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# DYSARTHRIA IN MULTIPLE SCLEROSIS

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## Introduction

Studies of dysarthria in MS indicate a prevalence ranging from 35% to 51%.1-4 Self-reporting of speech and other communication disorders has varied widely: 23% in a study in the United States (n = 656)3; 44% in a Swedish study (n = 200)5 and 57% in a preliminary study in South Africa (n = 30).6 The range in prevalence figures reflects inconsistencies in study design, including the size and characteristics of the study samples, and the terminology and assessment tools used. In addition, a lack of congruence between evaluation results by a speech/language pathologist and self-report by individuals with MS has been proposed and needs further study.

Speech and voice problems may be identified by the person with MS, a family member, or a healthcare professional. Common complaints include difficulty with precision of articulation, speech intelligibility, ease of conversational flow, speaking rate, loudness, and voice quality. When these problems interfere with a person's quality of life—particularly the ability to communicate daily needs—a referral for evaluation and treatment by a speech/language pathologist is recommended. [7]

## Normal speech production

The normal processes of speech and voice production are overlapping and require the following five processes to work together smoothly and rapidly8-9:

1. **Respiration:** Using the diaphragm to quickly fill the lungs fully, followed by slow, controlled exhalation for speech.
2. **Phonation**: Using the vocal cords and air flow to produce voice of varying pitch, loudness, and quality.
3. **Resonance:** Raising and lowering the soft palate to direct the voice to resonate in the oral and/or nasal cavities to further affect voice quality.
4. **Articulation:** Coordinating quick, precise movements of the lips, tongue, mandible, and soft palate for clarity of speech.
5. **Prosody:** Combining all elements for a natural flow of conversational speech, with adequate loudness, emphasis, and melodic line to enhance meaning.

## Definition of Dysarthria and Dysphonia

**Dysarthria** refers to a speech disorder, caused by neuromuscular impairment, which results in disturbances in motor control of the speech mechanism.[10] The demyelinating lesions caused by multiple sclerosis may result in spasticity, weakness, slowness, and/or ataxic incoordination of the lips, tongue, mandible, soft palate, vocal cords, and diaphragm. Therefore, articulation, speaking rate, intelligibility, and natural flow of speech in conversation are the areas most likely to be affected in those with multiple sclerosis.

**Dysphonia**, which refers to a voice disorder, often accompanies dysarthria because the same muscles, structures, and neural pathways are used for both speech and voice production. Therefore, voice quality, nasal resonance, pitch control, loudness, and emphasis may also be affected in those with MS. [1]

## Common features of dysarthria in MS

Dysarthria is considered the most common communication disorder in those with MS.[11] It is typically mild, with severity of dysarthria symptoms related to neurological involvement.

Darley and colleagues published the first comprehensive scientific study identifying common features of dysarthria in 168 people with MS, in which they rank ordered analyses of speech characteristics and descriptions of deviations in the processes of respiration, phonation, resonance, articulation and prosody. (See Table 1) [11]

**TABLE 1**
**Rank Order of Deviations in Speech and Voice in Multiple Sclerosis**

| **Percent** (N=168) | **Deviation** | **Description** |
|---|---|---|
| 77% | Loudness control | Reduced, mono, excess, or variable |
| 72% | Harsh voice quality | Strained, excess tone in vocal cords |
| 46% | Imprecise articulation | Distorted, prolonged, irregular |
| 39% | Impaired emphasis | Phrasing, rate, stress, intonation |
| 37% | Impaired pitch control | Monopitch, pitch breaks, high, low |
| 35% | Decreased vital capacity | Reduced breath support and control |
| 24% | Hypernasality | Excessive nasal resonance |

Since then, three replication studies have reported insufficient reliability of clinicians' judgments in the more specific areas, yet high agreement in such overall speech dimensions as intelligibility and naturalness.[12]

A cross-linguistic analysis of dysarthria in Australian (N=56) and Swedish (N=77) speakers with MS, using a 33-point protocol, identified six deviant features: harsh voice, imprecise articulation, impaired stress patterns, rate, breath support, and pitch variations.[13] Even though they found somewhat different rank orders and problem frequencies, the authors noted agreement with Darley's list of seven most common features, with the exception of loudness and hypernasality.

## Differential diagnosis

There are three types of dysarthria associated with MS (see Table 2): spastic, ataxic or mixed. Differential diagnosis depends on the extent and location of MS lesions, and the specific speech, voice, and accompanying physical signs that result. Mixed dysarthria is most common in MS because multiple neurological systems are typically involved. [11]

**TABLE 2: Comparing the Three Types of Dysarthria**

| Speech and Voice Signs | Related Neuromuscular/Physical Signs |
|---|---|
| **SPASTIC DYSARTHRIA: Due to bilateral lesions of corticobulbar tracts** | |
| Harsh, strained voice quality<br>Pitch breaks<br>Imprecise articulation<br>Slow rate of speech<br>Reduced breath support and/or control<br>Reduced or mono-loudness<br>Short phrases, reduced stress<br>Hypernasality | Hypertonicity (excess muscle tone)<br>Bilateral spasticity<br>Restricted range of motion (jaw)<br>Reduced speed of movement<br>Bilateral hyperreflexia<br>Sucking and jaw jerk reflexes<br>Cortical disinhibition |
| **ATAXIC DYSARTHRIA: Due to bilateral or generalized lesions of the cerebellum** | |
| Vocal tremor<br>Irregular articulation breakdown<br>Dysrhythmic rapid alternating movements of the tongue, lips, and mandible<br>Excess and equal stress (scanning speech)<br>Excess and variable loudness<br>Prolonged phonemes and intervals | Intention tremor: head, trunk, arms, hands<br>Broad-based, ataxic gait<br>Nystagmus and irregular eye movements<br>Balance or equilibrium problems<br>Hypertonicity<br>Overshooting; slow, voluntary movements |

| (Table 2, cont'd.) MIXED DYSARTHRIA: Due to bilateral, generalized lesions of multiple areas in the cerebral white matter, brainstem, cerebellum, and/or spinal cord | |
|---|---|
| Impaired loudness control (reduced, mono-loudness, or excess and variable)<br>Harsh or hypernasal voice quality<br>Impaired articulation (imprecise, distorted, prolonged, or irregular breakdowns)<br>Impaired emphasis (slow, prolonged intervals or sounds, reduced, or excess and equal stress)<br>Impaired pitch control (monopitch or pitch breaks, too low or too high) | Any combination of spastic and ataxic features as mentioned above |

## Symptom management of contributing factors

Differential diagnosis of the type of dysarthria has important implications for treatment planning by the speech/language pathologist, as well as decision-making by the physician regarding pharmacologic management. Dysarthria and dysphonia in MS may be accompanied by the underlying symptoms of spasticity, weakness, tremor and ataxia, and complicated by fatigue. Therefore, evaluation of medication trials to treat these symptoms, and ongoing communication with the patient and physician about the impact on speech and voice, are recommended during therapy.[1]

## Assessment of Dysarthria

Evaluation of dysarthria and dysphonia in MS typically involves five main aspects:

1. Assessment of oral-motor function of the peripheral speech mechanism by:
    - Examining the structure and function of the articulators (lips, teeth, tongue, mandible, hard and soft palates) for symmetry, strength, speed, and coordination
    - Evaluating respiratory support and control for speech
    - Analyzing laryngeal control of loudness, pitch and voice quality during phonation
2. Perceptual analysis (i.e., listening to speech characteristics) to describe the various dimensions of respiration, phonation, articulation, resonance, and prosody in order to classify type and severity of dysarthria
3. Rating of speech intelligibility and naturalness in conversation
4. QOL (Quality of Life) of the dysarthric speaker[14]
5. Cognitive-linguistic evaluation, as indicated.15 Mackenzie and colleagues noted that deficits in these areas could impact clinical decision-making related to dysarthria treatment approaches and prognosis.

Dysarthia evaluation in MS has traditionally included both informal and formal measures of a variety of oral-motor, speech, and voice functions, with comparison to referenced norms. Formal articulation tests are not commonly used because MS-related dysarthria tends to have an irregular pattern of breakdown that is not necessarily based on misarticulation of specific speech sounds. Rather, measures of oral reading rate in phonetically balanced passages (i.e., My Grandfather) and analysis of a brief, recorded spontaneous speech sample (i.e., describe job, family, interests, etc.) are standard procedures. Speaking rate, articulation precision, number of words/breath unit, pauses within and between words, intelligibility, and naturalness of conversational flow are then measured and described. Speaking rate varies according to the task: oral reading sentences—190 words per minute; oral reading of paragraphs—160-170 words per minute; speaking rate in conversation—150-250 words per minute. The wide range in conversation is due to a variety of cognitive-language factors, including the complex verbal formulations that are used, word retrieval/fluency abilities, turn-taking, and lack of concrete cues for pauses (such as the commas and periods in reading materials).

Some formal, published measures used in dysarthria evaluation in MS include:

- *Assessment of Intelligibility in Dysarthric Speech*, (word and sentence levels) in which a judge, unfamiliar with the material, transcribes the recorded responses.[16]
- *Dysartri-test*, which includes 54 test items, scored on a five-point interval scale. Items measured in each speech parameter include: respiration, phonation, oral-motor performance (divided into lips, jaw, tongue, and soft palate, plus a diadochokinesis rating), articulation, prosody and intelligibility.[17]
- *Queensland Protocol*, an adapted version of the perceptual analysis/dysarthria classification procedure introduced by Darley and colleagues. This protocol includes[33] items relating to the five speech dimensions of respiration, phonation, resonance, articulation and prosody, and uses a 4-point descriptive equal-interval scale to measure rate, intelligibility, articulation precision of consonants and vowels, and phoneme length.[18]

## New directions in assessment

There has been a trend in recent years, to supplement perceptual analyses of dysarthria with acoustic analyses of speech parameters.[19] Advancement in physiological instrumentation for assessment is aimed at improving objectivity in measurement, refining our understanding of dysarthria features specific to MS, and ultimately aiding clinical decision-making and treatment planning.

Spectrographic displays have been used to obtain specific measures of acoustic distinctiveness during speech samples. For example, Tjaden and Wilding used a sound-treated booth, head-mounted microphone, and recording software (such as the CSpeechSP 4.0 or windows-based version TF32, Turbo Pascal 5.5) to objectively measure variations in sound/syllable duration, rate of articulation, vocal intensity, and size of working space (i.e., time) time for vowel and consonant production.[20]

Lip and tongue transducers have been used to objectively measure range, force, and diadochokinesis (or rapid alternating movements) of their function. Results of a study by Hartelius and Lillvik using this technique found that tongue function was more severely affected than lip function in MS, that tongue dysfunction could be detected subclinically (in non-dysarthric subjects), and that there was a moderate correlation with severity of neurological deficit and years of disease progression. Based on their findings, the importance of targeting improvement in tongue functioning early in articulation therapy was suggested. [21]

Despite advances in the development of instrumental assessment techniques in recent years, perceptual analysis of recorded speech remains a primary tool for differential diagnosis and treatment planning. Measures to assess quality of life (QoL) of the dysarthric speaker[14] and cognitive-linguistic status[15] have also recently been suggested as a means of evaluating and treating the whole person.

## Treatment

Evaluation of evidence-based research and expert opinion to support the treatment of dysarthria and to develop practice guidelines has been a project of the American Speech/Language Hearing Association (ASHA) and Academy of Neurologic Communication Disorders and Sciences (ANCDS) since 1997.[22] A series of four practice guideline reports were published in the Journal of Medical Speech/Language Pathology (2001-2004) and are available at www.ancds.org.[23] Guidelines for improving speech intelligibility and naturalness are forthcoming.

The World Health Organization's 2002 international classification of function, disability and health has had a significant impact in the field of rehabilitation. The goal of addressing physical function and structure within the broader context of a person's ability to participate actively in his or her world, has influenced both assessment protocols and treatment planning.[24] In dysarthria therapy, the trend has been away from a focus on specific impairments (e.g., oral exercises to normalize movement patterns), toward the acquisition of specific skills to facilitate participation in functional real-world activities (e.g., speaking with adequate loudness and intelligibility for telephone activities at work or home).[25]

Clinical decision-making in treatment planning is individualized according to the person's specific problems and communication needs. Improving speech intelligibility and naturalness should be the goal of therapy. Selection of appropriate treatment approaches, and where to begin therapy, depend on which deviant speech dimension(s) are most disabling in these two areas. Work on one target behavior can have overlapping, indirect effects on other physiological and acoustic variables. For example, improving breath support/control can increase loudness and indirectly reduce rate, thus allowing more precise articulation and improving overall speech intelligibility. Measuring impact on participation and quality of life are recommended, to assess functional outcomes of dysarthria therapy.

Traditional dysarthric compensations taught to MS speakers include: improving breath support and control; reducing the rate of speech; using strategic pauses within and between words; exaggerating articulation; and actively self-monitoring/self-correcting speech.[1]

In a review of the intervention literature on respiratory/phonatory dysfunction in dysarthria,[23] evidence was found to support the following:

1. Improving breath support by using biofeedback to gauge respiration (and loudness or phrase length) during speech tasks, and when learning a new breath pattern with deeper inhalation, increased force at exhalation, and use of abdomen. Physiological and acoustic biofeedback methods, such as a Visipitch computer software, VU meter, recorder, Respitrace®, water manometer, velocity/air pressure transducer, oscilloscope, and EMG were mentioned.
2. Improving respiratory/phonatory coordination by increasing awareness of the irregular speech-respiratory pattern, determining optimal words/breath groups, gradually increasing them, and practicing flexibility in cued and non-cued conversational scripts.
3. Improving phonatory functioning
    a. Hyperadduction (harsh voice quality, typical of MS): Often not directly treated because it is difficult to modify, with negligible impact on intelligibility.
    b. Hypoadduction (soft, breathy, whispered voice quality): Significant improvement has been demonstrated using the Lee Silverman Voice Treatment (LSVT™) in those with Parkinson's disease and hypokinetic dysarthria.[26] The LSVT seeks to increase vocal loudness, by increasing phonatory effort, which has been shown to improve speech intelligibility. Variable results with the LSVT technique have been noted in MS speakers and their spastic, ataxic, and mixed types of dysarthria.[27]

A review of the literature on evidence-based practices in dysarthria therapy also found the technique of managing speaking rate to be effective in improving speech intelligibility. However, with rate control techniques there can be a negative impact on naturalness of conversational flow, which must be considered in treatment. Slowing rate can be accomplished by changing either the speech time ("stretching out the word"), or the increasing the pause time (within or between words). The two types of rate control include:[28]

a. Rigid: use of external aids—such as finger tapping, a pacing board, or a metronome—to slow speaking rate and allow more precise articulation of each word or syllable. Although this technique provides the fastest and greatest improvement in intelligibility, naturalness in flow of speech can suffer. It can be a motivating starting point, when combined with rhythmic rate control.
b. Rhythmic: rate control techniques that also attempt to preserve naturalness by using biofeedback systems—including the Pacer/Tally software,[29] Visipitch, and delayed auditory feedback (DAF)—during speech tasks. The direct magnitude production technique (DMP), which uses no external device, can also be effective. The DMP is self-devised and asks the individual to speak at half his habitual pitch. Whereas the rhythmic techniques take more time to learn, both speech intelligibility and naturalness may be improved.

Imprecise articulation of consonants has been noted as the greatest contributor to reduced overall speech intelligibility. In two studies specific to dysarthria treatment in MS speakers, the combined/overlapping effects of multiple techniques (increasing loudness, reducing rate, and exaggerating articulation) showed a positive impact on preciseness and speech intelligibility. Hartelius found tongue function to be more severely affected than lip function in dysarthric and non-dysarthric speakers with MS (n=77).[21] Therefore, increasing articulatory excursions while reducing rate is recommended,

Increasing loudness and reducing rate have also been associated with increasing the size of the articulatory-acoustic working space, and thus improving articulation precision and acoustic distinctiveness. Tjaden & Wilding performed acoustic and perceptual analyses of 15 mild to moderate spastic, ataxic, and mixed dysarthric speakers with MS and found that acoustic distinctiveness of vowels, as indexed by vowel space, was maximized in the slow condition, whereas distinctiveness of stop consonants was maximized in the loud condition.[20] In 2014 Tjaden and colleagues, found that clear speech maximized vowel space areas for speakers with MS while also reducing rate and increasing vocal intensity. These results suggested that a speech style focused on increasing articulatory amplitude yields the most robust changes in vowel segmental articulation. [30]

## Augmentative and alternative communication

The need for augmentative and alternative communication (AAC) devices in individuals with MS is relatively uncommon. However, when severe dysarthria interferes with the individual's well-being, safety, and functional communication of daily needs, evaluation for an appropriate speech generating device (SGD) is indicated.[31] Speech supplementation devices (such as voice amplifiers) and non-speech alternatives are also available. There are low-tech alternatives, such as: alphabet, picture, or eye gaze boards, as well as bells, buzzers, and yes-no systems—any of which offer manual, optical, or partner-assisted selection. And there are high-tech alternatives with dedicated devices such as Link™ or Lightwriter™; or multi-purpose/integrated devices, such as Ipad or Dynavox that use special PC software such as a keyboard with word-prediction software, EZ keys, touch screen, joystick, mouse, optical or switch scan as input, and text to digitized or synthesized speech output. Information about AAC devices, vendors, materials, and tutorials can be found at www.aac.unl.edu.[32]

Yorkston and Beukelman developed a functional staging system for AAC intervention to aid in clinical decision-making.[33] It rates five areas—speech, cognition, literacy, vision, and upper and lower extremity functioning—on a 5-point scale. A team approach to AAC evaluation (including a physical therapist, occupational therapist, and speech/language pathologist) that takes into account the full range of a person's symptoms, is recommended. Once assessment and training on the appropriate device has been completed, routine re-evaluation and update is essential. In 2001, Medicare began providing reimbursement for evaluation, treatment, and appropriately-prescribed SGD devices. Medicare's assessment protocol and guidelines set the standard for

state, federal, and private health plans. For example, prior to SLP recommendation and physician prescription, an assessment trial of at least three systems that incorporate the necessary features is required before Medicare will provide authorization. Information about Medicare funding is available at www.aac-rerc.com.

## Conclusion

In a preliminary MS study in South Africa[6], 62% of the respondents experiencing speech and language problems reported that these difficulties had a negative impact on their quality of life (QOL). Although the prevalence of dysarthria in MS has been reported to be at least 35%, referral rate is low—a significant gap that needs to be addressed.

Assessment protocols and treatment procedures for dysarthria in MS have shown recent advances. Trends have included the refinement of perceptual and acoustic analyses, and incorporation of the World Health Organization's international classification of function, disability and health, which aids functional goal-setting. Specific treatments are being studied with the MS population and controls, to add evidence-based research to the expert opinion of clinicians.

Ongoing MS research continues in the international community in the areas of dysarthria prevalence, acoustic and physiological dimensions relating to perceptual analysis, treatment outcomes relevant to quality of life, and the impact of possible cognitive-linguistic deficits. MacKenzie and Green's study results indicate that SLPs who work with dysarthric patients with chronic progressive multiple sclerosis should also monitor cognitive-linguistic impairment, as it may influence assessment and treatment planning.[15] Piacentini and colleagues found 35% of 163 consecutive patients with MS had dysarthria, with most being of mild severity. Even though their dysarthria was not significantly correlated with MS duration and only weakly with MS severity, there was a strong correlation with impact on quality of life. They recommended using a specific dysarthria-related QOL questionnaire as a supplementary measure in clinical practice and research.[14]

## References


1. Sorensen PM. Dysarthria. In: Burks JB and Johnson KP (ed) *Multiple sclerosis: Diagnosis, medical management, and rehabilitation.* New York: Demos Medical Publishing, 2000; 21:385-405.

2. Darley F, Brown J, Goldstein N. Dysarthria in multiple sclerosis. *J Speech Hear Res* 1972; 15: 229-245.

3. Beukelmam D, Kraft G, Freal J. Expressive communication disorders in multiple sclerosis: A survey. *Arch Phys Med Rehabil* 1985; 10:675-677.

4. Hartelius L, Runmarker B, Anderson O. Prevalence and characteristics of dysarthria in a multiple sclerosis incidence cohort: In relation to neurological data. *Folia Phoniatr Logop* 2000; 52:160-177.

5. Hartelius L, Svensson P. Speech and swallowing disorders associated with Parkinson's disease and multiple sclerosis: A survey. *Folia Phoniatr Logop* 1994; 46:9-17.

6. Klugman TM, Ross E. Perceptions of the impact of speech, language, swallowing, and hearing difficulties on quality of life of a group of South African persons with multiple sclerosis. *Folia Phoniatr Logop* 2002; 54:201-221.

7. Netsell R. Physiological studies of dysarthria and their relevance to treatment. In: *Normal aspects of speech, language, and hearing*. Englewood Cliff, NJ:Prentice-Hall,1973.

8. Sorensen PM. Speech and voice disorders. In: Kalb RC (ed) *Multiple sclerosis: The questions you have, the answers you need.* New York: Demos Medical Publishing, 2004; 7:171-186.

9. Duffy JR. *Motor speech disorders: Substrates, differential diagnosis, and management.* St. Louis: Mosby Yeat Book. 1995.

10. Murdoch BE, Theodoros DG (eds). *Speech and language disorders in multiple sclerosis.* London, Whurr, 2000.

11. Darley FL, Aronson AE, Brown JR. Differential diagnostic patterns of dysarthria. *J Speech Hear Res.* 1969; 2:246-269.

12. Darley FL, Aronson AE, Brown JR. Clusters of deviant speech dimensions in dysarthria. *J Speech Hear Res* 1969; 12:462-496.

13. Hartelius L, Theodoros D, Cahill L, Lilivik, M. Comparability of perceptual analysis of speech characteristics in Australian and Swedish speakers with multiple sclerosis*. Folia Phoniatr Logop* 2003; 55:177-188.

14. Piacentini V, Mauri I, Cattaneo D, Gilardone M, Montesano A, Schindler A. Relationship between quality of life and dysarthria in patients with multiple sclerosis. Arch Phys Med Rehab 2014;Nov;95(11):2047-54.

15. Mackenzie C, Green J. Cognitive-linguistic deficit and speech intelligibility in chronic progressive multiple sclerosis. Int J Lang Commun Disord. 2009; Jul-Aug;44(4):401-20.

16. Yorkston KM, Beukelman DR. *Assessment of intelligibility in dysarthric speech.* Austin: Pro-ed, 1984.

17. Hartelius L, Svensson P. *Dysartri-test.* Stockholm: Psykologiforlaget, 1990.

18. Fitzgerald FJ, Murdoch BE, Chenary HJ. Multiple Sclerosis: Associated speech and language disorders. *Aust J Hum Commun Disord* 1987; 15:15-33.

19. Tjaden K, Wilding GE. Rate and loudness manipulations in dysarthria: Acoustic and perceptual findings. *J Speech Lang Hear Research* 2004; 47:766-783.

20. Tjaden K, Watling E. Characteristics of diadochkinesis in multiple sclerosis and Parkinson's disease. *Folia Phoniatr Logop* 2003; 55: 241-259.

21. Hartelius L, Lillvik M. Lip and Tongue Function Differently Affected in Individuals with multiple sclerosis. *Folia Phoniatr Logop* 2003; 55:1-9.

22. Strand EA. Treatment of dysarthria: Support by evidence-based research and expert opinion. *ASHA Perspectives* (2) 2002; 12(4):3-4.

23. Spencer KA, Yorkston KM. Evidence for the treatment of respiratory/phonatory dysfunction from dysarthria. In Strand EA (Ed). Treatment of dysarthria: Support by evidence-based research and expert opinion. *ASHA Perspectives* (2) 2002; 12(4):4-16.

24. World Health Organization. *International classification of function, disability, and health.* 2001; http://www3.who.int/icf.

25. Hodge MM. Nonspeech oral motor treatment for dysarthria: Perspectives on a controversial clinical practice. In Strand EA (ed). Treatment of dysarthria: Support by evidence-based research and expert opinion. *ASHA Perspectives* (2) 2002; 12(4):22-27.

26. Ramig LO, Pawlas A, Countryman S. *The Lee Silverman Voice Treatment* (LSVT*): A practical guide to treating the voice and speech disorders in Parkinson disease.* Iowa City: University of Iowa, National Center for Voice and Speech, 1995.

27. Sapir S, Pawlas A, Ramig LO, Seeley E, Fox C, Corboy J. Effects of intensive phonatory-respiratory treatment (LSVT) on voice in two individuals with multiple sclerosis. *J Med Speech Lang Path* 2001; 9:141-151.

28. Hammen VL. Managing speaking rate in dysarthria. In Strand EA (ed). Treatment of dysarthria: Support by evidence-based research and expert opinion. *ASHA Perspectives* (2) 2002; 12(4):17-21.

29. Beukelman DR, Yorkston KM., Tice R. *Pacer/tally rate measurement software.* Lincoln, NE: Tice Technology Services, 1997.

30. Tjaden K, Lam J, Wilding, Vowel acoustics in Parkinson's Disease and Multiple Sclerosis: comparison of clear, loud, and slow speaking conditions. J Speech Lang Hear Res. 2013 Oct;56(5):1485-502.

31. Buzolich MJ. Augmentative and alternative communication (AAC) assessment: Adult aphasia. *ASHA Div2 Perspectives* 2006; 16(4): 6-12.

32. Mathy P. Augmentative and alternative communication intervention in neurogenic disorders with acquired dysarthria. In Strand EA (ed.). Treatment of dysarthria: Support by evidence-based research and expert opinion. *ASHA Perspectives* (2) 2002; 12(4): 22-27.

33. Yorkston KM, Beukelman DR. Decision-making in AAC intervention. In Beukelman DR. Yorkston KM, Reichle J (ed.s). *Augmentative and alternative communication for adults with acquired neurologic disorders.* Baltimore: Paul H. Brookes, 2000.

## Patient resources

**Speech and Swallowing Problems: The Basic Facts:** nationalmssociety.org/brochures
**Swallowing Difficulties in MS** (video): nationalmssociety.org/videos

Other resources for
**Talking with Your MS Patients include:**

Cognitive Dysfunction
Diagnosis of Multiple Sclerosis
Progressive Disease
Elimination Problems
Sexual Dysfunction
Depression and Other Emotional Changes
Initiating and Adhering to Treatment with Injectable Disease Modifying Agents
Family Issues
Reproductive Issues
The Role of Rehabilitation
Life Planning
Primary Progressive MS (PPMS)
Palliative Care, Hospice and Dying
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