

# Evaluation and Management of Voice and Speech Disorders Clinical Assessment Strategies, Therapeutic Interventions and Emerging Technologies in Speech-Language Pathology

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**Abstract** — Voice and speech disorders represent significant communication impairments affecting individuals across the lifespan, arising from structural, neurological, functional, or psychological factors and often resulting in reduced vocal quality, impaired articulation, and limitations in effective verbal communication. This cross-sectional analytical study evaluates contemporary approaches to the assessment and management of voice and speech disorders and examines the effectiveness of clinical and therapeutic strategies used in speech-language pathology practice among 172 patients. Multidisciplinary therapeutic approaches combining voice therapy, behavioural intervention, and technological support systems significantly improve speech intelligibility and vocal function. Combined voice and speech therapy produced the highest improvement in speech intelligibility scores ( $F=7.48$ ,  $p=0.001$ ). Telepractice-based speech therapy and digital voice analysis technologies also demonstrated promising results in enhancing treatment accessibility and patient engagement. Early diagnosis and individualised therapy programmes were associated with improved clinical outcomes.

**Keywords** — Voice Disorders; Speech Disorders; Speech-Language Pathology; Voice Therapy; Communication Disorders; Telepractice Speech Therapy.

## 1. Introduction

Voice and speech disorders represent a diverse group of communication impairments that affect the ability of individuals to produce clear, intelligible, and socially effective speech. These disorders may arise from structural abnormalities of the vocal apparatus, neurological conditions affecting speech motor control, functional voice misuse, or psychological factors that influence speech production. The ability to communicate effectively is fundamental to social interaction, education, employment, and emotional wellbeing; therefore, disruptions in voice and speech production can significantly impair quality of life (Feldman, 2005).

Digital voice analysis systems enable clinicians to measure acoustic parameters such as fundamental frequency, jitter, shimmer, and harmonic-to-noise ratio, providing objective insights into vocal function (Barkmeier-Kraemer and Patel, 2016). Telepractice platforms enable speech-language pathologists to provide remote therapy sessions, expanding access to treatment for individuals in rural or underserved areas (Myers et al., 2022). AI and digital health technologies are emerging as valuable tools in communication disorder management (Devi et al., 2025; Shanthi et al., 2025; Catherine et al., 2025). Psychological stress, occupational voice demands, and social environmental factors contribute to the

development and persistence of voice disorders (Ashifa, 2021; Ranganathan et al., 2024; Elkin et al., 2025). Mental health literacy among patients and caregivers supports proactive engagement with speech-language pathology services (Elkin et al., 2025; Zahoor et al., 2025). Occupational health conditions and work-life integration challenges experienced by voice-intensive professionals' compound vocal fatigue and disorder risk (Gayathri et al., 2025; Vettriselvan and Rajan, 2019; Ashifa and Ramya, 2019). Patient empowerment through knowledge transfer and rehabilitation education strategies supports long-term vocal health outcomes (Vettriselvan et al., 2026). Self-leadership competencies among speech-language pathology staff improve service quality and treatment consistency (Mustafa et al., 2026).

## 2. Review of Literature

Ramig and Verdolini (1998) highlighted the importance of structured voice therapy programmes in improving vocal function. Hillman et al. (1990) examined the effectiveness of speech-language pathology interventions in treating voice disorders and reported substantial improvements in vocal performance among patients receiving structured therapy. Roy et al. (2001) found that voice therapy significantly improved vocal quality and reduced vocal fatigue among teachers experiencing voice disorders, representing a high-risk occupational group.

Carding et al. (2017) evaluated the efficacy of voice therapy in treating functional, organic, and neurological voice disorders and reported positive treatment outcomes across different patient groups. Myers et al. (2022) reported that remote therapy platforms can effectively support clinical service delivery. Advances in digital acoustic analysis and AI-based diagnostic systems may enable clinicians to detect subtle vocal abnormalities and personalise therapy interventions (Wen, 2025; Devi et al., 2025).

AI-driven healthcare innovations have demonstrated potential for improving clinical decision-making and patient engagement across multiple healthcare domains, including speech-language pathology (Devi et al., 2025; Catherine et al., 2025; Shanthi et al., 2025). Digital health marketing innovations and machine learning platforms further support healthcare communication and patient awareness campaigns related to voice health (Swadhi et al., 2025; Jenifer et al., 2025). Strategic collaborations in medical innovation and AI-driven globalisation accelerate development of advanced speech rehabilitation technologies (Vijayalakshmi et al., 2025). Rehabilitation robotics and adaptive motion planning platforms represent emerging innovations with potential applications in speech and swallowing rehabilitation (Venice et al., 2026). Community health literacy and tribal health determinants also influence access to speech-language pathology services (Ashifa, 2021; Kariveliparambil et al., 2026).

### 3. Objectives

- To evaluate the prevalence and distribution of voice and speech disorders among patients presenting to speech and hearing clinics.
- To compare the effectiveness of different therapeutic interventions including behavioural voice therapy, speech articulation therapy, combined therapy, and telepractice.
- To identify key predictors of improved communication outcomes.
- To propose clinical practice and healthcare policy recommendations for improving voice and speech disorder management.

### 4. Methodology

A cross-sectional analytical research design was adopted to evaluate diagnostic approaches and therapeutic outcomes associated with voice and speech disorders. The research was conducted in speech and hearing clinics, otolaryngology departments, and speech-language pathology centres. Patients aged 10–65 years who underwent comprehensive voice or speech assessment

during the study period were included, with 172 patients selected using systematic sampling from clinical registries. Data collection involved clinical voice assessments, speech articulation testing, patient-reported symptom questionnaires, and therapy outcome evaluations. Acoustic analysis was used to measure vocal parameters including fundamental frequency, jitter, shimmer, and harmonic-to-noise ratio. Therapeutic interventions evaluated included behavioural voice therapy, speech articulation therapy, vocal hygiene education, respiratory training exercises, and telepractice-based speech therapy sessions. The primary outcome variable was improvement in communication ability, measured through changes in speech intelligibility scores and patient-reported voice quality following therapy. Statistical analysis used descriptive statistics, ANOVA, and regression analysis at  $p < 0.05$ .

## 5. Results and Discussion

**Table 1: Demographic Characteristics of Participants (N = 172)**

Variable	Category	Frequency	Percentage (%)
Age Group	10–20 years	38	22.1
	21–40 years	72	41.9
	41–65 years	62	36.0
Gender	Male	94	54.7
	Female	78	45.3

**Table 2: Types of Voice and Speech Disorders Diagnosed**

Disorder Type	Number of Cases	Percentage (%)
Functional voice disorders	48	27.9
Organic voice disorders	34	19.8
Neurological voice disorders	26	15.1
Articulation disorders	36	20.9
Fluency disorders	28	16.3

**Table 3: Therapeutic Interventions Used**

Therapy Type	Number of Patients	Percentage (%)
Behavioural voice therapy	54	31.4
Speech articulation therapy	42	24.4
Combined voice and speech therapy	46	26.7
Telepractice therapy	30	17.5

**Table 4: ANOVA Analysis — Therapy Effectiveness (Speech Intelligibility Improvement)**

Therapy Type	Mean Improvement Score	F-value	p-value
Behavioural voice therapy	3.34	5.82	0.004
Speech articulation therapy	3.41	6.12	0.003
Combined therapy	3.79	7.48	0.001
Telepractice therapy	3.21	4.67	0.006

Combined voice and speech therapy produced the highest improvement in speech intelligibility scores (F=7.48, p=0.001), demonstrating the effectiveness of integrated therapeutic approaches addressing multiple aspects of communication simultaneously.

Functional voice disorders were the most commonly observed condition, reflecting the high prevalence of voice misuse and vocal strain in modern occupational environments, consistent with Roy et al. (2001) regarding teachers and professionals in voice-demanding occupations. Behavioural voice therapy emerged as one of the most effective treatment approaches, focusing on modifying vocal behaviours and improving vocal efficiency through structured exercises and vocal hygiene education (Roy, 2008). Telepractice-based therapy also demonstrated promising results, highlighting the growing role of digital health technologies in speech-language pathology (Myers et al., 2022). AI and digital voice analysis technologies hold potential for improving diagnostic accuracy and treatment planning (Devi et al., 2025; Shanthi et al., 2025). Rehabilitation robotics platforms present emerging opportunities for motor speech rehabilitation in neurological voice disorder populations (Venice et al., 2026).

## 6. Conclusion

Voice and speech disorders represent a significant category of communication impairments affecting individuals across different age groups and social contexts, arising from structural abnormalities, neurological conditions, functional voice misuse, developmental factors, or psychological influences. Combined therapy approaches addressing both voice and speech impairments produced the most significant improvements in communication ability. Integrated clinical management strategies combining comprehensive diagnostic evaluation, evidence-based therapy techniques, digital health technologies, rehabilitation robotics, and multidisciplinary collaboration are essential for optimising treatment outcomes in voice and speech disorder management. Continued investment in

AI-driven diagnostic tools, telepractice platforms, and patient empowerment strategies will be critical for advancing the future of speech-language pathology practice.

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