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LITERATURE REVIEW

Long COVID and COVID-Induced Ménière's Disease: Overview and Recommendations

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Abstract

SARS-CoV-2, the infectious agent causing the ongoing COVID-19 pandemic, often has long-term impacts on the health of those who survive initial infection [1-6] and can lead to premature death [1]. An understudied outcome of COVID-19 is its effect on the audiovestibular system [7,8]. Impacts of the virus on this system create a pattern of disability similar to that of Ménière's Disease (MD), a progressively degenerative condition that can cause severe falls and deafness [1]. COVID-induced MD (CMD) impacts physical, social, psychological, financial, and other dimensions of health in profound ways that must be addressed throughout public and individualized health systems as early in its course as possible in order to increase individuals' quality of life and decrease costs to individuals and society. In this paper, we define "post-COVID syndrome," describe MD in more detail, and provide additional information on how MD impacts health, quality of life, and potential social and economic costs of COVID-19-induced MD (CMD). We also discuss options for early detection and intervention. Finally, we provide suggestions for public- and community-based health approaches to addressing MD and COVID-19-originated MD (CMD) that focus on early detection and intervention, provider education, integrated treatment options that include use of interdisciplinary teams and paraprofessionals, fall prevention, and future avenues for research.

Introduction

SARS-CoV-2, the infectious agent for the ongoing COVID-19 pandemic, often has long-term impacts on the health of individuals who survive initial infection [1-6] and can lead to premature death [1]. Multiple organ systems may be singly or interactively impacted by the virus, compounding the resultant long-term negative health outcomes of SARS-CoV infection. Organ systems that may be impacted include but are not limited to the cardiovascular systems. The central and peripheral nervous systems, and the cardiopulmonary system [1,3,6,7,9-11].

An understudied outcome of COVID-19 is its effect on the aural system, notably on the inner ear, responsible for vestibular balance and hearing [7,8]. Impacts of the virus lead to a pattern of disability similar to that of Ménière's Disease (MD), a progressively degenerative condition that can ultimately cause severe falls and deafness [1]. COVID-induced MD (CMD) impacts physical, social, psychological, financial, and other dimensions of health in profound ways that must be addressed throughout public and individualized health systems as early in its course as possible in order to increase individuals' quality of life and decrease costs to individuals and society.

Ménière's Disease (MD) has historically been diagnosed primarily in people aged 40-60 (AHRF, 2022). Its effects on the inner ear include stiffening of the "hairs" (stereocilia) that line the cochlea, tinnitus, deafness, dizziness, vertigo and loss of balance that can lead to increased risk for falls [7,12]. Falls caused by MD typically occur without warning, loss of consciousness, or neurological symptoms and are known as drop attacks, Tumarkin drop attacks, drop vestibular attacks, or otolithic crises [12]. These can be severe, especially before MD/CMD is identified, and early in symptom

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and sign progression. Outcomes mirror those of other falls and can include spinal column, skull, hip, and other bone damage; spinal cord damage; organ punctures and lacerations; and other severe injury. Notably, as individuals' deafness becomes more profound, vestibular system difficulties decrease, as does the risk of falls (England-Kennedy, unpublished research). Progressive hearing loss and physical damage due to falls can require rehabilitative services and, potentially, long-term care.

Although incidence and prevalence are higher in people aged 40-60, younger individuals also can acquire MD, especially as outcomes of viral infections such as SARS-CoV-2 [1] or if they are genetically predisposed to the condition [13-15]. Such instances can be met with skepticism by medical professionals due to historic rarity of MD in younger age groups [15], potentially delaying rehabilitation and other therapeutic processes and increasing personal and societal costs.

In this paper, we explain the concept of "post-COVID syndrome," describe MD in more detail, the association between SARS-CoV-2 and the audiovestibular system, and the causes of hearing loss and vertigo due to COVID-19. Next, we provide additional information on potential social and economic costs of COVID-19-induced MD (CMD). After this, we discuss options for early detection and intervention. Last, we provide suggestions for public- and community-based health approaches to addressing MD and COVID-19-originated MD (CMD) that focus on early detection and the need for early intervention, public- and community-based health approaches including fall prevention programs, and future areas and avenues for research.

Literature Review

"Post-COVID Syndrome" defined

The term "post-COVID syndrome" (PCS), sometimes referred to as "long COVID" or "long-haul COVID," refers to a wide array of physical and mental health sequelae that persist for four or more weeks after initial resolution of SARS-CoV-2 infection [1,3,10,11]. Progression varies: Symptoms and signs may individually or collectively persist or may appear intermittently or in patterns of recovery and relapse/remission. The syndrome has been described as falling into two stages: Post-acute (symptoms continue for 3-12 weeks) and chronic (symptoms continue for longer than 12 weeks) [10]. The majority of those experiencing post-COVID syndrome test negative for the virus [10], indicating that the virus itself is no longer directly causing symptoms.

Symptoms and signs include chronic breathing difficulties, fatigue, headache, diarrhea, cough, joint and/or chest pain; heart palpitations; rashes; neurologically-based discomforts (e.g., "pricking" sensations); mental health difficulties such as depression, anxiety, and trauma responses; reduced capacity to complete acts of daily living (ADL), and reduced quality of life (QOL) [6,10] gustatory and gastrointestinal impacts [4] neural system invasion through the neuro/olfactory bulb linkage [5,6] and/or through the angiotensin-converting enzyme 2 mechanism found in alveoli, glial cells, and neurons [4] sensory loss (most commonly taste and smell, but also hearing; [2,4] neurological impairments and multiorgan failure [4,5] cognitive processing difficulties sometimes referred to as "brain fog" [3,6], and inner-ear-related conditions such as dizziness, vertigo, and tinnitus [2,4,16]. No universal upper length of chronicity limit has been established, though an upper limit of one year is sometimes noted [3,17].

Association of SARS-CoV-2 and the audiovestibular system

Lovato, et al. [17] focused directly on the association between COVID-19 and CMD by calculating differences in incidence of MD diagnosis before and after COVID-19. Diagnosis was defined using the number of first audiological evaluations over three years; incidence rose from 1.3% and 1.2% in 2018 and 2019, respectively, to 3.2% in 2020. It is possible that this increase is an underestimation, as social distancing protocols at the time may have made individuals reluctant to see diagnoses.

Jafari, et al. [4] concluded that a statistically significant association ($p \leq 0.001$) between COVID-19 infection and hearing loss, tinnitus, and dizziness exists, most often in a pattern of sudden sensory-neural hearing (SSNHL) loss with tinnitus. In addition, the authors posit that non-severe cases may have been overlooked to date, resulting in case undercounts and a general lack of data that would lead to a more complete understanding of incidence and progressions [4]. Reasons for the undercount include a focus on more immediate symptoms such as respiratory symptoms and signs that leads to overlooking audiovestibular impacts and, conversely, an absence of pulmonary symptoms that leads to underdiagnosis of COVID-19 [4]. Risks of each possibility are exacerbated by a lack of frontline providers' specific knowledge about CMD.

Causes of hearing loss and vertigo

Sudden sensorineural hearing loss (SSNHL) is defined as a 30 dB or greater loss in three or more contiguous audiometric frequencies that develops within three days of symptom onset. It ranges from mild to profound and can occur in either or both ears. In cases caused by COVID-19, SSNHL can occur even in the absence of typical respiratory signs [9]. Most SSNHL cases are idiopathic [18] and can be caused by viral infections [7,9]. Hearing loss prognosis depends on the duration and degree of deafness [18].

Multiple possible mechanisms by which COVID-19 affects the aural system have been posited: Neuritis can be caused by the virus' invading and causing

inflammation-related damage to the meninges, labyrinth, or cochlear nerve [9,19]. Cochleitis (infection of the cochlea) can be caused by viral involvement in perilymphatic tissues and the cochlea itself. Embolus formation can cause corruption of the microvascular structure in the inner ear, as can an increase in endolymph volume [13,19]. Damage to the sensory cells of the cochlea can cause stiffening of the "hairs" (stereocilia) that line the cochlea [19] and limit their ability to respond to sound. Latent viral infections within spiral ganglia or the auditory brainstem may be reactivated, causing damage patterns often seen in viral-induced SSNHL [9]. Finally, it has been posited that SARS-CoV-2 may create an autoimmune dysfunction within the inner ear, causing antibodies to the virus to attack inner ear antigens [19]. Further research on causal mechanisms is needed.

Potential indirect causes of MD and CMD-induced SSNHL include hemorrhage within the labyrinth [16], which could itself be caused by COVID-19's impacts on the cardiovascular system. Further research needs to be done to identify most probable causes of CMD.

Potential reversibility of MD and CMD hearing loss

SSNHL outcomes are affected by multiple factors such as the duration of hearing loss, vertigo, and tinnitus and comorbidity or pre-existence of conditions such as diabetes and hypertension that increase the risk of ischemic vascular diseases (e.g., stroke) [18]. Reversibility of SSNHL is in part dependent on prompt diagnosis: If treatment begins within one week after initial hearing loss, clients have a 67% chance of regaining hearing. After two weeks, probability of recovery is 52%, after which recovery probability drops to 10% or less. If initial hearing loss is associated with diabetes, hypertension, and/or vertigo, reversibility rates are lower [18]. It should be noted that this pattern is generalized for all-cause SSNHL; further research is needed to determine rates of reversibility of CMD-related SSNHL.

The American Academy of Otolaryngology-Head and Neck Surgery guidelines recommend treatment with oral corticosteroids within two weeks of symptom onset, followed by intertympanic steroid injection for clients who do not respond to this treatment protocol within 2-6 weeks. The effectiveness of this protocol is not certain and corticosteroid use may be contraindicated for some clients [7,9]; further research on treatment is needed. Lye, et al. [9] report on a case of a woman who experienced sudden hearing loss due to COVID-19 infection. After treatment with oral prednisolone for 2 weeks followed by an initial oral corticosteroid protocol, hearing loss began to reverse. However, the client then was without treatment for 3 months, during which time both ears lost hearing [9]. This case underscores the importance of treatment completion and consistent client tracking and retention.

Correia, et al. [19] assessed the potential impact of psychological factors on the course of MD that can be extrapolated to CMD. They found that the duration of MD had a positive moderate correlation with anxiety and mood disorders. Similarly, Lovato, et al. [17] found that approximately 50% of tested clients with MD had co-morbid depression. This team and that of Kitahara, et al. [20] also report that depression and anxiety exacerbate symptoms and signs of MD and CMD, especially vertigo. Psychological support and treatment are recommended for clients with MD in order to improve their quality of life as well as supporting MD treatment more generally [17,19-21]. Similar supports could be adapted from these to support clients whose MD results from COVID; future research results on possible additional psychological impacts of generalized pandemic- and specific COVID-related trauma can be integrated into support provision for CMD.

Potential social and economic costs of CMD

Vestibular problems such as dizziness, vertigo, and MD increase costs at all levels of the health care system. Direct costs include treatment, consultations, emergency transport and care, use and overuse of diagnostic imaging such as magnetic resonance imaging. Indirect costs include workplace absenteeism, lost productivity and efficiency in the workplace, and time lost to changing or losing jobs [22]. Co-morbid anxiety and/or anxiety are common for clients with MD [3,17,22]. Comorbid anxiety typically increases the number of consultations by clients, thereby increasing overall costs [22]. CMD can lead to a level of disability (e.g., profound deafness) that qualifies the person for Federal and other assistance programs such as SSDI, SNAP, and Medicaid, increasing social costs.

Information on economic costs of MD is limited, but Jeong, et al. [23] found that direct costs of MD in the United States in 2018 averaged $9579 per person annually (approximately $19.68 billion/year), with potential increases if magnetic resonance imaging or computed tomography scans were included in assessments. Inpatient assessments were more costly than outpatient [23]. Cases of CMD that progress to severe or profound hearing loss can cost an average of $297,000 across an individual's lifetime, although costs of special education for young children can increase this cost by up to 21% [24]. Total lifetime costs for all vestibular conditions combined for U.S. adults older than 60 cost up to $225 billion er year [22]. Direct costs of all-cause falls (i.e., including but not limited to MD-induced falls of U.S. adults aged 65 and older have been estimated at $50 billion in 2015, with costs paid primarily by Medicare and Medicaid [25]. Newgard, et al. [26] found that costs for all-cause falls increased for 74.6% of inpatient and outpatient clients, with a median cost of $12,682; the highest cost increases were for inpatient services.

Social costs of CMD must also be considered in assessing the impact of CMD on individuals and society, e.g., decreased quality of life and reduced capacity for completing tasks of daily living. Decreased quality of life alone can cost approximately $65,000 in the United States [22]. In cases of younger individuals with children, fear of losing parental custody and lack of CMD knowledge may lead individuals to seek diagnosis late, potentially delaying occupational and other rehabilitation [27-29].

Custody loss fears are not unfounded. In the United States, parental disability can be legally considered as a reason for loss of child custody despite protections included in the Americans with Disabilities Act. All but 15 states explicitly include disabling conditions to be sufficient legal grounds for parental rights termination (Washington PAVE 2022), and up to 80% of child removals involve parents with disabilities, including those who are deaf or hard of hearing [30].

Recommendations

In addition to treatment, recommendations have been made for earlier diagnosis and treatment initiation, psychological support for those diagnosed with CMD, improved provider education, increased use of telemedicine, fall prevention and amelioration programs, and further research on aspects of CMD and SSNHL. In this section, we review potential options.

Lye, et al. [9] recommend further investigation of the association between COVID and SSNHL, as well as early screening for CMD in clients diagnosed with COVID-19 and COVID-19 screenings for anyone experiencing sudden idiopathic hearing loss. As noted above, multiple authors also recommend integrating psychological support and treatments into any treatment plans for people with CMD [19-21]. Within their own practice and through their professional organizations, professionals specializing in head and neck medicine can advocate for and participate in interdisciplinary teams that include psychologists and, potentially, social workers who can assist clients with accessing social services.

Early Detection and Intervention

Additionally, Lye, et al. [9] recommend early screening for CMD in clients diagnosed with COVID-19 and COVID-19 screenings for anyone experiencing sudden idiopathic hearing loss. Because MD is not common in individuals under the age of 40, individuals below this typical age of onset who develop severe audiovestibular debilitation due to SARS-CoV-2 infection may have difficulty convincing medical professionals who are not fully educated on CMD to "take them seriously" (England-Kennedy, unpublished research). This can potentially delay treatment and hasten the onset of chronic disability. Costs of rehabilitative services required to address CMD-related loss of hearing, deafness, and fall outcomes could be higher in younger individuals if treatment is initiated late in CMD progression. COVID-19-related incidence of CMD in younger people will increase prevalence in these age ranges, potentially necessitating increased health provider education on this specific impact of COVID-19. This can be provided through medical and nursing education courses, continuing education credit requirements, voluntary webinars provided by state- or federally-funded programs, and similar venues.

Currently, vertigo, including MD- and CMD-induced vertigo, are rarely first identified at the primary care level of medical services provision [22]. Earlier diagnosis and treatment initiation could reduce costs of rehabilitation, days of work lost, years of productive or potential life lost, and social costs to systems such as Medicaid, Medicare, unemployment benefits services, and foster services. We therefore recommend enhanced training in audiovestibular conditions in medical school and residency and nursing programs, particularly for students pursuing degrees related to primary health care across the lifespan and those planning to specialize in head and neck medicine.

A study in Japan assessing the impact of COVID-19 on outpatient cancellations by clients who were experiencing vertigo and dizziness at the pandemic's onset found a cancellation rate of 88.2% by clients with MD. The primary reason given was fear of infection [21]. The authors recommend increased use of telemedicine for cases of MD and CMD. Including assessment of aural symptoms in SARS-CoV-2 and other forms of severe viral infection in telemedicine consultations could lead to earlier detection and treatment, lowering personal and social costs associated with falls and deafness. Preliminary findings by Houston and Stredler-Brown [31] indicate that telemedicine can be especially useful for children with hearing impairments and their families in rural areas. We recommend that protocols for such assessments be included in telemedicine procedures, especially those that are government-funded, and recommend that head and neck medicine professionals become more comfortable with screenings of this type.

Because MD has traditionally been primarily seen as being a condition impacting people aged 40 and older and because CMD is under-reported in professional literatures, there is a strong possibility that impacts of SARS-CoV-2 on child audition and balance could be overlooked. Currently, hearing screening recommended by bodies such as the CDC [11] are not required by all states. We recommend that the Federal government build on the 2017 Early Hearing Detection Intervention Act (PL 115-71) [32] to extend mandatory school-based audiological screening to all children ages 0-5 (National Institute on Deafness and Other Communication Disorders [NIDCD]) [32]. We also recommend that young children who have been diagnosed with or who

have evidenced hallmark medical signs of COVID-19 (e.g., loss of taste or smell) through federally-funded school-based services be included in the list of "… young children who are [included in requirements under PL 116-71 because they are] at risk of losing their hearing during childhood from infection, harmful noise exposure, or genetic causes" [33]. Rehabilitative services for CMD-related disabilities such as hearing loss and traumatic brain injuries related to CMD-related falls should be provided through school-based services.

Funding for school-based screenings and services can be provided through coordination with the Title V Maternal and Child Health Services Block Grant Program and the Medicaid Early Periodic Screening, Diagnostic, and Treatment benefit (Health Services and Research Administration [HRSA], n.d.) [34] Increased Federal funding that allows schools to meet recommended caseload, workload, IEP, and 504 requirements (e.g., as recommended by the American Speech-Language-Hearing Association [ASHA]) [35] may be needed. Professionals in fields related to head and neck medicine advocate for early screening, diagnosis, and treatment with local school boards and superintendents of school systems, and through professional organizations.

Public- and Community-Based Health Approaches to CMD

Involving Community Health Workers (CHWs, also known as *promotores*) in promoting community-based health of individuals affected by CMD may also prove valuable. CHWs are paraprofessionals who are recruited from the communities in which they work and provide services such as outreach and health education. Programs involving paraprofessionals such as CHWs rather than medical personnel have been successful in supporting client health, including members of populations that are typically seen as "hard-to-reach" [36]. Notably, one program in which CHWs delivered hearing aids to elders living independently in the community found that self-reported communication skills of the experimental group improved significantly ($p \leq 0.05$) compared to those of a control group [37]. CHWs could also educate individuals on methods for "falling safely" by controlling anxiety, avoiding panic, and protecting vulnerable parts of the body (e.g., as described by Zimmerman) [38]. Emergency Medical Technicians (EMTs), CHWs, and social workers affiliated with fire departments could also assist community residents at risk of falling in completing home safety assessments for fall prevention using online tools (e.g., CDC, 2005). These individuals could also help a resident access a physician who could approve a more intensive Medicare-funded fall-prevention assessment [39]. Integrated services that identify households that call repeated times for emergency services due to falls and arrange for follow-up services could reduce falls and costs to households and communities (e.g., City of Las Cruces Public Safety, [n.d.]) [40]. Professionals in fields related to head and neck medicine can be integrated into such teams and advocate with local firefighting units and emergency rooms for their creation.

Future Avenues for Research

As case reports of CMD-associated SSNHL are limited [9], documentation and publication of individual cases are recommended in order to increase provider awareness [7]. Further research is also needed on multiple aspects of CMD, including direct and indirect causality, specific linkages between COVID-19 variants and SSMHL, long-term outcomes of CMD and how these compare with similar outcomes of MD, relative effectiveness of treatments and rehabilitative services, the impact on social networks of affected persons, and needs for specialized schooling of impacted children. Given the paucity of research on children with MD or CMD, case studies of children aged 0-18 are also critically needed.

Conclusion

COVID-19 case numbers continue to rise, sometimes in localized surges and/or in patterns that include SARS-CoV-2, flu, and (primarily in children) Respiratory Syncytial Virus [41], and variants continue to emerge [42-44]. Cases of CMD can therefore be expected to rise in number, including cases of children. Research on CMD and its treatments are needed. Additional public, school, and medical interventions can reduce costs and improve quality of life for individuals whose audiovestibular system is impacted by SARS-CoV and its variants. Professionals specializing in head and neck medicine can use their unique training and experience to argue for enhanced assessment practices, particularly through schools; to advocate for and participate in interdisciplinary teams, e.g., including psychologists, social workers, nurses, Community Health Workers, educators, and as audiovestibular specialists; and publish and present on their own case studies and research in order to improve service delivery and decrease personal and social costs of COVID-19-induced Ménière's Disease.

References

1. Ahmad FB, Anderson RN, Cisewski JA, Sutton PD (2022) Identification of deaths with post-acute sequelae of COVID-19 from death certificate literal text: United States, January 1, 2020-June 30, 2022. CDC Stacks 25.

2. Gabr T, Kotait M, Moaty AS (2022) Audiovestibular and vaccination complications of COVID- 19. Egypt J Otolaryngol 38: 105.

3. Han Q, Zheng B, Daines L, Sheikh A (2022) Long-term sequelae of COVID-19: A systematic review and meta-analysis of one-year follow-up students on post-COVID symptoms. Pathogens 11: 269.

4. Jafari Z, Kolb BE, Mohajerani MH (2021) Hearing loss, tinnitus, and dizziness in COVID-19: A systematic review and meta-analysis. Can J Neurol Sci 1-12.

5. McQuaid C, Brady M, Deane R (2021) SARS-CoV-2: Is there neuroinvasion? Fluids and Barriers of the CNS 18: 32.
6. Iroegbu JD, Ifenatuoha CW, Ijomone OM (2020) Potential neurological impact of coronaviruses: Implications for the novel SARS-CoV-2. Neurol Sci 41: 1329-1337.
7. Umashankar A, Prakash P, Prabhu P (2021) Sudden sensorineural hearing loss post coronavirus disease: A systematic review of case reports. Indian J Otolaryngol Head Neck Surg 74: 3028-3035.
8. AHRF (2022) Balance disorders: An overview. American Hearing Research Foundation.
9. Lye MH, Lin CT, Othman NA (2022) Sudden sensorineural hearing Loss in coronavirus disease -2019: Our experience. Indian Journal of Otology 28: 186-188.
10. Raveendran AV, Jayadevan R, Sashidharan S (2021) Long COVID: An overview. Diabetes Metab Syndr 15: 869-875.
11. Centers for Disease Control and Prevention (CDC) (2022) Screening and diagnosis of hearing loss.
12. JAMA Neurology (2020) Drop attack in Meniere Disease, JN Learning.
13. American Academy of Audiology (AAA) (2021) New genetic findings in familial Meniere's Disease.
14. Gallego-Martinez A, Lopez-Escamez JA (2020) Genetic architecture of Meniere's Disease. Hear Res 397: 107872.
15. Chiarella G, Petrolo C, Cassandro E (2015) The genetics of Ménière's Disease. The Application of Clinical Genetics 8.
16. Chern A, Famuyide AO, Moonis G, Lalwani AK (2020) Bilateral sudden sensorineural hearing loss and intralabyrinthine hemorrhage in a patient with COVID-19. Otol Neurotol 42: e10-e14.
17. Lovato A, Frosolini A, Marioni G, de Filippis C (2021) Higher incidence of Ménière's disease during COVID-19 pandemic: A preliminary report. Acta Otolaryngol 141: 921-924.
18. Kuhn M, Heman-Ackah SE, Shaikh JA, Roehm PC (2011) Sudden sensorineural hearing loss. Trends Amplif 15: 91-105.
19. Correia F, Medeiros AB, Castelhano L, Cavilhas P, Escada P (2021) Personality and psychopathology in Ménière's disease. Acta Otorrinolaringologica Espanola 72: 344-351.
20. Kitahara T, Sakagami M, Ito T, Shiozaki T, Kitano K, et al. (2019) Ménière's disease with unremitting floating sensation is associated with canal paresis, gravity-sensitive dysfunction, mental illness, and bilaterality. Auris Nasus Larynx 46: 186-192.
21. Ueda K, Ota I, Yamanaka T, Kitahara T (2020) The impact of the COVID-19 pandemic on follow- ups for vertigo/ dizziness outpatients. Ear Nose Throat J 100: 163S-168S.
22. Kovacs E, Wang X, Grill E (2019) Economic burden of vertigo: A systematic review. Health Econ Rev 9: 37.
23. Jeong SS, Simpson KN, Johnson JM, Rizk HG (2022) Assessment of the cost burden of episodic recurrent vestibular vertigo in the US. JAMA Otolaryngol Head Neck Surg 148: 1103-1110.
24. Mohr PE, Feldman JJ, Dunbar JL, McConsky-Robbins A, Niparko JK, et al. (2000) The societal costs of severe to profound hearing loss in the United States. Int J Technol Assess Health Care 16: 1120-1135.
25. Florence CS, Bergen G, Atherly A, Burnsm E, Stevens J, et al. (2018) Medical costs of fatal and non-fatal falls in older adults. J Am Geriatr Soc 66: 693-698.
26. Newgard CD, Lin A, Caughey AB, Eckstrom E, Bulger EM, et al. (2021) The cost of a fall among older adults requiring emergency services. J Am Geriatr Soc 69: 389-398.
27. NCD (2012) Rocking the cradle: Ensuring the rights of parents with disabilities and their children. National Council on Disability.
28. Washington PAVE (2022) Parents with disabilities have rights.
29. NPR (2012) Parents with disability and family law. National Public Radio.
30. Sligh Law Firm (2020) Can you lose custody due to your disability? Horry Law.
31. Houston KT, Streder-Brown A (2012) A model of early Intervention for children with hearing loss provided through telepractice. The Volta Review 112: 283-296.
32. Health Resources & Services Administration (HRSA) (2022) Early Hearing Detection & Intervention (EHDI).
33. National Institute on Deafness and Other Communication Disorders (NIDCD) (2017) New law to strengthen early hearing screening program for infants and children.
34. Health Resources & Services Administration (HRSA) Early periodic screening, diagnosis, & treatment.
35. American Speech-Language-Hearing Association (ASHA) (2022) Guidelines for Audiology Service Provision in and for Schools.
36. Perry HB, Zulliger R, Rogers MM (2014) Community Health Workers in low-, middle-, and high-income countries: An overview of their history, recent evolution, and current effectiveness. Annu Rev Public Health 35: 399-421.
37. Nieman CL, Betz B, Garcia Morales EE, Suen JJ, Trumbo J, et al. (2022) Effect of a Community Health Worker-delivered personal sound amplification device on self-perceived communication function in older adults with hearing loss: A randomized clinical trial. JAMA 328: 2324-2333.
38. Zimmerman M (2017) The art of falling safely. American Association of Retired Persons.
39. Esch J (2022) Does Medicare cover home safety assessments. MedicareFAQ.
40. City of Las Cruces Public Safety, Mobile Integrated Health.
41. Harvard TH Chan School of Public Health (2022) The latest on the coronavirus.
42. Centers for Disease Control and Prevention (CDC) (2022) SARS-CoV-2 Variant classifications and definitions.
43. World Health Organization (WHO) (2022) Tracking SARS-CoV-2 Variants.
44. Centers for Disease Control and Prevention (CDC) (2021) Variants of the Virus.