms: Facebook, Twitter, and YouTube (*AJA.* 2018. doi:10.1044/2018_AJA-18-0033).

Conference Poster Presentations

1. O'Brien, C., & **Deshpande, A. K.** (2019). Are individuals with tinnitus more susceptible to online misinformation? ASHA convention, Orlando, FL. (*Featured talk in the 'Selections from ASHA Convention' series)

SUMMARY: The quality of online medical information can conflict with evidence-based research. Tinnitus is a target for misinformation and bogus treatments due to its prevalence and lack of objective treatments. This study assessed how people with and without tinnitus respond to online misinformation regarding tinnitus, and determined whether a counseling session regarding causes and management of tinnitus affected susceptibility to misinformation.

2. Kraft, R., Birk, F., Reichert, M., **Deshpande, A. K**., Schlee, W., Langguth, B., Baumeister, H., Probst, T., Spiliopoulou, M., & Pryss, R (2019). Design and implementation of a scalable crowdsensing platform for geospatial data of tinnitus patients. The 32nd IEEE International Symposium on Computer-Based Medical Systems. Cordoba, Spain.

SUMMARY: Smart devices and low-powered sensors are becoming increasingly ubiquitous and nowadays everything is connected, which is a promising foundation for crowdsensing of data related to various environmental phenomena. Resulting data is especially meaningful when it is related to time and location. Interestingly, many existing approaches built their solution on monolithic backends that process data on a per-request basis. However, for many scenarios, such technical setting is not suitable for managing data requests of a large crowd. For example, when dealing with millions of data points, still

many challenges arise for modern smartphones if calculations or advanced visualization features must be accomplished directly on the smartphone. Therefore, we realized an architectural design for managing geospatial data of tinnitus patients, which combines a cloud-native approach with Big Data concepts used in the Internet of Things. The architectural design shall serve as a generic foundation to implement (1) a scalable backend for a platform that covers the aforementioned crowdsensing requirements as well as to provide (2) a sophisticated stream processing concept to calculate and pre-aggregate incoming measurement data. Following this, a visualization feature was realized to provide users with a comprehensive overview of noise levels in their environment based on noise measurements. This shall help tinnitus or hearing-impaired patients to avoid locations with a burdensome sound level.

Professional Presentations:

1. **Deshpande, A. K.** (2019). Advancements in tinnitus management. 3rd Annual Silence was stolen: Tinnitus awareness walk and fundraiser, Co-sponsor: American Tinnitus Association, East Meadow, NY.

2. **Deshpande, A. K**., & O'Brien, C. (2019). Tinnitus, twitter, and technology. Hearing Loss Association of America, Great Neck, NY.

3. **Deshpande, A. K.** (2019). Tinnitus research at the Hear-Ring Lab. National Institute for Occupational Safety and Health, Cincinnati, OH.

Aniruddha Deshpande – *Audiology/Speech-Language-Hearing Sciences*

Peer-reviewed Research Publications

1. **Deshpande, A. K.,** Deshpande, S. B., & O'Brien, C. (2018). A study of social media utilization by individuals with tinnitus. *American Journal of Audiology, 27* (4), 559-569.

ABSTRACT: Purpose: As more people experience tinnitus, social awareness of tinnitus has consequently increased, due in part to the Internet. Social media platforms are being used increasingly by patients to seek health-related information for various conditions including tinnitus. These online platforms may be used to seek guidance from and share experiences with individuals suffering from a similar disorder. Some social media platforms can also be used to communicate with health care providers. The aim of this study was to investigate the prevalence of tinnitus-related information on social media platforms. Method: The present investigation analyzed the portrayal of tinnitus-related information across 3 social media platforms: Facebook (pages and groups), Twitter, and YouTube. We performed a comprehensive analysis of the platforms using the key words "tinnitus" and "ringing in the ears." The results on each platform were manually examined by 2 reviewers based on social media activity metrics, such as "likes," "followers," and "comments." Results: The different social media platforms yielded diverse results, allowing individuals to learn about tinnitus, seek support, advocate for tinnitus awareness, and connect with medical professionals. The greatest activity was seen on Facebook pages, followed by YouTube videos. Various degrees of misinformation were found across all social media platforms. Conclusions: The present investigation reveals copious amounts of tinnitus-related information on different social media platforms, which the community with tinnitus may use to learn about and cope with the condition. Audiologists must be aware that tinnitus sufferers often turn to social media for additional help and should understand the current climate of how tinnitus is portrayed. Clinicians should be equipped to steer individuals with tinnitus toward valid information.

2. **Deshpande, A. K.,** Tan, L., Lu, L. J., Altaye, M., & Holland, S. (2018). fMRI as a pre-implant objective tool to predict children's post-implant auditory and language outcomes as measured by parental observations. *Journal of American Academy of Audiology, 29* (5), 389-404.

ABSTRACT: Background: The trends in cochlear implantation candidacy and benefit have changed rapidly in the last two decades. It is now widely accepted that early implantation leads to better postimplant outcomes. Although some generalizations can be made about postimplant auditory and language performance, neural mechanisms need to be studied to predict individual prognosis. Purpose: The aim of this study was to use functional magnetic resonance imaging (fMRI) to identify preimplant neuroimaging biomarkers that predict children's postimplant auditory and language outcomes as measured by parental observation/reports. Research Design: This is a pre–post correlational measures study. Study Sample: Twelve possible cochlear implant candidates with bilateral severe to profound hearing loss were recruited via referrals for a clinical magnetic resonance imaging to ensure structural integrity of the auditory nerve for implantation. Intervention: Participants underwent cochlear implantation at a mean age of 19.4 mo. All children used the advanced combination encoder strategy (ACE, Cochlear Corporation_, Nucleus_ Freedom cochlear implants). Three participants received an implant in the right ear; one in the left ear whereas eight participants received bilateral implants. Participants' preimplant neuronal activation in response to two auditory stimuli was studied using an event-related fMRI method. Data Collection and Analysis: Blood oxygen level dependent contrast maps were calculated for speech and noise stimuli. The general linear model was used to create z-maps. The Auditory Skills Checklist (ASC) and the SKI-HI Language Development Scale (SKI-HI LDS) were administered to the parents 2 yr after implantation. A nonparametric correlation analysis was implemented between preimplant fMRI activation and postimplant auditory and language outcomes based on ASC and SKI-HI LDS. Statistical Parametric Mapping software was used to create regression maps between fMRI activation and scores on the aforementioned tests. Regression maps were overlaid on the Imaging Research Center infant template and visualized in MRIcro. Results: Regression maps revealed two clusters of brain activation for the speech versus silence contrast and five clusters for the noise versus silence contrast that were significantly correlated with the parental reports. These clusters included auditory and extra-auditory regions such as the middle temporal gyrus, supramarginal gyrus, precuneus, cingulate gyrus, middle frontal gyrus, subgyral, and middle occipital gyrus. Both positive and negative correlations were observed. Correlation values for the different clusters ranged from 20.90 to 0.95 and were significant at a corrected p value of 0.05. Correlations suggest that postimplant performance may be predicted by activation in specific brain regions. Conclusions: The results of the present study suggest that (1) fMRI can be used to identify neuroimaging biomarkers of auditory and language performance before implantation and (2) activation in certain brain regions may be predictive of postimplant auditory and language performance as measured by parental observation/reports.

Conference Poster Presentations:

1. McMonagle, K., O'Brien, C., **Deshpande, A. K.,** & Deshpande, S. B. (2018). Social media utilization in the central auditory processing disorder community. ASHA convention, Boston, MA.

ABSTACT: Social media utilization in the central auditory processing disorder (CAPD) community was investigated among Facebook pages, Facebook groups, Instagram, Twitter, and YouTube. Posts were categorized according to their functionality. Each platform exhibited patterns of what kind of information was shared, whether it was to promote service providers, provide advice/support for families, provide general information/awareness, or share personal stories.

2. Shimunova, T., O'Brien, C., & **Deshpande, A. K.** (2018). A comprehensive evaluation of tinnitus apps. AAA 2018. Nashville, TN.

ABSTACT: The use of mobile phones is on the rise worldwide. Many tinnitus applications (apps) are available for download on mobile operating systems and hand-held tablets. The primary aim of this study was to summarize features and investigate trends of different free and paid tinnitus apps available on three platforms - Apple iOS, Google Android, and Windows Mobile. Relevant apps were reviewed, tested and classified into four categories based on their functionality – tinnitus education, assessment, management and misinformation.

3. O'Brien, C., Deshpande, S. B., & **Deshpande, A. K**. (2018). Hyperacusis and social media trends. AAA 2018. Nashville, TN.

ABSTACT: Recently, social media platforms have helped spread awareness about various health conditions including hyperacusis. This study investigated trends in usage of four social media platforms (Facebook pages and groups, Twitter, and

YouTube) by individuals with hyperacusis. Almost half of the recorded activity was seen on YouTube, while Facebook pages were popular with service providers. False claims and misinformation was also prevalent. Results of this study will equip audiologists with additional information useful during counseling of hyperacusis patients.

4. O'Brien, C.*, Deshpande, S. B., & **Deshpande, A. K**. (2018). A study of social media utilization by individuals with tinnitus. AAA 2018. Nashville, TN. *(* STAR award recipient)*

ABSTACT: Social media platforms are being used increasingly by patients to seek health-related information and support for various health conditions including tinnitus. This study analyzed the portrayal of tinnitus-related information across four social media platforms (Facebook pages and groups, Twitter, and YouTube). Greatest activity was seen on Facebook pages, but substantial misinformation was found across all platforms. Audiologists must be aware that tinnitus sufferers often turn to social media for additional help and be equipped to steer them toward valid information.

Professional Presentations:
1. Deshpande, S.B., **Deshpande, A. K.,** & Thomas, J. (2018). Hearing screening and audiology education on Staten Island. St. John's University, Staten Island Campus, NY.

2. Deshpande, A. K. (2018). Music induced hearing loss and tinnitus: Signs, symptoms and prevention. East Meadow High School, East Meadow, NY.